Torsten Reiners · Lincoln C. Wood
Editors

Gamification in Education and Business

Springer

Gamification in Education and Business

Torsten Reiners • Lincoln C. Wood
Editors

Gamification in Education and Business

Springer

Editors
Torsten Reiners
School of Information Systems
Curtin University
Bentley, WA, Australia

Lincoln C. Wood
Department of Business Information Systems
Auckland University of Technology
Auckland, New Zealand

ISBN 978-3-319-10207-8 ISBN 978-3-319-10208-5 (eBook)
DOI 10.1007/978-3-319-10208-5
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014953389

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

We did not intend this book to be a manual or to provide a complete examination of all elements of gamification. Clearly, given the pace with which research has been developing in this nascent area, a comprehensive overview within the confines of publication schedules would be an ambitious and ultimately unachievable task. Instead, we have elected to focus our attention on two areas (namely, business and education) and provide an overview for the scientific and business community on the work that has been conducted as well as providing direction for further research. We included a small number of salient use cases for insight into practical use and application of gamification approaches.

While the world appears to be drifting towards hyper-competitiveness, we hear of people feeling ‘trapped’ in many jobs from the high-powered through to the mundane. Facing the ‘electronic whip’, we can see that many people are yearning for greater meaning within their lives. In some cases, people just want to enjoy their jobs more. They want to move away from their regular work processes (e.g. efficiencies and effectiveness in meeting corporate goals) towards something more meaningful and personal to them; something that will get them motivated, provide a sense of accomplishment, and which will help them to smile at work each day.

Meanwhile, our educational philosophies have changed little over several thousand years. Students are still treated as minds to be shaped, despite the overwhelming evidence that we should be encouraging them to seek and explore. What stops a student from learning? While towering geniuses often speak fondly of their love for learning, a love of learning is infrequently encouraged and we hear few students express a desire to spend more time learning.

Gamification has been positioned as one approach, tool, or set of techniques which may change how various activities are undertaken so that those involved begin to experience more fun, enjoyment, and pleasure in their tasks. The term became popular in 2010 and dominates especially areas with human interaction and focus on the quality of the experience since then. And the hype is still progressing today as people continue to investigate how the appropriate theories can be implemented and further developed. There are now many definitions of 'gamification'; yet, some are concise (fun, play, passion) or too specific with strong reference to gaming mechanisms. Thus, we propose a simple, comprehensive definition unrestricted in its application, environment, or discipline:

Gamification is a designed behaviour shift through playful experiences

Saying that, we should not get between you and your exploration of this book and learning more about gamification and its value for education and business. Enjoy. And keep us informed about your thoughts about how you use gamification now and it will develop in the future.

Bentley, WA, Australia — Torsten Reiners
Auckland, New Zealand — Lincoln C. Wood

Acknowledgements

This book would not have been possible without the input of many friends and colleagues along the away. We have both been heavily influenced by our interactions with a variety of our students that have suffered through our incessant experiments and work to better engage, motivate, and teach our students. Furthermore, the ongoing support from our institutions Curtin University (Perth, Australia) and Auckland University of Technology (Auckland, New Zealand) has been fundamental in allowing us the freedom and flexibility to pursue these concepts and ideas within the scope of our teaching and research. This book is a major step forward on our pathway, but also opens up new exciting ideas and invaluable connections to be explored in the near future. Join us on our travel and follow our reports on facebook *nDiVE Project* or blog *ndive-project.com*.

We further acknowledge the immense amount of work that the editorial team at Springer has provided. Without the help of Matthew Amboy, Christine Crigler, Mishra Manoranjan, and Rekha Udaiyar this book would not have been possible. Thanks for your support, trust, and patience. We thank the authors of the included manuscripts, the reviewers and all the colleagues who invested some of their precious time to help us.

Finally and most importantly, we thank our long-suffering wives: Kirsten Reiners and Penny Wood. From the very first BBQ where the pair of us crept away to discuss, debate, and argue about the ideas that led to our projects and this book, our wonderful wives have stood with us, helped, and supported us throughout the process. Without them, we would certainly be lost and unable to complete this project.

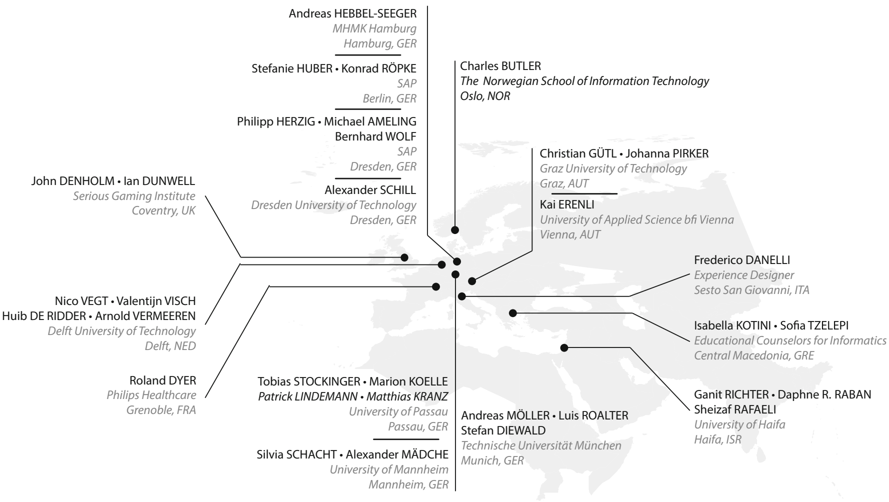
Support for the production of this publication has been provided by the Australian Government Office for Learning and Teaching (Grant: Development of an authentic training environment to support skill acquisition in logistics and supply chain management, ID: ID12-2498). The views expressed in this publication do not necessarily reflect the views of the Australian Government Office for Learning and Teaching.

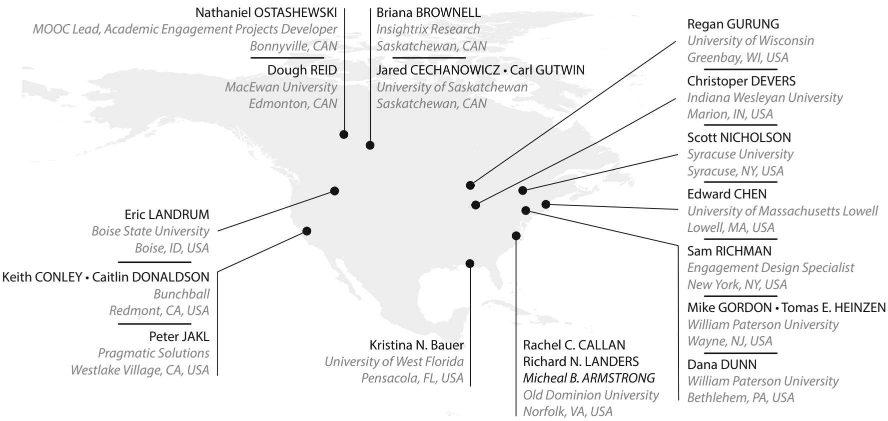
Book Overview

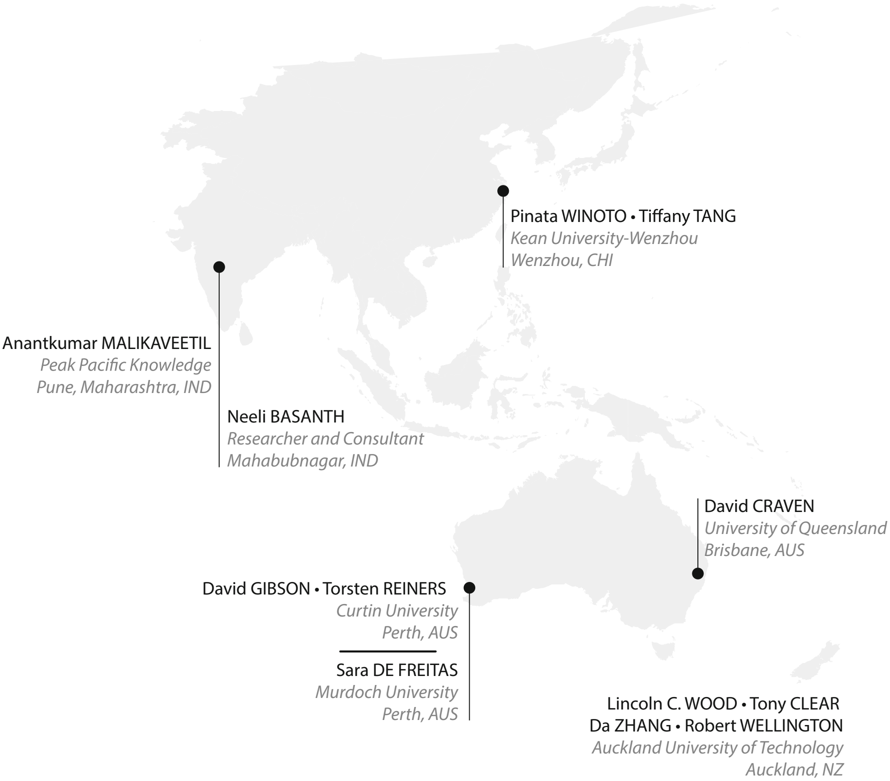
We have experienced a great deal of enjoyment while working towards bringing this volume to print and we hope that this sense of pleasure has been shared by the contributors to the work. It has been a time-consuming and arduous task from the first dissemination of the call for chapters to the final selection of interesting chapters demonstrating the influence and impact of gamification within business and education. We received lots of feedback and proposals for chapters, of which we had to pick those of the highest quality but also best fit to tell a story of interest for the reader. The final selection came from a widely dispersed group of international authors—all experts with years of experience in research or practice—who discuss the current state-of-the-art in their areas of expertise and how they anticipate the development of gamification over the ensuing years. Before we send you off to immerse yourself in the book and enjoy your journey through the four parts (Theory, Education, Business, and Use Cases), you should get some insight into what you can expect. Warning: if you dislike spoilers, skip the chapter overviews presented after the maps showing the current location of the authors. Some plain facts of the book are:

- 58 Proposals received
- 41 Submitted chapters
- 34 Chapters accepted (58.6 % acceptance rate)
  - 8 Theory-driven and empirical
  - 13 Education
  - 11 Business
  - 2 Use case focus
- 66 Authors from 14 countries on 4 continents (see below)
- 764 pages
- 137 Figures, 99 in colour

All chapters were double-blind peer reviewed. The difficult process of composing the book based on the proposals was completed by us [editors]; however, the review itself was only possible with the help of colleagues. Our very special thanks go to the anonymous reviewers and supporters that worked tirelessly to improve this publication. Thanks, you did an awesome job. Any errors, omissions, problems, or mistakes that remain have been made by us.







Part I provides a foundation on the question of 'where gamification originates' and this also provides some insight into the outstanding questions that have yet to be addressed. As a concept, gamification draws from multiple areas and (at present) from multiple theories borrowed from multiple disciplines, providing a medley of theoretical foundations for research in this area. Within this section the focus, even on the empirically grounded papers, is on presenting a strong theoretical foundation for their work.

While many have criticised gamification as either simply being points-based (e.g. 'pointsification'), or exploitationware (Bogost), the development of intrinsic motivation to create an experience that is meaningful for the participant has been a lauded objective of gamification. *Scott Nicholson* from Syracuse University (Canada), also being Director of the 'Because Play Matters' game lab, examines the role of play and fun in extending the reward-based gamification towards developing intrinsic motivation. The theoretically grounded framework presented direct attention on long-term change in a way that helps participants create a more personal connection to the system.

Ganit Richter, *Daphne R. Raban*, and *Sheizaf Rafaeli* from The Center for Internet Research and LINKS I-CORE Program, University of Haifa (Israel), take a closer look at the provision of feedback—one of the key elements that makes gamification work—and develop a framework to aid designers in providing adequate attention to this element. The work rests on understanding motivation from a game-design perspective, the use of rewards, and the concepts around game achievements.

As with all scientific endeavours, whether or not we have made a difference is crucial. Therefore, the concepts of 'measurement' are important and it is this concept that *Ronald Dyer*, Grenoble Ecole de Management (France), discusses. The design of appropriate metrics is necessary, particularly given that we are still in the early stage of understanding gamification; Dyer presents elements of play, rubrics, pre- and post-assessments, and a performance assessment as aids in the development of a multidimensional measure of gamification approaches.

Despite the hype around gamification, *Federico Danelli*, Gamification Consultant (Italy), presents a timely reminder that the cynical use of gamification in business (e.g. focused on Points-Badges-Leaderboards (PBL)) can easily gloss over the elements of game-design within the system. Instead, play and fun should be built in. Danelli provides a review of concepts in these areas and demonstrates how to develop a balanced game-based initiative.

Contemporary approaches to economics require a strong understanding of what motivates and influences human behaviour. *Charles Butler*, Norwegian School of Information Technology (Norway), uses applied behavioural economics to examine how concepts and mechanics from modern games can be applied to other areas to change user behaviours. Errors, pitfalls, and challenges in the implementation or use of these methods are discussed, which may aid future work in this area.

Tobias Stockinger, *Marion Koelle*, *Patrick Lindemann*, and *Matthias Kranz* (University of Passau, Germany) and *Stefan Diewald*, *Andreas Möller,* and *Luis Roalter* (Technische Universität München, Germany) approach the design of mobile applications from the perspective of understanding human behaviour. They demonstrate how app design can be improved by understanding what influences decision making, working from the application of behavioural economics to the area of user experience.

A foundation from psychological sciences is provided for gamification by *Thomas E. Heinzen*, *Michael S. Gordon* (William Paterson University, USA), *R. Eric Landrum* (Boise State University, USA), *Regan A. R. Gurung* (University of Wisconsin, Green Bay, USA), and *Dana S. Dunn* (Moravian College, USA), and *Sam Richman* (User Experience Strategist, USA). They examine how the principles of behaviourism and the language of games are connected to gamification as they examine the role of the different gamification mechanics. Challenges and pitfalls relating to gamification implementation are also presented as a caution to the unwary designer.

Robert Wellington, Auckland University of Technology (New Zealand), approaches the subject of design from the theoretical foundations of Human–Computer Interaction (HCI). The role of Familiarity (based on context) and Enculturement (based on culture) are examined in the process of requirements engineering. The design of artefacts in gamified environments must draw on a syncretic combination of these elements.

Part II covers the application and value that gamification can bring within the educational sector. We had originally conceived of a focus on university and high school education but have been delighted with the response from the wider community. Clearly, game-based approaches have experimented with by globally dispersed groups and over a wide range of distinct activities and different areas of education. We present a range of contributions that span a range of different teaching/educational levels and also scientific methods from experiments to conceptual pieces and forward-looking chapters.

Richard N. Landers, *Rachel C. Callan*, *Michael B. Armstrong* (Old Dominion University, USA), and *Kristina N. Bauer* (University of West Florida, USA) address the current lack of theory in gamified instructional design. They draw on theories from psychology including classic conditioning, expectancy-based theories, goal setting, and motivation through self-determination theory. While gamification is not entirely novel, the synthesis of existing approaches has yet to be conclusively proven to provide additional advantage and further work still needs to be conducted to improve theoretical foundations of gamification in education.

Nathaniel Ostashewski (Curtin University, Australia) and Doug Reid (Grant MacEwan University, Canada) present an overview of the history on the most recent developments and frameworks for the use of one of the most foundational elements in gamification: badges. The included frameworks are used to demonstrate how readers can explore the possibilities of using badges to enrich their own teaching.

Assessment remains one of the core learning activities, much hated by many students. *Thomas E. Heinzen* (William Paterson University, USA), *R. Eric Landrum* (Boise State University, USA), *Regan A. R. Gurung* (University of Wisconsin, Green Bay, USA), and *Dana S. Dunn* (Moravian College, USA) review contemporary education practices relating to assessment. This paves the way for demonstrating how we can modify existing approaches to create game-based assessments that may be more beneficial for both institutions and students.

Isabella Kotini and *Sofia Tzelepi* (Educational Counselors for Informatics in Central Macedonia, Greece) present a student-centred framework designed to strengthen intrinsic motivation for learning, working from a constructivist learning theory foundation. With a focus on teaching computational thinking and helping students to appreciate mathematical algorithms, they present several scenarios and explanations of the role of the activities to guide implementations.

Similarly noting that contemporary approaches in Science, Technology, Engineering, and Medicine (STEM) subjects are rooted in constructivism, *Johanna Pirker* (Institute for Information Systems and New Media (IICM), Graz University of Technology, Austria) and *Christian Gütl* (IICM, Graz University of Technology, Austria and Curtin University, Australia) examine the role of educational simulations. They present a model to help users adapt gamification techniques to this particular use of simulations and present a case study and framework to help users implement these ideas in their own teaching.

Pinata Winoto and *Tiffany Y. Tang* (Kean University, USA) present a series of case studies of gamification in education. These range from individual behaviours and driving intrinsic motivation, through to understanding group behaviour, drawing on behavioural economics. The role of careful pedagogically designed and consideration is emphasised in order to fully benefit from the benefits of gamification to enhance desired group dynamics.

Andreas Hebbel-Seeger (MHMK—University of Applied Sciences, Media and Communication, Germany) explores the transferability of skills between the real and digital environments. A number of cases and theoretical exploration of the topic are presented. Then, focusing on basketball skills, a study is presented to show transfer of skills developed in the real world can be transferred to skills in virtual worlds through an augmented reality (AR) basketball game.

Lincoln C. Wood (Auckland University of Technology) and *Torsten Reiners* (Curtin University) report about their ongoing research on creating an immersive and authentic learning environment for students and worker. Their focus is on self-directed learning with automatically generated feedback as well as integrated gamification to engage the learner and achieve a higher learning retention.

The increasing provision of a range of educational spaces is examined by *Da Zhang* and *Tony Clear* (Auckland University of Technology, New Zealand), with a particular focus on virtual environments. The notions of ‘space’ and ‘place’ are explored, examining how gamified designs shape and influence people with resulting behaviours often unanticipated. Promotion of productive behaviours in virtual environments can be more readily assured with the policies regarding virtual environments that are presented in this chapter.

John Denholm, *Ian Dunwell* (Serious Game Institute, UK), and *Sara de Freitas* (Murdoch University, Australia) take a closer look at team-based education and assessment, one of the key challenges in management education. They use a team-based mixed reality game, which is a computer-assisted event with social interactions between participants. The development of the game is detailed along with the evaluation of effectiveness. While it was highly rated by most participants, interesting differences emerged in the evaluation with classes consisting of a single, international ethnic group; here, ratings were lower, indicating strong relationships.

Using a virtual world in education was once a significant undertaking, before businesses developed improved product offerings in this area. *David Craven* (PierSim Academic Programs, Australia) outlines the use of PierSim, focusing on the development of integrated action and reflection amongst learners in the virtual environment. This shift away from merely using badges appears to be considered fun by both genders and may even lead to greater engagement and satisfaction amongst female students. Therefore, Craven suggests that ‘learnification of games’ may supersede ‘gamification of learning’.

David Gibson (Curtin University, Australia) and *Peter Jakl* (Pragmatic Solutions, USA) provide insight into the implications of game-based learning analytics. New approaches to collecting data mean that with the wealth of possible measurements that can be made to feed into improved learning, methods must be developed and used to make use of this resource. Thus, computer-assisted analysis and data-mining approaches will need to be employed, with the ability to evaluate patterns-over-time in learner capabilities and improvements. Together, such learning analytics represent a significant change in the way that assessment is measured and used in institutions.

However, is this 'gamification in education' simply all hype? The section closes with a critical perspective, offered by *Christopher J. Devers* (Indiana Wesleyan University, USA) and *Regan A. R. Gurung* (University of Wisconsin, USA). The use of game elements and design in education is explored in relation to other, similar technologies. This is discussed in the context of other technological changes in education, with particular emphasis on student learning. Finally, a framework is presented to help scholars move forward by planning and executing studies based on a stronger, evidence-based approach to the use of gamification in education.

Part III represents a change of focus and places the spotlight on the use of gamification within business environments. The topics also cover educational aspects like improved learning outcome, motivation, and learning retention at the workplace; however extend into areas that are more related to businesses. This includes workplace psychology, frameworks to create the best experience for customer and employees, and motivation. Furthermore, some chapters address the manager to support the decision on how to implement gamification in the company including law, risks, side effects, and sustainability.

Philipp Herzig, *Michael Ameling* (SAP AG, Germany), and *Alexander Schill* (TU Dresden, Germany) focus on the application of gamification principles to the workplace with the focus on increasing motivation and improving employee outputs. The impact from an ERP gamification application is evaluated based on the theoretical foundations from organisational psychology, the job demand-resource model, psychological capital, and positive emotions. Improvements were identified in factors including 'enjoyment' and 'flow' along with 'perceived ease of use'.

Implementation of gamification principles would be made significantly easier if the concepts were standardized within an easy access software platform. *Philipp Herzig*, *Michael Ameling*, *Bernhard Wolf* (SAP AG, Germany), and *Alexander Schill* (TU Dresden, Germany) address this need by focusing their attention on the implementation of information systems relating to gamification. They describe the software development process required to realise gamification implementations and analyse the specification for a gamification solution.

Edward T. Chen (University of Massachusetts Lowell, USA) focuses on the use of gamification as an approach to improve work performance, going beyond customer engagement to also focus on the impact on employees. A range of small business cases are presented to demonstrate the range of potential applications across the enterprise.

Basanth Kumar Neeli (Expert and Consultant, Gamification and Business Process Management, India) further examines the implications of gamification targeting employees. The case is made such that this is distinctly different to consumer- or market-focused gamification applications. An iterative framework is presented to help implementation of enterprise gamification solutions, with further insight provided by some small case studies.

Niko Vegt, *Valentijn Visch*, *Huib de Ridder*, and *Arnold Vermeeren* (Delft University of Technology, The Netherlands) take aim at the teamwork and team-based performance in businesses. While many team activities can reach sub-optimal outcomes, as conflicts and group dynamics take over, gamified design principles may provide a method to ensure alignment of goals. A framework is presented to aid implementation with further illustrations provided by some cases.

As we have seen in the past, legislation, regulation, and law have often been slow to adapt to changes and technologies. Kai Erenli (University of Applied Sciences Vienna, Austria) examines gamification and the related rules that are necessary for games—from the perspective of law. A number of gamified elements are examined in light of the legal implications of possible changes that gamification may involve. Some common risks and possible pitfalls are outlined, providing a basis for informed implementation and allowing those involved in implementation to be better positioned to seek legal counsel where necessary.

While much has been said of gamification, it has invariably been positive news. However, any tool used to influence people can often have unintended side effects and it is these consequences that are examined by *Rachel C. Callan*, *Richard N. Landers* (Old Dominion University, USA), and *Kristina N. Bauer* (University of West Florida, USA). Ten different business scenarios are presented with fairly innocuous gamification approaches applied. However, using drawing on psychological science, the authors caution that various consequences may emerge creating additional harms in the workplace.

Briana Brownell (Insightrix Research, Canada), *Jared Cechanowicz*, and *Carl Gutwin* (University of Saskatchewan, Canada) examine the role of improving engagement in survey research to improve engagement with this valuable research approach (in both industry-focused research and academic research) is clearly important. They show that gamification is not a silver bullet and the successful implementation likely rests on careful design throughout. In this case, those participating in surveys have altruistic intentions, while the perceptions tied to gaming relate more strongly to entertainment.

One of the difficulties with projects is that learning is often not carried from one project to another. *Silvia Schacht* and *Alexander Maedche* (University of Mannheim, Germany) address this problem by applying gaming mechanics to the project knowledge management systems that are supposed to capture and make these lessons available for others. While their research was not framed as a cohesive gamification approach, they show that the gamification elements incorporated did influence users to participate in the system more fully.

Stefanie Huber and *Konrad Röpke* (SAP AG, Germany) present their work in the use of gamification to influence organisations—in this case, helping companies become more sustainable by encouraging desired behaviours. Using an established framework to provide a guide to the development, a ride-sharing system was gamified, while accommodating a range of player personas amongst the intended participants. A range of mechanisms are built in to enable greater playfulness and fun in this activity.

Stefan Diewald, *Andreas Möller*, *Luis Roalter* (Technische Universität München, Germany), *Tobias Stockinger*, *Marion Koelle*, *Patrick Lindemann,* and *Matthias Kranz* (Universität Passau, Germany) examine how gamification can help designers address the need for rapid learning and adaption to the user interfaces in new vehicles. Participants explore relevant interfaces and functions in both the vehicle and on mobile devices. Some of the difficulties in maintaining the flow of activities while introducing new information or evaluating outcomes are discussed, highlighting the inherent difficulties in application of gamification to some areas and resulting in the presentation of guidelines for further use of gamification in the automotive sector.

Part IV opens the door to applications and the use of gamification, presented without a strong scientific foundation. Through a series of use-cases, key elements of gamification are used in real situations to drive real results. Note that this part is containing chapter just on case studies; many of the previous chapters also contain smaller case studies.

Anantkumar Malikaveetil (Gamification Expert and Consultant, India) applies gamification to one of the most crucial, but often neglected, processes for new employees—the on-boarding process. Working in the context of a software company, a game-based training and on-boarding process was developed, modelled on the Amazing Race. Drawing from learning theories, the event was staged to make the process both more fun and effective.

Keith Conley and *Caitlin Donaldson* (Bunchball, Inc., USA) show how the careful establishment of gamification principles are important, using one of the commonly applied software platforms for gamification: Bunchball. Using measurement and evaluation as a foundation for the chapter, readers are taken through deployment in a controlled fashion so that desired outcomes will be achieved by design and not by chance. There is a strong emphasis on the Measurement and Learning Plan to align the analytics to the strategy and ensure that desired results are achieved.

Contents

1 **A RECIPE for Meaningful Gamification** 1
Scott Nicholson

2 **Studying Gamification: The Effect of Rewards and Incentives on Motivation** 21
Ganit Richter, Daphne R. Raban, and Sheizaf Rafaeli

3 **A Conceptual Framework for Gamification Measurement** 47
Ronald Dyer

4 **Implementing Game Design in Gamification** 67
Federico Danelli

5 **Applied Behavioral Economics: A Game Designer's Perspective** 81
Charles Butler

6 **Towards Leveraging Behavioral Economics in Mobile Application Design** 105
Tobias Stockinger, Marion Koelle, Patrick Lindemann, Matthias Kranz, Stefan Diewald, Andreas Möller, and Luis Roalter

7 **A Parallel Universe: Psychological Science in the Language of Game Design** 133
Thomas E. Heinzen, Michael S. Gordon, R. Eric Landrum, Regan A.R. Gurung, Dana S. Dunn, and Sam Richman

8 **Context to Culture for Gamification HCI Requirements: Familiarity and Enculturement** 151
Robert Wellington

9 **Psychological Theory and the Gamification of Learning** 165
Richard N. Landers, Kristina N. Bauer, Rachel C. Callan, and Michael B. Armstrong

10 **A History and Frameworks of Digital Badges in Education** 187
Nathaniel Ostashewski and Doug Reid

11 **Game-Based Assessment: The Mash-Up We've Been Waiting For** 201
Thomas E. Heinzen, R. Eric Landrum, Regan A.R. Gurung, and Dana S. Dunn

12 **A Gamification-Based Framework for Developing Learning Activities of Computational Thinking** 219
Isabella Kotini and Sofia Tzelepi

13 **Educational Gamified Science Simulations** 253
Johanna Pirker and Christian Gütl

14 **From Market Place to Collusion Detection: Case Studies of Gamification in Education** 277
Pinata Winoto and Tiffany Y. Tang

15 **Physical Skills and Digital Gaming: The Relationship between Basketball and an Augmented Reality Adaption** 291
Andreas Hebbel-Seeger

16 **Storytelling to Immersive Learners in an Authentic Virtual Training Environment** 315
Lincoln C. Wood and Torsten Reiners

17 **Shaping Behaviours Through *Space and Place* in Gamified Virtual Learning Environments** 331
Da Zhang and Tony Clear

18 **The Development and Assessment of a Team-Based Management Game** 355
John Denholm, Ian Dunwell, and Sara de Freitas

19 **Gamification in Virtual Worlds for Learning: A Case Study of PIERSiM for Business Education** 385
David Craven

20 **Theoretical Considerations for Game-Based e-Learning Analytics** 403
David Gibson and Peter Jakl

21 **Critical Perspective on Gamification in Education** 417
Christopher J. Devers and Regan A.R. Gurung

22 **Implementing Gamification: Requirements and Gamification Platforms** ... 431
Philipp Herzig, Michael Ameling, Bernhard Wolf, and Alexander Schill

23 **Workplace Psychology and Gamification: Theory and Application** ... 451
Philipp Herzig, Michael Ameling, and Alexander Schill

24 **The Gamification as a Resourceful Tool to Improve Work Performance** ... 473
Edward T. Chen

25 **Gamification in the Enterprise: Differences from Consumer Market, Implications, and a Method to Manage Them** ... 489
Basanth Kumar Neeli

26 **Designing Gamification to Guide Competitive and Cooperative Behavior in Teamwork** ... 513
Niko Vegt, Valentijn Visch, Huib de Ridder, and Arnold Vermeeren

27 **Gamification and Law** ... 535
Kai Erenli

28 **How to Avoid the Dark Side of Gamification: Ten Business Scenarios and Their Unintended Consequences** ... 553
Rachel C. Callan, Kristina N. Bauer, and Richard N. Landers

29 **Gamification of Survey Research: Empirical Results from Gamifying a Conjoint Experiment** ... 569
Briana Brownell, Jared Cechanowicz, and Carl Gutwin

30 **Project Knowledge Management While Simply Playing! Gaming Mechanics in Project Knowledge Management Systems** ... 593
Silvia Schacht and Alexander Maedche

31 **How Gamification Can Help Companies to Become More Sustainable: A Case Study on Ride Sharing** ... 615
Stefanie Huber and Konrad Röpke

32 **Gamification-supported Exploration and Practicing for Automotive User Interfaces and Vehicle Functions** ... 637
Stefan Diewald, Andreas Möller, Tobias Stockinger, Luis Roalter, Marion Koelle, Patrick Lindemann, and Matthias Kranz

33 **Application of Game Thinking and Game Elements in New Joiner Induction and On-Boarding Process** ... 663
Anantkumar Malikaveetil

34 Gamification: The Measurement of Benefits 673
Keith Conley and Caitlin Donaldson

Index 689

About the Editors

Torsten Reiners is Senior Lecturer in Logistics at the Curtin University, Australia. His research and teaching experiences are in the areas of operations research, but include instructional design, development of adaptive learning environments, distant collaboration, and mobile learning. His Ph.D. thesis is about adaptive learning material in the field of operations research. He participated in multiple projects to use 3D spaces for learning support; i.e., to improve the authenticity of learning in classes about production and simulation. He is project leader on a competitive grant from the Australian Office of Learning and Teaching (www.ndive-project.com) about developing a theoretical framework for authentic and immersive education with gamified elements.

Lincoln C. Wood is a Senior Lecturer (operations and supply chain management) at Auckland University of Technology (New Zealand) and an Adjunct Research Fellow at Curtin Business School (Australia). He received the Council of Supply Chain Management Professional's (CSCMP) Young Researcher Award in 2009 in the USA and earned his Ph.D. at the University of Auckland (New Zealand). After developing a strong interest in effective supply chain education, Dr. Wood received the Outstanding Research Award at the International Higher

Education Conference in 2010 and is now the Project co-Leader on a competitive grant from the Australian Office of Learning and Teaching (www.ndive-project.com). Dr. Wood has published in leading international journals including *Transportation Research Part B: Methodological*, *International Journal of Operations & Production Management*, *The Service Industries Journal*, *Journal of Performance of Constructed Facilities*, and *Habitat International*.

About the Authors

Michael Ameling holds a Ph.D. in Computer Science and a diploma in Media Computer Science from Technische Universität Dresden. He has a strong background in software and systems engineering, mobile computing, and human–computer interaction. Michael joined SAP in 2006 where he was working in numerous research projects in the area of Internet of Things (IoT). In his current position he leads a team focused on mobile application development, IoT platform development, and gamification. Michael published multiple publications and holds numerous patents.

Michael B. Armstrong is a Ph.D. student and research assistant at Old Dominion University studying Industrial and Organizational Psychology. He graduated from Western Kentucky University in 2013 with a Bachelor of Arts in Psychology. Michael's research interests focus upon the Internet and related technologies as they affect human capital. He is particularly interested in the effectiveness of gamification in workplace training, faking behavior in online selection measures, selection to virtual teams, and the use of mobile devices in both training and education.

Kristina N. Bauer, Ph.D. is an Assistant Professor of Psychology at the University of West Florida. She earned her M.S. and Ph.D. in Industrial/Organizational Psychology at Old Dominion University. She holds a B.S. in Psychology from the University of Pittsburgh and an M.A. in Human Resource Management from the George Washington University. Her primary research interests include self-regulated learning with an emphasis on technology-enabled instruction and transfer of training. She also has a passion for research methods and statistics. Kristina has presented her work at several conferences, including the *Society for Industrial and Organizational Psychology*, the *Academy of Management*, the *American Psychological Association*, and the *Association for Psychological Science*, and her work has been published in *Military Psychology*, *Journal of Experimental Psychology*: *Applied*, *Academy of Management Learning and Education*, and *The Psychologist-Manager Journal*. In her free time, she enjoys yoga and trips to the beach.

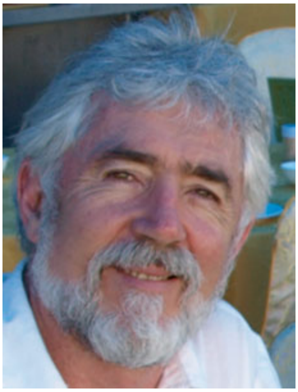
Briana Brownell is a marketing research industry innovator who frequently publishes on new research methodologies and trends in business strategy. With a combination of technical expertise and creativity, she endeavours to make multivariate statistical analysis relevant and easily applicable for businesses. She is the Manager of Analytics at Insightrix Research Inc., a boutique research firm in Saskatoon, Canada.

Charles Butler is currently an Assistant Professor and Director of the Game Design Bachelor Program at the Norwegian School of Information Technology in Oslo, Norway. He is also a co-founder of the independent game studio, Kreative Spill, and a former marketing manager and designer at MMO developer, Funcom. He received his Master of Interactive Technology in Digital Game Development from the Guildhall at Southern Methodist University and his Master of Business Administration from Tennessee State University.

Rachel C. Callan, M.S. is a doctoral student at Old Dominion University who is working in Dr. Richard Landers's Technology iN Training Laboratory. Her research interests focus on the use of technology in employee selection and training contexts, including how individual differences like experience and personality may have direct and indirect effects on outcomes. Her Master's thesis investigated the effects of learner control on time and learning outcomes in web-based training. More recently she has turned her attention to the use of gamification in work settings and the use of social networking data in selection. Within these areas, she is equally interested in how these technologies can improve human resource management processes and potential pitfalls of utilizing these technologies in the workplace.

Jared Cechanowicz, M.Sc. is a researcher at the University of Saskatchewan under the supervision of Dr. Carl Gutwin. His broad interests in technology and entertainment have led his research into the areas of interaction design, simulation tools for game design, adaptive games, and the gamification of work.

Edward T. Chen is Professor of Management Information Systems of Operations and Information Systems Department in the Manning School of Business at the University of Massachusetts Lowell. Dr. Chen has published over 60 refereed research articles in scholarly journals and reference books. Dr. Chen has served as vice president, board director, track chair, and session chair of many professional associations and conferences. Professor Chen has also served as journal editor, editorial reviewer, and ad hoc reviewer for various academic journals. Dr. Chen has received the Irwin Distinguished Paper Award at the Southwestern Federation of Administrative Disciplines conference and the Best Paper Award at the International Conference on Accounting and Information Technology. His main research interests are in the areas of Project Management, Knowledge Management, Software Development, and Green IT.



Tony Clear is Associate Dean Research with the Faculty of Design and Creative Technologies at Auckland University of Technology, New Zealand. His research interests are in Collaborative Computing, Global Virtual Teams, Global Software Development, and Computer Science Education Research. Tony has been engaged in global virtual research collaborations over the last 15 years spanning the continents of Europe, Australia, Asia, and the United States. Among these has been a decade long action research project into collaboration with global virtual teams in educational settings. In 2008 he was a guest researcher at Uppsala University, Sweden, and now supervises doctoral research projects through AUT's Software Engineering Research Lab. Tony holds positions as an Associate Editor and regular columnist for ACM Inroads magazine and Editorial Board member for the journal *Computer Science Education*. He is program co-chair for ACM's Innovation and Technology in Computer Science Education Conference 2014.

Keith Conley joined Bunchball in November of 2011 and has been instrumental in defining the value proposition and proving the business impact of gamification. He has served as Communications Strategist and Analytics Manager for Young & Rubicam and Universal McCann. These roles focused his efforts on generating attitudinal and behavioral measurement plans and subsequently delivering insightful optimization recommendations and clearly demonstrating program efficacy. During his tenure, Keith guided Branding and Direct advertising initiatives for Microsoft, HP, Wells Fargo, The NCAA, Palm Inc., and others in nationwide and global advertising efforts.

David Craven David has thirty-five years' experience within the educational and business consultancy sector. In this role, David has sought to develop a product that could enable people to develop their business skills. This quest arose from the observation that although students might read about business in textbooks and journal articles, they never really understood the practical fundamentals of operating a business.

In 2010, David assembled a team of developers drawn from graduates of the Queensland University of Technology (QUT) Game Development Degree. David developed a 3-D business simulation on an OpenSim platform. The 3-D business simulation was prototyped within the Business Management program of the University of Queensland Foundation Year. The initial response from the business students and lecturers was overwhelmingly positive. The business simulation is currently being used within 15 Brisbane secondary schools, the Foundation Year program for the University of Queensland and as part of an international Youth Leadership program: Chrysalis. In 2011, the business simulation won the Queensland State Government Big Idea Award from over 600 applicants.

PIERSim will be used in November, in conjunction with the G20, to showcase Brisbane to the world as an important hub for international education.

Federico Danelli Born near Milan (Italy) on June 5, 1982, Federico Danelli is a gamification consultant and entrepreneur, graduated in Epistemology with a thesis about epistemic and behavioural applications of cognitive studies, and author of several indie rpg, a game about board management, an ongoing tabletop game, and a tool to framework a gamification experience. He previously worked as teacher, human resources assistant, editor, community and market research manager, game designer, writer, and actor. He is currently working on an essay about faults and problems of Social Roi calculation.

John Denholm is in the final stages of his Ph.D. at the Serious Games Institute, Coventry, doing research into the value of educational games. He has an M.Sc. from Imperial College, London, and has held several senior positions in major UK companies, working on the development of strategic business models. He has lectured on Business, Project Management, and Finance at Birmingham City and Coventry Universities and supervises Master's students at Warwick and Manchester Universities. He has a number of journal publications on business simulation and games for training in business management.

Christopher J. Devers received a Ph.D. in curriculum and instruction from the University of Illinois at Urbana-Champaign as well as an MS in educational administration and a BS in engineering and technology education from Purdue University. He is an Assistant Professor in the School of Education and the Director of Research for the Center for Learning and Innovation at Indiana Wesleyan University (IWU). Broadly, Professor Devers' research focuses on how and when technology promotes learning. Past research on the integration of technology has focused on the simple question of whether or not a particular technology increases learning. Instead of asking whether or not it works, Dr. Devers' research asks "how and when does it work?" Specifically, his research explores the optimal components that impact learning and matching those to the right situations. Overall, the broader questions regarding how and when technology is effective are applied to Professor Devers' lines of research—online education, online video learning, and the Scholarship of Teaching and Learning (SoTL). Currently, his research focuses on using self-explanation to improve online video learning. To learn more about his research, courses, and students visit: http://www.edprofessor.com.

Stefan Diewald studied Electrical Engineering and Information Technology, majoring in Communication and Information Technology, at the Technische Universität München (Germany). He received his Bachelor of Science (B.Sc.) in September 2010 and his "Diplom-Ingenieur (Univ.)" in May 2011.

In June 2011, he joined the Institute for Media Technology at the Technische Universität München as Ph.D. candidate where he is working as a member of the research and teaching staff in the Distributed Multimodal Information Processing Group. Since March 2013, he is also part of the Embedded Systems Group of the Embedded Interactive Systems Laboratory (EISLab) at the University of Passau. His research interests are in the fields of automotive user interfaces and vehicle-to-x communication with the focus on increasing driver awareness.

Caitlin Donaldson joined Bunchball in November of 2012. She brings with her close to 5 years of experience in data analysis. Since joining Bunchball, she has conducted analyses for such companies as NBC, MTV, Adobe, Mattel, Cisco, and Intercontinental Hotels Group. As a Data Analyst, she assists clients in setting goals to guide digital strategy as well as provides reports and data to monitor the progress toward those goals. Caitlin previously worked at ADM Associates, Inc. as a Program Analyst and the Center for Strategic Economic Research as a Research Analyst. Caitlin holds an M.A. in Economics from California State University, Sacramento.

Dana S. Dunn earned his B.A. in psychology from Carnegie Mellon University and received his Ph.D. in social psychology from the University of Virginia. Former chair of the Psychology Department at Moravian College, he is currently Assistant Dean for Special Projects and Professor of Psychology there. Author or editor of 19 books and over 150 journal articles, chapters, and book reviews, his scholarship examines teaching, learning, and liberal education, as well as the social psychology of disability. Dunn's *Psychology Today* blog on teaching is called 'Head of the Class'. He is a fellow of the *American Psychological Association* (APA) and the *Association for Psychological Science* (APS) and served as president of the *Society for the Teaching of Psychology* (APA Division 2) in 2010. In 2013, Dunn received the APF *Charles L. Brewer Award for Distinguished Teaching of Psychology.* He is currently editor-in-chief of the *Oxford Bibliographies (OB): Psychology*.

Ian Dunwell obtained his Ph.D. in Computer Science in 2007. As a Research Fellow in Coventry University's Serious Games Applied Research Group, Dr. Dunwell has recently completed the evaluation of the Department for Transport's £2.5 m *Code of Everand* serious game for road safety. As a multiplayer online role-playing environment, this game sought to create communities among its players as a basis for social learning. As lead author of the project's final evaluation report, he co-ordinated in-depth qualitative and quantitative research to gain insight into the game's 100,000 user base. His key research interests lie in the assessment and evaluation of game-based learning solutions and how best to feed this research into pragmatic and participatory design processes.

Ronald Dyer has held senior ICT Strategy positions in Trinidad and the United States across the financial, education, and agriculture sectors where his work experience spans 20 years working with the likes of Citibank, Goldman Sachs, and The Inter-American Development Bank. He specializes in the area of technology strategy, transformation, and change for performance improvement at the organizational and individual level. Mr. Dyer is an affiliate lecturer at the University of the West Indies, St. Augustine, Trinidad and Tobago in the M.Sc. in Project Management Programme, Faculty of Engineering and Grenoble Ecole de Management's B.Sc. in Management. He is a graduate of Wilfrid Laurier University, Waterloo, Ontario, and holds an M.B.A. from the University of Reading's Graduate School of Business. He is a June 2014 candidate for the Doctorate in Business Administration at Grenoble Ecole de Management, France, with a focus on technology, innovation, and change.

Kai Erenli studied law at the University of Graz. He wrote his doctoral thesis about the legal aspects of open-source licensing and has a deep insight into IT-Law. He is a member of the board of it-law at—the Austrian network for IT-lawyers and FNMA—the Forum for the usage of New Media for education. Kai spent much time in the multimedia business as he was the Art Director of advertising in Graz. Since 2011, he is the study director of the Bachelor Programme 'Film, TV, and Media Production' at the University of Applied Sciences bfi Vienna. Kai is also the Developer of the Location-based-Game 'QuizeRo'.

Sara de Freitas is Associate Deputy Vice Chancellor (Teaching and Learning) at Curtin University where she has responsibility for Teaching and Learning across the university. Her portfolio includes running Curtin Teaching and Learning, including the Learning Engagement, Assessment and Quality and Learning Design Teams. Her responsibilities also include delivery and support of programs such as Transforming Learning across Curtin, Curtin online provision, UniReady pathways, Open Universities Australia, Work Integrated Learning, and Flexible Learning.

Her previous role was Director of Research at Coventry University, UK, where she led the formation and development of the Serious Games Institute, a hybrid model of research, business, and study, the first institute of its kind. The Institute has attracted millions in research funding, a network of affiliated organizations in four continents, and on the business side of operations we supported successful commercial spinouts in the UK and Singapore.

In her role at Birkbeck College, University of London, she helped to establish the well-known London Knowledge Lab, with its focus upon ICT and education. Over the period, she has also directed a company which provided consultancy support for UK Department of Education and the Joint Information Systems Committee. She has attracted significant funding from the British Council, UK Engineering and Physical Sciences Research Council, European Union, and European Regional Development Fund.

Over her academic career, Sara has published extensively in the areas of higher education policy, pedagogy, and technology-enhanced learning. She has published seven books and over 100 journal articles, conference papers, and reports. She currently sits on over 100 program committees and advisory boards and has undertaken over 100 keynotes, presentations, and public lectures. Her most recent book, *Education in Computer Generated Environments* (2013), has just been published in hardback by Routledge in their Research in Education Series. With respect to awards she has gained a teaching award at Birkbeck College, was awarded Most Influential Woman in Technology 2009 and 2010 by the US Fast Company, is a Fellow of the Royal Society of Arts, and is an Adjunct Professor at Malta University.

David Gibson Associate Professor of Teaching and Learning and Director of Learning Engagement at Curtin University in Perth, Australia, works as a team thought leader, educational researcher, learning scientist, professor, and innovator. With funding from National Science Foundation, U.S. Department of Education, MacArthur Foundation, EDUCAUSE, and others, Gibson's research focuses on complex systems analysis, design and improvement of cyberlearning applications, games and simulations in education, and the use of technology to personalize learning via cognitive modeling, design, and implementation. He has published 8 books, 12 chapters, and over 60 articles and presentations on these topics. He is the creator of simSchool, a classroom flight simulator for preparing educators, and *eFolio* an online performance-based assessment system.

Michael S. Gordon studied Cognitive Psychology and Perception at the University of California—Riverside, and completed a Postdoctoral Fellowship on sensory processing across the lifespan at the University of Toronto with the Centre for Research on Biological Communication Systems. He is currently an Assistant Professor of Psychology at William Paterson University in New Jersey (USA) and the director of the Audiovisual Perception Laboratory. He is an active scholar with publications that explore audiovisual speech, motion, music, phenomenology, echolocation, and many related topics on the detection and use of sound. As an award-winning instructor, he has used game-based strategies to improve student motivation and flipped classrooms to empower students in their learning.

Regan A.R. Gurung is Ben J. and Joyce Rosenberg Professor of Human Development and Psychology at the University of Wisconsin, Green Bay. Dr. Gurung received a B.A. in psychology from Carleton College (MN) and a Masters and Ph.D. in social and personality psychology from the University of Washington (WA). He then spent three years at UCLA as a National Institute of Mental Health (NIMH) Research fellow. He has published articles in a variety of scholarly journals including *Psychological Review* and *Personality and Social Psychology Bulletin* and is the co-author/co-editor of 11 books. He is the newly appointed founding Editor of APA's journal *SoTL in Psychology* (January 2014).

Christian Gütl holds a Ph.D. in Computer Science from Graz University of Technology (TUG) and has received the "venia legendi" for applied computer science in 2009. He is the chief scientist at the Institute of Information Systems and Computer Media at TUG in Graz, Austria, where he leads the Advanced Motivational Media Technologies Group. He is adjunct research professor at the School of Information Systems at Curtin University in Perth, Western Australia, and he is the founder and head of Gütl IT Research and Consulting. Christian has authored and coauthored in more than 160 peer-reviewed book chapters, journals, and conference proceedings publications. He is involved in numerous organizational and editorial boards as well as program committees. He is founding member of the global Immersive Learning Research Network (ILRN), managing editor of J.UCS, coeditor of the International Journal of Knowledge and Learning (IJKL), advisory board member of the International Conference of Blended Learning (ICBL), initiator and chair of the CAF workshop series, and co-chair of the ViWo and e-Education Ecosystem workshop series. His research interests include information search and retrieval, e-education, e-assessment, adaptive media technologies, and virtual worlds for learning and knowledge transfer. He has established successful collaborations on these topics with European and overseas institutions. Given his knowledge and research interest, he is frequently invited as a visiting professor, such as to MIT and USyd.

Carl Gutwin is Professor of Computer Science at the University of Saskatchewan and the co-director of the University of Saskatchewan's Human–Computer Interaction (HCI) lab. He has published more than 150 papers in HCI and in 2012 was inducted into the ACM CHI Academy for his contributions to the HCI research community. His research covers a variety of topics including interface design and organisation, information visualisation, modelling of human performance, and groupware usability.

Andreas Hebbel-Seeger studied Education, Sport, and German Language at the University of Hamburg. In the first instance, he worked postdoctoral at the University of Hamburg, department of sport science. Later he covered a professorship for digital media at the University of Augsburg, Institute for Media and Educational Technology. Today he is a professor for media management at the Macromedia University of Applied Sciences and head of media school at Campus Hamburg. His focus in research and teaching is on the use of digital media for teaching, learning, and marketing purposes.

Thomas E. Heinzen I am a social psychologist and a fellow of the Eastern Psychological Association who works at the William Paterson State University of New Jersey. The researcher's toolbox of methods has always interested me which partially explains why I have published articles and books based on experiments, quasi-experiments, surveys, archival data, focus groups, theoretical models, content analysis, historical comparisons, case studies, commentaries, a statistics textbook, and even a collection of natural poetry by people living in nursing homes. I have also consulted as an evaluation researcher for a New York State Commission on veterans, the Rockefeller College of Public Affairs and Policy, the Johns Hopkins Center for Talented Youth, and several smaller organizations. The overall experience has been fun, which is probably why I am now attracted to data-driven game-based approaches to solving social problems, especially those in higher education.

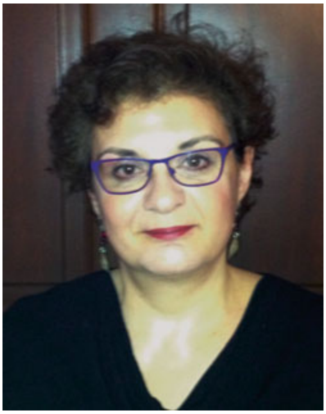
Philipp Herzig holds a B.Sc. in Computer Science, an M.Sc. in Information Systems Research and is currently a Ph.D. candidate at Technische Universität Dresden and SAP. His research interests include software and systems engineering, mobile computing, data management systems, gamification, and psychology. Philipp is the author or co-author of multiple publications and holds numerous patents.

Stefanie Huber is a senior user experience designer at SAP Berlin. She has a love for explorative, innovative projects and coordinates the New Experiences and Technology Group (NxT) at SAP. Her background comes from psychology, human factors, and engineering, where she holds a Ph.D. from Technische Universität Berlin. Stefanie has worked for companies such as Siemens AG, Daimler AG, and Roland Berger Strategy Consultants and was a lecturer for interface design at several German universities. When she is not into trending user experience, she is probably at home baking cupcakes.

Peter Jakl is founder and President of Pragmatic Solutions, a company that is dedicated to employing technology to advance learning analytics with a focus on game-based learning systems. Peter has leveraged his interest in providing depth of meaning from data by empowering businesses across all sectors to improve decision making. Peter is a technologist with a diverse background in software and database design and leads a team of experienced and talented software engineers to advance learning.

Marion Koelle studied Media Informatics at Ludwig-Maximilians-Universität Munich (Germany) where she received her "Master of Science" in June 2013. From October until December 2011, she was a visiting scholar at the University of Glasgow (UK), Inference, Dynamics, and Interaction Group.

In July 2013, she joined the Human–Computer Interaction Group at the University of Passau.



Isabella Kotini holds a Diploma in Computer Engineering and Informatics from the University of Patras, Greece, in 1985 and a doctoral degree (Ph.D.) in System Analysis and Modeling with Hybrid Automata from the Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki (AUTH), Greece, in 2003. She is an Educational Counselor for Informatics in the region of Central Macedonia, Greece. She has taught undergraduate courses mainly in the areas of database systems, computer graphics, information systems, computation theory, formal languages, and automata in Greek Universities. Her research interests include the areas of system modelling and analysis, formal methods, computation theory and automata, web-based collaborative applications, computational thinking, distance learning, collaborative learning and gamification. She has published more than 40 articles in refereed conference proceedings, chapters in books and journals. She is a member of the Greek Computer Society and the Technical Chamber of Greece.

Matthias Kranz studied Computer Science at Technische Universität München. He then completed his Ph.D. at Ludwig-Maximilians-Universität München (Germany). From 2009 to 2012, he was Assistant Professor for Distributed Multimodal Information Processing at Technische Universität München. From September 2012 to January 2013, he was Associate Professor for Pervasive and Mobile Computing at Luleå University of Technology.

Since March 2013, he is full Professor and heading the Institute for Embedded Systems at Universität Passau, Germany. His research interests are Ubiquitous Computing (UbiComp), Intelligent Environments (IE), pervasive and mobile computing (PMC), human–computer interaction (HCI), automotive user interfaces (AUI), multimodal information processing, and mobile learning.

Richard N. Landers, Ph.D. is an Assistant Professor of Industrial/Organizational Psychology at Old Dominion University. His research focuses on the use of technology in learning and assessment, especially as related to web-based learning, social media, gamification, 3D virtual worlds, and unproctored Internet-based testing in the contexts of both organizational science and higher education (http://rlanders.net). He has published in an assortment of interdisciplinary journals, including *Journal of Applied Psychology*, *Computers in Human Behavior*, *International Journal of Selection and Assessment*, *Journal of Virtual Worlds Research*, and *Social Science Computer Review*. He serves as Guest Editor of the *International Journal of Gaming and Computer-Mediated Simulations* and Associate Editor of *Technology*, *Knowledge, and Learning*. His work on social media and gamification in education has been featured in *Forbes* and the *Chronicle of Higher Education*, and he has been invited to speak on games and gamification by the Human Capital Institute, the Virginia Commonwealth University Center for Teaching Excellence, and the US National Research Council, among others. He is also author of SAGE textbook, *A Step-by-Step Introduction to Statistics for Business*. Finally, he maintains a science popularization blog spreading news about technology, business, and psychology at http://neoacademic.com.

R. Eric Landrum is a professor of psychology at Boise State University, receiving his Ph.D. in cognitive psychology from Southern Illinois University, Carbondale. His research interests center on the educational conditions that best facilitate student success as well as the use of SoTL strategies to advance the efforts of scientist-educators. He has over 300 professional presentations at conferences and published over 20 books/book chapters and 70 professional articles in scholarly, peer-reviewed journals. He has worked with over 275 undergraduate research assistants and taught over 12,500 students in 21 years at Boise State. During Summer 2008, he led an American Psychological Association working group at the National Conference for Undergraduate Education in Psychology studying the desired results of an undergraduate psychology education.

Eric is the lead author of *The Psychology Major*: *Career Options and Strategies for Success* (5th ed., 2013), authored *Undergraduate Writing in Psychology*: *Learning to Tell the Scientific Story* (2nd ed., 2012) and *Finding A Job With a Psychology Bachelor's Degree*: *Expert Advice for Launching Your Career* (2009). He coauthored *The EasyGuide to APA Style* (2nd ed., 2013) and *You've Received Your Doctorate in Psychology—Now What*? (2012), the lead editor for *Teaching Ethically—Challenges and Opportunities* (2012), and coeditor of *Assessing Teaching and Learning in Psychology*: *Current and Future Perspectives* (2013). With the launch of a new APA journal in 2015—*Scholarship of Teaching and Learning in Psychology*—he will serve as one of its inaugural coeditors. Eric served as Vice President for the Rocky Mountain region of Psi Chi (2009–2011). He is a member of the American Psychological Association, a fellow in APA's Division Two (Society for the Teaching of Psychology or STP), served as STP secretary (2009–2011), and is serving as the 2014 STP President.

Patrick Lindemann was born in Weiden in der Oberpfalz in 1987. He studied Media Informatics at the Ludwig-Maximilians-Universität München (Germany). He received his Master of Science in 2013 after completing his Master's Thesis in cooperation with the 1&1 Internet AG in Munich.

In September 2013, he started as a Ph.D. candidate at the Human–Computer Interaction Group of the Institute for Embedded Systems, University of Passau. There, he supports the research and teaching work of the Human–Computer Interaction Group. His research is focused on novel interfaces and methods of interaction for users with embedded systems in the car.

Alexander Maedche is a Professor and Chair in Information Systems IV at the Business School and Managing Director of the Institute for Enterprise Systems (InES) at the University of Mannheim. He earned his doctorate from the University of Karlsruhe and afterwards worked 3 years as head of a research group focusing on knowledge-based systems. He has 6 years industry experience in large-scale information systems in positions as IT manager in the Bosch Group and vice president of product management in SAP AG. His research focuses on user-centred software development, effective use in information systems, as well as intelligent process-aware information systems. He has published more than 100 papers in journals and conferences, such as the IEEE Intelligent Systems, AI Magazine, Information and Software Technology, International Conference on Information Systems (ICIS), and Conference on Advanced Information Systems Engineering (CAISE).

Anantkumar Malikaveetil is a techno-creative leader with over 14 years of experience in the learning technology products and services industry. The primary focus of his career has been on creating and growing technology teams for various multinational companies. Anant's core domain expertise is in the learning technologies, setting up and growing off-shore development centers and leadership, and culture and management practices development. He is passionate about creating an environment where people have a sense of personal commitment to their work and always strive to give their best to achieve success for the organization and themselves.

Anant is equally passionate about philately, numismatics, music, and social service.

Anant is based in Pune where he lives with his wife and dearest friend Vidya and is a doting father to an adorable daughter Diya.

Andreas Möller studied Media Informatics and communication science at Ludwig-Maximilians Universität Munich (Germany). He graduated with the title "Diplom-Medieninformatiker (Univ.)" in 2010. In 2008, he was for six months at Carnegie Mellon University Pittsburgh (USA) as visiting scholar, where he worked at HCI Institute.

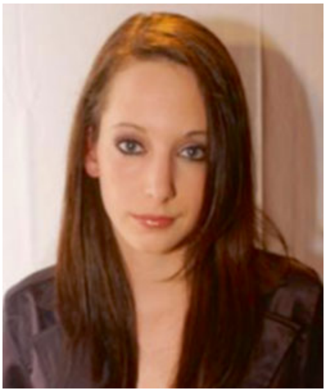
In July 2010 he joined the Institute for Media Technology at the Technische Universität München as Ph.D. candidate where he is currently working as a member of the research and teaching staff. His research interests are in the field of multimodal interaction and user interfaces for mobile devices. Andreas is part of the Distributed Multimodal Information Processing Group.

Basanth Kumar Neeli has 13+ years of experience in conceptualizing, implementing, and positioning in the enterprise domain. Basanth started his career with Cordys, a provider of enterprise class BPMS, where he held a variety of positions from engineering to product management, including senior product manager with responsibility of BPM stack of components. Basanth has consulted with several clients, helping them with BPM initiatives, worked with analysts including Gartner and Forrester on product briefings and the trends in the BPM space, and writes columns for BPM sites like BPTrends. Following his stint at Cordys, Basanth was engaged at Infosys Labs and actively involved in researching the topics around process-based compliance, dynamic processes, on-demand BPM, and Gamification. Currently Basanth has founded a company, Sail Emsoft, offering services, frameworks, and consulting in the areas of BPM, employee/customer engagement with a focus on using BPM to engage employees and customers.

Basanth holds a Master of Sciences (Mathematics) and Master of Technology (Computer Sciences).

Scott Nicholson is an Associate Professor at Syracuse University's School of Information Studies and the Director of the Because Play Matters game lab. His areas of interest include meaningful gamification and the creation of transformative games for informal learning and training. During the 2011–2012 academic year, he was a visiting professor at MIT in Comparative Media Studies and the GAMBIT game lab. Dr. Nicholson is the designer of two published board games—*Going, Going, GONE!* and *Tulipmania 1637* and wrote the book *Everyone Plays at the Library*. His research blog is at http://becauseplaymatters.com.

Nathaniel Ostashewski, B.Sc., B.Ed., M.Ed., Ed.D. is the Academic Engagement Projects Developer at Curtin Teaching and Learning, Curtin University. He has taught a complete range of subjects in K-12 including science, media, physical education, and language arts for 17 years before entering academia. Nathaniel has been also engaged in providing teacher professional learning related to technology use in the classroom since 1996 for numerous teacher conferences and school divisions. In his role at Curtin University since 2012, Nathaniel has been supporting faculty in their use of learning technologies focusing on authentic student engagement through discussion and collaboration. Nathaniel also manages the Curtin MOOC portfolio as part of a strategic initiative in Curtin's Centre for Teaching and Learning. His research track record has yielded over 60 refereed publications, numerous journal articles and book chapters describing technology-enhanced learning implementations such as 3D Printer use in education, tablets, and online and blended learning.



Johanna Pirker, M.Sc., B.Sc. is university assistant, software engineer, and researcher at the Institute of Information System and Computer Media at Graz University of Technology (TUG). She finished her Master's Thesis during a research visit at the Center for Educational Computing Initiatives at Massachusetts Institute of Technology working on the integration of simulations and animations of electromagnetic fields into collaborative virtual world environments. She is currently finishing her doctoral dissertation in computer science on motivational environments at TUG. She specialized in games and environments that engage users to learn, train, and work together through motivating tasks. She has long-lasting experience in game design and development as well as virtual world development. Her research interests include immersive environments, game research, gamification strategies, human–computer interaction, e-learning, computer science education, and information retrieval. She has authored and presented numerous publications in her field.

Daphne R. Raban researches the information society and the information economy. Specifically, she studies the subjective value of information, information markets and business models, behavioural economics of information, information/knowledge sharing, the interplay between social and economic incentives, and games and simulations. Daphne is a Senior Lecturer and Head of the Department of Information and Knowledge Management at the University of Haifa and a member of LINKS, the Israeli Center of Research Excellence on Learning in a Networked Society. She has published in refereed journals including JCMC, JASIST, EJIS, ICS, CHB, Internet Research, Simulation and Gaming and more.

Sheizaf Rafaeli, Ph.D. is Founding Director of the Center for Internet Research and former Head of the Graduate School of Management (2005–2012), University of Haifa, Israel.

He is the founding editor of the *Journal of Computer Mediated Communication (JCMC)*, serves as director and member of numerous editorial boards, the board of LINKS (the national Center of Excellence on Learning in the Networked Society), and the Wikimedia Foundation board.

His interests include Electronic Business, Information Studies, Computer Mediated Communication, Social Networks and their analysis, computer-mediated collaboration, and Online Games and Simulations.

Rafaeli has studied and taught computers as media and the social implications of new communication technologies. He has taught numerous Information Systems' courses and published in journals such as *Behavior and Information Technology, Communication Research*, Computers and the Social Sciences, and Computers and Human Behavior (CHB), *The Journal of Communication, Information and Software Technology*, *Information Systems Research (ISR)*, *Information Systems Journal (ISJ)*, *The European Journal of Information Systems (EJIS)*, *The International Journal of Electronic Business, The International Journal of Human-Computer Studies (IJHCS), Computers and Education, The International Journal of Simulation and Process Modelling (IJSPM), The Journal of Broadcasting*, and many others.

He has been writing a personal weekly column in the leading Israeli dailies Calcalist, Haaretz, Globes, and YNet for the last 10 years.

Sheizaf has served in research and teaching positions at the Hebrew University of Jerusalem, the Ohio State University, the Open University, Michigan State University, IBM, Stanford University, Technion, Israeli College of Management, IDC, University of Sydney, CIIM, and the University of Michigan. His personal homepage is here: http://rafaeli.net

Doug Reid, B.A., B.Ed., M.A., Ph.D. is the Operational Coordinator of eLearning Design & Delivery at Grant MacEwan University. In the past Doug has worked as a K-12 teacher, a professor, an instructional designer, and educational coordinator. Doug has delved deeply into using mobile technology to support student learning. Most recently, he has continued his exploration into mobile technology use and nontraditional teaching and learning opportunities. Doug's research track record has yielded over 80 refereed publications. His interdisciplinary research contributions include Technologically Mediated Learning, Online Learning, Professional Development, Instructional Design, and Technology Implementation. Doug has taught Education, Research, Technology, and Management in Australia and Canada.

Sam Richman is a New York City based engagement design consultant with a professional background in game design, K12 curriculum development, photography, film, web development, and marketing. She received her bachelor's degree from NYU, where she studied the collision of fantasy and reality as well as computer science. Her personal philosophy is that there is no reason every part of our lives can't be a fun, impassioned, and immersive experience.

Ganit Richter is a doctoral student at *The Department of Information and Knowledge Management* and *The Internet Research Center*, which is part of *The Faculty of Management, University of Haifa*. Ganit is also a member of LINKS, the Center of Excellence on Learning in the Networked Society, and a moderator in Executive Business Simulation workshops and courses.

Ganit completed an MBA with distinction, M.A. in pure mathematics, and a B.A. in pure mathematics and art. Her research interest lies in the field of serious games and simulations, specifically in topics such as serious games for crowds (in collaboration with IBM's Social Computing group), gamification, motivations for information sharing, and the role of rewards and incentives. In her research she combines her background in pure mathematics with fields such as psychology and behavior.

Huib de Ridder is full professor of Informational Ergonomics at Delft University of Technology, Faculty of Industrial Design Engineering. He holds an M.Sc. in Psychology from the University of Amsterdam and a Ph.D. in Technical Sciences from Eindhoven University of Technology. From 1982 till 1998 he was affiliated with the Vision Group of the Institute for Perception Research (IPO), Eindhoven, The Netherlands, where his research on image quality metrics was supported by a personal fellowship from the Royal Netherlands Academy of Arts and Sciences (KNAW). Since 1998 he is heading the Human Information Communication Design (HICD) group currently focusing on perceptual intelligence, persuasive experiences, and future interactions. He is (co-)author of more than 180 scientific publications in such diverse fields as user understanding, information presentation, picture perception, assessment methodologies, ambient intelligence, wireless communication, social connectedness, crowd well-being, and vision-based gesture recognition.

Luis Roalter studied Electrical Engineering and Information Technology at the Technische Universität München. He received his "B.Sc." in September 2008 from the Institute for Human–Machine Interaction, AG Technical Acoustics. In November 2009, he received his "Dipl.-Ing. (Univ.)" from the Institute for Human–Machine Interaction, AG Virtual Reality on the topic Multimodal Interaction in a CAVE.

In December 2009, he joined the Institute for Media Technology at the Technische Universität München where he is working as a member of the Distributed Multimodal Information Processing Group in research and teaching. Since March 2013, he is also part of the Embedded Systems Group of the Embedded Interactive Systems Laboratory (EISLab) at the University of Passau. His primary research topics are Intelligent Environments and Distributed Computing Systems with a focus on middleware and software engineering.

Konrad Röpke is a wanna-be musician, a contemporary art lover, and above all a user experience specialist. He studied industrial design, cognitive science, and interaction design before he finally moved to Berlin. As an Interaction Designer, Konrad has worked for IDEO Boston, Deutsche Telekom, and since 2013 he works for SAP.

Silvia Schacht studied business informatics at the University of Mannheim. For the last four years, she has been a Ph.D. student and Research Assistant at the Chair of Information Systems IV, Enterprise Systems (ERIS) at the University of Mannheim. Her research interest focuses on project knowledge management and methods to motivate knowledge sharing and reuse within project teams with a methodological emphasis on design science research.

Alexander Schill is a professor for Computer Networks at Technische Universität Dresden, Germany. His major research interests include distributed system architectures, advanced web technologies, and mobile and ubiquitous computing. Major projects focus on software platforms and use cases for these areas in cooperation with several industry partners.

Professor Schill holds M.Sc. and Ph.D. in Computer Science from the University of Karlsruhe, Germany, and received a Doctor Honoris Causa from Universidad Nacional de Asuncion, Paraguay. At Technische Universität Dresden, he was dean of the Department of Computer Science for 6 years and senator in the High Senate for another 5 years. Before his tenure in Dresden, he also worked at the IBM Thomas J. Watson Research Center, Yorktown Heights, New York. He is the author or coauthor of a large number of publications on computer networking, including several books.

Tobias Stockinger is a research and teaching assistant at the Embedded Interactive Systems Laboratory (EISLab) at the University of Passau since March 2013. After obtaining his Master's degree in Media Informatics at the Ludwig-Maximilians-Universität München (Germany) in September 2012, he worked as a user-experience designer for a Munich-based start-up.

He has specialized in facilitating decision making through interaction design. Aiming at a Ph.D. in Human–Computer Interaction, he set out to bridge the gap between psychology, behavioral economics, and computer science in his recent projects.

Tiffany Y. Tang is an Assistant Professor with the Department of Computer Science at Kean University. Her research interests include Web personalization and recommender systems, usability engineering and (educational) social software, and artificial intelligence in education. She has served on the program committee for a number of international conferences including the Recommender Systems Challenge 2012, in conjunction with ACM Recommender Systems 2012, and as editor for a number of journals on educational technology and recommender systems. Contact her at yatang@kean.edu.

Sofia Tzelepi is an Educational Counselor for Informatics in Greece. She received her B.Sc. and M.Sc. in Computer Science from the University of Strasbourg, France, in 1991 and 1992, respectively; her B.Sc. in Mathematics from Aristotle University of Thessaloniki, Greece, in 1988; and Ph.D. in multimedia database security from Faculty of Engineering, Aristotle University of Thessaloniki, Greece, in 2003. She teaches computer graphics, programming languages, and multimedia among others at Department of Applied Informatics, University of Macedonia, Greece, at Technological Educational Institution, Greece, and at High School. Her research interests include image synthesis, multimedia database security, computer science education, mobile applications, robotics, computational thinking, online distance learning, collaborative learning, and gamification. Her recent publications focus on computational thinking, gamification, and pedagogy. In the context of her duties, she organises a series of conferences, workshops, and competitions in computer science and pedagogy. She is a member of the Greek Computer Society.

Niko Vegt is a Ph.D. candidate in Industrial Design Engineering at the Delft University of Technology. He conducts research on behavior change through gamification (in the G-Motiv project). He specifically investigates the effects of social game elements on the behavior and experience of players in game and non-game contexts. Niko has background in Industrial Design at the Eindhoven University of Technology. So he follows a research through design approach where the design process of the gamification concepts is as valuable for gaining knowledge as testing their effects.

Arnold Vermeeren is Assistant Professor at Delft University of Technology, Faculty of Industrial Design Engineering. He is the leader of the Persuasive Experiences group, which focuses on developing an understanding of how experiences created by novel interactions with technology, or with people through technology, can help people make changes in their behavior, long term or short term. Next to persuasive experiences, his research interests include user experience design, and methods and tools for assessing user experiences. Arnold holds a Master's degree in Industrial Design Engineering and a Ph.D. in Methodological Aspects of Usability Testing.

Valentijn Visch (1971) works as Assistant Professor at the faculty of Industrial Design at the Technical University Delft. He conducts and coordinates persuasive game design research at this faculty and is project leader of the Economic Affairs granted CRISP G-Motiv project (2011–2015) and the NWO granted NextLevel project (2013–2017). Both research projects contain research as well as industry and user organizational partners. Valentijn has a background in Literature (M.A.), Art theory (M.A.—postgraduate Jan van Eijckacademy), Animation (postgraduate NIAF Tilburg), Cultural Sciences and Film studies (Ph.D.–VU), and emotion research.

Link: http://studiolab.ide.tudelft.nl/studiolab/persuasivegamedesign/

Robert Wellington is the director of the HCI lab at Auckland University of Technology. He is a Social Anthropologist in the School of Computer and Mathematical Sciences and presents papers for the undergraduate and postgraduate courses, typically teaching computing specialists about people. He has used gaming in coursework and game environments in research for a number of years, and although he has fond memories of Tekken, and developing levels in Doom II many years ago, is not an 'avid' computer gamer. This chapter reflects a longer association with gaming, communication, competition, and the use and design of artefacts in a very broad way in these contexts, based on an eclectic experience. Robert enjoys cooking, vintage things, renovating, bread making, sword fighting, drum playing, vegetable growing, and family time.

Pinata Winoto is an Assistant Professor with the Department of Computer Science at Kean University. Before holding this position, he was an Assistant Professor with the Department of Computer Science in Korea from 2008 to 2013. He received his Ph.D. in Computer Science from the University of Saskatchewan in 2007. His research interests include multiagent systems, recommendation systems, and edutainment. He has served as program committee members and reviewers of various conferences and journals, and has coauthored more than 30 journal/conference papers and book chapters.

Bernhard Wolf is a Senior Researcher working for SAP since 2006. His current areas of research include adaptive data stream processing and the integration of field device information with business information systems. He holds a Ph.D. in Computer Science and an M.Sc. in Electrical Engineering from Technische Universität Dresden.

Da Zhang worked in the IBM China Development Laboratory from 2009–2012, specializing in IBM middleware platforms and IBM BPM suite of products. Now, he is a Ph.D. student of Software Engineering Research Lab (SERL) at Auckland University of Technology, New Zealand. His studies focus on distributed software development and Global Virtual Teams. Da's current research projects include building the concept of habitus awareness for global virtual teams, and using simulated agents to demonstrate efficient practices for finding knowledge/expertise within virtual environments.

Chapter 1
A RECIPE for Meaningful Gamification

Scott Nicholson

1.1 Introduction

Gamification is a word that has become synonymous with rewards. Most gamification systems focus on adding points, levels, leaderboards, achievements, or badges to a real-world setting in order to entice people to engage with the real world to earn these rewards. Rewards have been used for centuries to change behavior; children and pets are trained through rewards and punishments, soldiers are rewarded for achievements through ranks and badges, and schools use grades to entice students to do schoolwork.

Reward systems do work as long as the rewards keep coming, and research by Skinner has shown how to use the timing of rewards to produce a behavior after the rewards are taken away through operant conditioning (1938). Casinos and recreational game designers have used operant conditioning to addict players to continued engagement with their games without rewarding the player every time. Therefore, gamification systems have also used this model in order to engage people in real-world behavior without having to supply rewards consistently.

When the rewards stop, however, the behavior will likely stop also unless the subject has found some other reason to continue the behavior. Operant conditioning can delay the extinction of behavior by creating the mindset in the subject that "perhaps this time, I will get a reward." The reward schedule that is most effective in slowing the extinction of behavior is known as a variable ratio reward schedule, where rewards of different strengths are given out at various times (Skinner, 1938). This type of reward schedule is used by those designing slot machines and lottery tickets to manipulate players into continuing to play a game without regular rewards.

S. Nicholson (✉)
Because Play Matters game lab, Syracuse University School of Information Studies,
245 Hinds Hall, Syracuse, NY 13024, USA
e-mail: scott@scottnicholson.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_1

In many life situations, having a reward structure is expected and accepted by subjects. For many, the only reason to do an unpleasant job is because of the monetary reward; if the reward stopped, then the subject would stop doing the unpleasant job. Others have found personal reasons that allow them to enjoy their jobs; if the monetary reward no longer came or was not as relevant because of their life situation, they might choose to continue this job anyway. Many tasks that are taken on every day are not done for a reward but are done for some other reason important to the subject.

The drive to do something without an external reward is known as intrinsic motivation (Deci & Ryan, 2004). Performing tasks for intrinsic reasons puts someone in a more healthy mental state than performing tasks for extrinsic rewards. Alfie Kohn, in his book *Punished by Rewards*, explores study after study that show how people perform tasks more poorly for rewards and, after receiving a reward, are less likely to do that task without the reward (1999).

The implications of this for gamification are important. Many forms of gamification are focused on providing external rewards for tasks. The designer of the gamification decides what actions are desired and assigns rewards, such as points or badges, for those actions. By doing so, the gamification system manipulates subjects to engage in a real world setting in order to earn rewards. Subjects earn points, which then lead to intangible status rewards or tangible rewards in the real world.

This system is not new; airlines and hotels have rewarded loyalty with points for decades. Customers accrue points by staying with a single airline and gain levels by doing so; these levels then correlate to perks while flying with that airline. Many businesses have adopted a tracking model offering rewards of free products, better treatment, or access to special opportunities not available to others.

Implementing a reward-based gamification system is relatively easy to do. A designer selects the behaviors to be rewarded and assigns points. These points can then be converted into levels and may also be used in a leaderboard to encourage competition between subjects. An achievement system can encourage behaviors that go outside the point structure that the designer wants to reward. Badges are ways of allowing a subject to publicly display successes and achievements within the system. This concept of adding Badges, Levels/Leaderboards, Achievements, and Points to a real-world setting is called BLAP gamification by Nicholson (2012a), and is also be referred to here as reward-based gamification.

1.2 Situations for Reward-Based Gamification

Reward-based gamification is suitable for some situations. If the organization is looking for immediate and short-term change, reward-based gamification can certainly create that. Many reward-based gamification systems create an immediate spike in engagement as users strive to explore this new system. As long as the organization is willing to continue supplying rewards, the behaviors can continue by those motivated to earn the rewards. However, if the rewards are stopped, then the behavior can stop with it. As Zichermann and Cunningham say in their book, *Gamification by Design*, "once you start giving someone a reward, you have to keep her in that reward loop forever" (2011, p. 27).

If the goal is to teach a skill with real-world value, such as using a hammer or being toilet trained, then reward-based gamification can be effective. As the subject learns the skill, he or she is rewarded. But as the subject then masters that skill and recognizes the real-world value, the rewards are no longer needed, as the subject will continue to use the skill for the real-world benefits instead of the gamification rewards.

If there is a situation where the subject has no way of developing intrinsic motivation to perform the task, then the reward-based gamification can be valuable in helping someone engage with the task. This use of incentives to motivate someone to do something when they have no other reason to do so is a very common use of rewards and for tasks that do not require creative thinking, incentive programs can improve performance (Pink, 2011). Designers of gamification for this situation need to be aware that the participants in this type of reward cycle will expect an increase in the rewards as their performance increases, and this can be a never-ending process once begun (Zichermann & Cunninham, 2011).

1.2.1 Long-Term Change

The danger with reward-based gamification comes when the goal is to create long-term change in the subject's behavior. If the goal is to change someone for life, using rewards in the short-term can be damaging in the long-term. A key finding by Deci and Ryan in their studies of motivation is that **extrinsic rewards undermine intrinsic motivation** (2004). If rewards are used to encourage a behavior that someone already has some intrinsic motivation to engage with and those rewards are removed or no longer seen as valuable, the subject will be less likely to engage in the behavior than when he or she began.

There are many learning-based situations where this is of concern. Libraries use reward-based summer reading programs to develop a lifelong love of reading in children. Zamzee is a gamification system used to facilitate rewards for children as they exercise (http://www.zamzee.com). Rewards have been used to encourage learners to play the piano, take up dancing, or engage with other cultural activities. Grades, which are a well-established form of badges that reward learning, are so powerful that many students will refuse to engage in activities for which there is no grade assigned. The reward-based testing culture in the United States in schools has created a situation where teachers fear teaching content that is not on the test.

Reward-based systems have caused harm over the years, and reward-based gamification is another way of doing this (Kohn, 1999). BLAP gamification is very tempting to use—it is easy to implement and it has an immediate effect. The news about the short-term benefits is easy to locate while data about user dropout rates and the long-term engagement with the desired behavior is rarely discussed.

1.3 Building Intrinsic Motivation

There is another way to encourage behavior, and that is through building intrinsic motivation. Rather than providing rewards for behavior, designers can create systems that help users find their own reasons for engaging with the behavior. The theory behind how to do this is known as Self-Determination Theory by Deci and Ryan (2004). The concept behind this theory is that intrinsic motivation is a combination of three psychological needs: competence, autonomy, and relatedness.

Competence is when participants feel that they have mastered something well enough to make a difference in the world; when the participant no longer feels able to make a difference, he or she then seeks new ways to increase their competence. Autonomy is experienced when the actions and behaviors that someone engages in matches their own sense of who they are, and the extent to which someone makes his or her own decisions about behavior. Relatedness is based upon the connections that an individual feels with other people through their behaviors. Intrinsic motivation is a construct that combines these three concepts of competence, autonomy, and relatedness (2004).

Instead of using game design elements to increase external motivation through rewards, designers can use game design elements to increase intrinsic motivation. Getting a good score is just one reason that people play games; players engage with games for an exploration of narrative, to make interesting decisions, and to play with other people. There are other game design elements that are available to the gamification designer that can bring about an increase in intrinsic motivation. Using game design elements to help build intrinsic motivation and, therefore, meaning in non-game settings is known as meaningful gamification.

1.4 Meaningful Gamification

At the heart of meaningful gamification is the humanistic belief that there are some activities people engage in because they have intrinsic or internalized motivations for doing so. This ties in with Organismic Integration Theory, which states that when people act upon these internalized motivations, they will have a more positive outlook toward the activity than if they are doing something due to extrinsic motivation (Deci & Ryan, 2004). The term "meaningful" is based out of Mezirow's model of transformative learning, where learners connect an experience to previously-held beliefs, which can allow transformation of those beliefs and long-term change (Mezirow, 1991). The challenge in creating something meaningful is that the concept of what is meaningful is defined by each individual; in order for something to be meaningful, there has to be a connection to something or someone in the individual's past. A designer of a meaningful gamification system will have to provide a variety of experiences and ways of engaging to raise the chances that each participant can find something meaningful. This falls in line with the concept of Universal Design for Learning (Rose & Meyer, 2002) where learners need to have the ability to learn a concept in different ways and to demonstrate mastery of that concept in different ways. By allowing the learner choices, it raises the chance that each learner will find a meaningful connection to the material.

Nicholson (2012a) developed a theoretical framework for meaningful gamification starting with Self-Determination Theory. Key results of this framework are the recognition that no one gamification system will benefit every user, that users need to be empowered to create within the gamification system, and that systems need to provide users with the ability to learn and to demonstrate mastery in different ways. Another key result is that the system needs to be built with the user's benefits at the center; by benefitting the user first and the organization second, the chances of long-term change through building intrinsic motivation are greatly improved.

In order to develop strategies for meaningful gamification, Nicholson (2012b) explored concepts behind play and participatory museums. Key elements that arose from this exploration included the fact that play is, by definition, optional. If gamification is to use concepts of play, then the player needs to have the choice to engage with the system on his or her own terms. In order to provide participants with the information needed to make decisions with the system, the concept of creating a ludic learning space (akin to a science museum) is useful. By thinking about the gamification space as a three-dimensional real-world space instead of a linear reward-based system, designers can create gamified worlds for participants to explore.

1.4.1 The RECIPE for Meaningful Gamification

To operationalize these concepts, six elements inspired by game design will now be explored more in-depth:

- Play—facilitating the freedom to explore and fail within boundaries.
- Exposition—creating stories for participants that are integrated with the real-world setting and allowing them to create their own.
- Choice—developing systems that put the power in the hands of the participants.
- Information—using game design and game display concepts to allow participants to learn more about the real-world context.
- Engagement—encouraging participants to discover and learn from others interested in the real-world setting.
- Reflection—assisting participants in finding other interests and past experiences that can deepen engagement and learning.

When reordered, these six elements form the mnemonic RECIPE, and thus this is a RECIPE for meaningful gamification. The six elements will now be presented with a brief theoretical background, how they can be applied to gamification, and a few examples of how they have been used.

1.4.1.1 Play

Over the years, many theorists have explored the concepts surrounding play and its role in society. While there is no one accepted definition of what play is, Gordon (2009) explored different approaches to defining play in an attempt to build a framework that connects these different approaches. One common factor inspired by Huizinga is that play is something that people engage with outside of the real world (1955). Ironically, another key play theorist, Sutton-Smith (1997), argues that play is critical to preparing organisms to deal with the variability in the real world; therefore, playing creates opportunities for evolution. In order to do this, play has to be an activity that someone chooses to engage with and the space for play has to provide freedom for exploration (Callois, 2001). Gordon (2009) explores the importance of the concept of a boundary in play and centers the idea of play on the voluntary interaction with and crossing of boundaries.

When thinking about "playification," it is valuable to think about the difference between play and games. One definition of games is that "a game is a form of play with goals and structure" (Maroney, 2001, para. 2). Since gamification is about taking game elements and applying them to a real-world setting, and one of the elements of a game is the play element, then play-based gamification is a valid approach. By flipping the above definition around, one can assert that play is a game with neither goals nor structure. There is an important addition to make to this assertion, and that is the difference between goals and structure created by those involved in the play activity compared to goals and structure created externally and enforced by the players.

When playing, it is very common that a player will create a new constraint under which to play; in fact, much fun can be found by adding constraints to something in life. This idea of having boundaries, bumping up against them, and occasionally crossing them is part of the concept of play. A key difference is that these constraints, rules, and goals are emergent from the play activity and are quickly changed and broken during the play session. Conversely, when players agree to play a game, they are agreeing to certain rules and goals that they will all adhere to; changing the rules or the goals during a game without explicit discussion and agreement is not good sportsmanship.

To create a play-based gamification system, then, means to create a space where the players can establish and change their own constraints. When something is no longer fun or playful, the players need the ability to change it to make it more fun and playful. If the players are finding fun in the gamification activities, then there isn't a need for external rewards, as the players are creating their own fun. It is the play, instead of the points, that brings people to become engaged in the real-world setting through the play-based gamification.

A key concept from play that is important when thinking about gamification is that play must be optional (Callois, 2001). If something is not optional, then it is not, by definition, play. If a worker is forced to engage with a game, it is no longer a play experience. To create a play-based gamification experience, the designers and funders of the system must recognize that it needs to be a system that the users choose to engage with and are not forced to engage with. This may cause some points of conflict with gamification in the workplace or school where the participants are forced to engage with the system.

One way to soften a required engagement with a gamification system is to ensure that the system allows for exploration. This falls in line with the concept of Choice; players need to be able to select what they want to play with. By conceptualizing a playground and the freedom it allows, gamification designers can have a mental model of what kind of gamification space can create a playful experience. Kolb and Kolb (2010) coined the term “ludic learning space” for a play-based space where learning can occur. These spaces are designed to encourage participants to play, and as they play, they also can learn.

One real-world model of play-based gamification is the science museum (Nicholson, 2012b). Science museums are spaces based on elements from play and games used to connect people to the real world. Science museums do not rely upon rewards like points and badges to get people to engage; instead, they use engaging play as the “reward” to drive engagement. Because there are so many things to engage with, attendees decide with their feet if something is engaging; if an exhibit is not engaging, then the attendee moves on to another exhibit. Many modern science museum exhibits are interactive, allowing the participant to engage with the material in the exhibit, and have been designed such that as the patron engages with the activity, he or she can learn by doing something and then seeing the effects of that action.

Gamification designers can use the mental model of a science museum to create a ludic learning space. By conceptualizing the gamification system in a three-dimensional space where players can explore, designers can push out of the traditional structures. Even if the actual implementation of the gamification system has no three-dimensional visualization, the concept of a space where people can roam, explore, see where others are, engage with those others, and set temporary rules and goals can create a gamification space that people engage with because it is playful.

1.4.1.2 Exposition

Exposition in this context is the process of presenting a narrative layer through game design elements. There are two important parts of exposition: the development of a meaningful narrative element, and the presentation of that narrative element to the player. According to Simons, narrative has been the “core pattern for cognition, comprehension, and explanation and is the most important tool for construing identities and histories” (2007, para. 1). One of the challenges in making an engaging game is to balance the development of a strong narrative with the desire of the player to be in control of the game (Simons, 2007). One of the advantages of a narrative is that it can allow the player to see the relationship between the past and the present, and between the present and the future. This can help the listener to make a more informed decision when a life situation mirrors that of the situation in a narrative (Branigan, 2006).

Brand and Knight (2005) did a study of the narrative elements of eighty different games based on four dimensions of narrative elements in games. Evoked narrative embeds the game in a pre-existing world, such as a movie, book, or previous game. Enacted narrative is the use of elements like cut-scenes, fixed game sequences and limited game play to present a backstory to the player. Embedded narrative is when the player discovers elements in the game world that tell a story that occurred in the past; this could be due to actions by characters in the story or actions previously taken by the player. Finally, emergent narrative is when the player is at the heart of creating the narrative by making meaningful choices in the game.

The purpose of using exposition in gamification is to provide the players with additional ways to be connected to the real-world setting. One path of doing this is to create a narrative that mirrors the real world. This may create a gamification system that is more like a simulation than a game, where players can explore different paths and see potential outcomes. In addition, this type of narrative based on the real world can provide information to the participants about the real world setting.

Another path of providing narrative is the use of analogy. The narrative may not directly lead into the real world, but may be analogous to the real world setting. This may be useful because an analogy may provide richness that the real world setting does not, the analogy may motivate and inspire players in different ways, or there are aspects of the real world setting that would be inappropriate to use as a primary narrative. For example, designers creating a gamification system for a marketing department may choose to use a battleground analogy to represent the "war" that goes on in attempting to win over customers. The challenge when using an analogy is ensuring that the player makes the connection between the analogy and the real-world setting; methods for this are explored later as a Reflection activity.

A danger of using a narrative is when the storyline of the narrative is a distraction from the real-world setting. A world of wizards and warriors may be quite engaging for participants to get involved with, but if it is not analogous to the real world setting, it can be problematic for the longer-term transference of players from the gamification system into the real world. Players may get frustrated who are drawn into the gamification system for the narrative and then learn that the goals of the system are to engage them into a completely different real world setting.

Another consideration about exposition is the need to share the story with the players. During the design process, the game designers may start with a backstory that explains what is going on in the gamification world. Through the design process, the focus will be on how the players engage with the current system, and the designers may forget to create the opportunities for the players to learn about and be engaged in the larger story. This can be an issue in alternate reality games, where the players are engaged with a game system without understanding everything that is going on; designers have to work to bring players into the narrative as they explore the game.

A powerful, but challenging, approach to adding an exposition-based layer to a real-world setting is to enable the players to create their own story. This supports Self-Determination Theory in that it helps participants to feel more autonomy about the gamification system, which supports a more positive mental state (Deci & Ryan, 2004). This can be done in several ways: players can create, name, and share their own challenges and goals within the gamification system, players can make choices as to what story-based layers they want to have as an overlay, or players can create their own story on top of game-based mechanisms. This can create the situation where the narrative is then a distraction from the real world, so a designer has to balance that risk with the rewards of allowing people to create their own narrative.

An example where players helped tell the story comes from *Find the Future*, a game-based experience created by Jane McGonigal for the New York Public Library (NYPL). During this game, 500 players (including the author of this chapter) were brought into the NYPL in the evening and spent all night writing a book about the collections of the library. The game layer empowered players to find 100 marked items around the library, to reflect upon those items, and then to write in response to a challenge that was based upon the items. For example, there was a board game in the collection, and the reflection about the game regarded the fact that board games were used at one point to communicate what it was like to visit an area to people who haven't been there. The writing challenge was to create a game about something in the author's life that few others would experience. As these writing challenges were completed, they were uploaded, laid out into book format, and then bound into a book during the event.

1.4.1.3 Choice

The introduction of Choice into a gamification system puts the player in control of how he or she engages with the system. The theory for the importance of Choice comes from Deci and Ryan's Self-Determination Theory (2004). One aspect of this theory is that a person will have a more positive sense of self-being if he or she has autonomy. In a gamification system, this means that the player has meaningful choices to make within the system.

This is also reflected in the theory of Universal Design for Learning (UDL) from education, where learners are given the ability to learn content in different ways and express their mastery of content in different ways (Rose & Meyer, 2002). This allows each learner to learn in the ways in that he or she is most capable. The underlying concept is that UDL removes barriers between the learner and the content to allow more learners to be successful. Taking this concept into gamification means that the player has to be given choices about how he or she engages with the real-world setting and how success is measured.

The aforementioned concept of Play connects well with the idea of Choice; in order to have a playful experience, the participants need to have choices as to how to engage with the gamification system. By creating a system where the participants can choose what they want to engage with, a more playful ambience can be created for the system. Using the concepts of Play also means that the participant needs to have the choice to **not** engage with the system.

There are several ways to bring in the concepts of Choice to the players. The first, and most commonly used, is to give the players a choice of which activities they want to undertake. This is common in gamifying the classroom; the instructor provides students with a variety of choices as to which assignments they want to do, if they want to work alone or in groups, and in what order they want to take on tasks. Different assignments are worth differing numbers of points, and the students are heading toward a total number of points to reach the grade that they want achieve (Sheldon, 2011). One problem with this model is that weaker students can become lost without some type of guidance as to what to do (Nicholson, 2013).

In order to help players avoid being overwhelmed by choices, one route is to let players choose a goal, and then provide the players with a guide that they can follow to reach that goal. Badges can be used as a set of signposts instead of goalposts to reduce the danger they have as rewards. Using badges in this way allows the players to set their own goals and be assisted by the system instead of doing things simply because there is a badge attached to them. These routes can be created by the gamification designer, and as players become experts with the domain and the system, can be created by expert players for new players to explore.

Taking this concept further, a gamification designer could create a gamification toolkit around a real-world setting. This would empower the players to select and create their own play-based and game-based elements, to engage with those elements, and to share them with others. To still reach the desired behavioral goals, all of the elements of the toolkit would need to lead players toward desirable outcomes. By using a toolkit like this, players will feel empowered as they engage with the real-world setting, they will be able to create their own gamification systems for others to explore, and the players won't be relying upon rewards for engagement, as the meaningful engagement is the reward.

A toolkit that uses game design elements for real-world changes is SCRATCH by MIT. SCRATCH is a toolkit for kids (of all ages) to learn the basics of programming. The toolkit uses a game-like graphical interface, and players can create their own worlds within SCRATCH. As the players learn to drag and connect blocks, they are learning about logic structures, variables, and the other basic concepts of programming. Players can share their creations with each other through a vibrant Web-based interface and once they have downloaded a project, the players can see the "code" behind the scenes and can modify it in order to learn that way. The players have all of the control with SCRATCH—they can choose what tools to use, they can choose to start from scratch or to start with an existing game, and there's no listing of accomplishments, badges, or points that players are trying to earn. Instead, the reward comes from seeing what this freedom of choice and creation can bring about (Lifelong Kindergarten Group, 2013).

1.4.1.4 Information

The concept of providing information through gamification is based upon the idea of providing the player with the "why" and the "how" behind the gamification system instead of just the "what was done" and "how many points is it worth." Theoretically, the importance of providing information comes out of Self-Determination Theory. One of the three elements of this theory is mastery; people have a more positive mental outlook when they feel they are gaining mastery in a topic area (Deci & Ryan, 2004).

If the player only sees rewards for specific behavior, he or she will learn only what behaviors have value to the game designers. Skinner studied different ways that reward systems change behavior; while reward-based gamification can use Skinner's concepts to change behaviors, the player will not gain a sense of mastery in the real-world setting. Using this concept of behaviorism can create engagement, but participants will most likely not know why they are engaged (other than to earn rewards) (Kramlinger & Huberty, 1990).

On the other hand, humanism is focused on helping the participants understand the reasons for changing behavior. Humanists are focused on understanding the needs of the participants and matching concepts to those needs. This humanistic approach requires the participants to be informed about what is going on. While participants may still earn rewards, they will learn why those actions are being rewarded. As they learn more about the real-world setting and the effect of their actions, they can reach the mastery desired by Self-Determination Theory (Kramlinger & Huberty, 1990).

In order to create a gamification system to support the humanist approach, it is important to provide the player the information needed to connect what he or she is doing to the real-world setting. This is not typically done in many reward-based gamification systems; points and badges are given to players for performing desired behaviors in the same way that treats are given to dogs to get them to behave. Instead of just telling players what is a good thing, designers can use game elements to provide information about why that activity is a good thing.

There are several game-based methods for doing this. The first is with a graphical user display. Over the years, video games have gotten quite good at displaying a significant amount of real-time information to the player. Some games allow the user to customize their own interface through menu choices or modifications. One example of this in the real world is with hybrid cars. Some hybrid cars use a basic graphical element like a tree growing to indicate power-conserving driving habits. Other cars provide graphical displays that display where power is being taken from and how it is being used as the driver brakes and accelerates. Users that pay attention to this information will be able to improve their driving habits in any vehicle instead of just trying to make a tree grow.

Another method of providing a player with information about the real world is through non-player characters in the game. Many games have a guide or sage who provides the player with guidance and assistance, and this character could also provide the player with real-world information. Another way of providing information is with characters who are on different sides of an issue and trying to win the trust of the player by providing him or her with information. One risk in using non-player characters to provide information is trust; if the player has a reason not to trust a character in the game, then the player may also not trust the information provided in the game.

A third way of giving the player information is to tie it in with the Exposition. Embedded narrative is providing the player with information about the backstory through elements in the game world, and this concept of embedded narrative can provide players with information about the real world. Alternate reality games (ARGs) start with the current reality, but then add some type of narrative and gameplay layer that adds narrative to the activity. A method of using an ARG to make a difference is to start with something that players have the ability to change in the real world, and then create the layer based a scenario of "what if" many people made that same choice. For example, the game-based activity, *World without Oil* (http://worldwithoutoil.com), had players creating local news stories exploring the impact of an oil crisis. Players did research about how running out of oil would affect their local communities, and then created stories about steps taken to continue life in an energy crisis. As the players engaged with this activity, they developed a plan of actions that they could take in the current world to lower their energy consumption. The goal of using this method is to help the player explore the potential impact of current decisions on the future through a narrative that could come true if action is not taken.

Another game-based method of providing information about the real world is through the game mechanics that the player interacts with. Educational games can take two approaches—they can provide the player with information about the topic, or they can immerse the player in a simulation where they engage with mechanisms reflective of the real world. The author's board game, *Tulipmania 1637*, was a recreational board game designed around a bubble stock market that is controlled by the players; to create the game, the author did research on how bubble markets work and used that research in developing the game mechanisms. After playing the game, players can be much more aware of how bubble markets function to avoid being swept up in one.

If the goal is to provide the player with information, it is important to provide that information in different ways. The theory of Universal Design for Learning states that learners need to have access to information in different ways so that each learner can learn in the way that is best for him or her (Rose & Meyer, 2002). Applying this theory here, this means that the gamification designer needs to consider different ways of providing similar information to the player.

Another challenge is that of providing relevant information to the user. This is a more difficult challenge than many consider, due to the theory of situational relevance. This theory states that each user has his or her own knowledge base and background, and because of this, there is no way to know what information will be relevant to a specific user (Schamber, 1994). Libraries are built around this concept; by having a variety of information available, each user is likely to find the information that is most relevant to him or her. There is no one correct source of information for an information need. Gamification designers need to consider providing information for users who are new to the real-world setting as well as information for users who have more experience with the setting.

1.4.1.5 Engagement

In this context, engagement has two definitions. The first is through social engagement, by creating opportunities for participants to engage with others in meaningful ways. This comes out of the third element of Self-Determination Theory, which is relatedness. People have a more positive mental well-being when they feel connected to the world around them (Deci & Ryan, 2004). Many gamification systems are designed as single-player experiences as the player engages in his or her own journey, gaining points by overcoming obstacles. Engagement can be introduced by creating peer groups of participants working through the same gamification system, or by creating connections between participants and people who are already involved with the real-world setting.

A second definition of engagement in this context is the creation of an engaging gameplay experience. One theory behind creating an engaging experience is the concept of Flow. The basic idea of flow is that the difficulty of the challenges in the gamification system increases as the player's skill increases; a player who is in a state of flow is fully engaged with the system. This state can occur when the player understands what actions are needed to take to reach specific goals (Csikszentmihalyi, 1997). Many gamification systems do not get more challenging, which creates boredom. If the challenges presented to the player are too far above his or her skill level, this creates anxiety and frustration. Engagement is reached when the challenges match the skill level of the player.

These two concepts can be brought together; as players get more skilled with a system, they are better prepared to engage with other players. Creating opportunities for social engagement in a gamification system requires the designer to think about the best time to introduce other players. Until a player feels confident within a game environment, the player may not be comfortable engaging with others. This has led to a game design structure in digital games where players engage with the world, controls, and mechanisms on their own at first, and once they are comfortable, are then ready to engage with other players. While many tabletop games have players engaging with each other from the beginning, many players of these games hesitate to have a conflict with another player until they have spent time engaging with game mechanisms. Forcing a player into a social engagement too quickly can drive him or her away from the gamification system.

There are two types of types of player engagement to consider when creating a gamification system: engagement between players in a social manner and engagement between players through game mechanisms. Social engagement can be facilitated through discussion boards, chat spaces, and other methods of allowing players to talk to each other. Social engagement can also be facilitated through encouraging people to connect their social networking spaces to their in-game profile, although this should not be forced upon a player. Engagement through game mechanisms can come through comparative scoring systems such as leaderboards, players creating challenges for each other, players interacting with each other through game elements, or players working together toward a shared goal. Players can be engaged with each other in both dimensions; looking at the model of multiplayer online games through *Xbox Live*, players preparing to engage with each other on the battlefield through shared game mechanisms are first placed into a shared chat room while the game is prepared and then may have opportunities during the game to talk with each other using voice chat.

Taking these concepts into a gamification system connects well into the aforementioned idea of creating a gamification system that is structured like a museum. When museum attendees are encouraged to engage with each other around a shared exhibit, they can share their viewpoints, ideas, and learn from each other. This can happen in a gamification system if players who are engaged with the same challenge at the same time are able to socially engage with each other as well. The *Nike+* system allows players who are going out to exercise to indicate via a social network that they are starting their workout. Other people can see this and send virtual cheers, which are then send through a mobile device to support the person who is exercising.

Another consideration when developing engagement opportunities for a gamification system is if players will compete, cooperate, or both. Competitive gamification systems can encourage some type of people to put more into the system in order to do better than others, but these same systems can discourage others. A leaderboard, for example, can inspire those at the top of the leaderboard to push each other to stay on top. That same leaderboard can be quite demotivating to those at the bottom of the leaderboard. When the author used leaderboards in a class, he found that the effect on most of the class was to demotivate them to the point where most students had given up doing class assignments as they felt there was no way to catch the leaders (Nicholson, 2013). If the real-world setting is already a competitive setting, such as a sales team, gamification systems can enhance this competition by providing more tools to those who need to engage in the competition.

Cooperative gamification systems are about bringing people together. These systems can tap existing friendships and social networks to encourage players to recruit others whom they already know, and allow friends to work together as a team in the system. The systems can also create challenges that require cooperation; these systems can create the opportunity for people to work together in short-term encounters or to get to know each other for longer-term engagement. These systems can also create the platform for those who are more experienced with a real-world setting to assist those who are new to the setting, which can create very powerful mentorship-based relationships.

Systems can combine both competition and cooperation. One method of doing this is through prior allegiances, such as with sports teams. Fans of the same team can be brought together to compete against fans of other teams through the gamification system. This type of a setup has the advantages of both systems; it creates the opportunities for people to engage with each other around a shared passion, and also can fire up the competitive spirit which can get people more engaged with a system than they might be without the competition. Another twist is to start people as competitors, but as they work through the gamification system, they have opportunities to join forces and work together. This can create a set of shared experiences that are valuable for bonding between strangers and can create teams of players who already respect each other from prior game play.

Another reality about game systems is that players are now used to being able to find other players of the same game through the Internet. This did not used to be the case; if the tools weren't in the system to engage with others, it might be very difficult to find others who were playing the same game. Now forums, Frequently Asked Questions (FAQs), and reference websites are created for most games. Those designing a gamification system may find that players are able to work together to solve challenges in ways that they were not expecting. If there are solutions that players need to work through, there will most likely be a FAQ produced with the answer to those challenges. Many creators of complex alternate reality games who planned on challenges taking weeks to resolve found that ingenious players join forces online and solve these challenges in days. If there are backdoors or shortcuts, they will be posted online for all to find. Designers trying to make a challenge-based gamification system must recognize the power of the shared Internet-based brain and design the tasks accordingly with randomized or customized elements.

1.4.1.6 Reflection

The concept of Reflection is creating opportunities for players to step back and think about their game-based experiences. This opportunity for reflection creates the situation where a learner can connect what happened in the game to elements in his or her own life. Dewey explored the importance of reflection in learning, and argued that without reflection after action, people do not find meaning in what they are doing (Rodgers, 2002). Reflection is commonly overlooked, but it is a powerful tool in helping a game-based activity to have meaning well after the experience is over.

Kolb and Fry (1975) created an experiential learning model around the concept of reflection. This cyclical model starts with a learner having an experience. This is followed by the learner reflecting upon this experience, which forms connections between the experience and other aspects of his or her life. After reflecting upon the experience, the learner then generalizes aspects of the experience to create abstract concepts. Finally, the learner applies those abstract concepts to a new setting, which starts the cycle again.

In the training domain, reflection is represented as debriefing, which is a key part of any training experience. Thiagarajan (2004) has developed a six-stage process for debriefing that may be valuable to those putting reflection into gamification. It starts by having the learners explore their emotions after the learning experience, and then has the learners discuss what happened during the experience. After this, the learners then break down the learning experience to consider what they actually learned, and then explore how these topics can relate to the outside world. Learners are then asked to consider how they could apply these concepts in new settings, and then to consider what their next steps will be based upon their experiences.

Both of these pathways to reflection are much more powerful when they are done with others. During a learning experience, each individual learner will follow one path and see a subset of what was available. Much as with the parable of the blind men each feeling part of an elephant and coming away with a different perception of the beast, learners who see only their own learning experiences do not get a chance to understand the bigger picture. By reflecting about the experience with a group, learners can learn from the insights of others.

Few educational games have reflection components as part of the activity; instead, they depend upon the teacher who is facilitating the game to lead the students through a reflection. When these games are taken out of the classroom setting, they lose much of their effectiveness without the reflection. Designers looking to educational games as a model for educational gamification systems need to be aware that, to be effective, the shared reflection process needs to be part of the gamification system.

There are three basic components of reflection that can be the areas of focus in developing a reflection component in a gamification system. The first is *description*, where the participant thinks about and shares what he or she actually did as they engaged with the activity. This first step is important, as it will help the participants to think beyond the last few things that happened, but go back to the beginning and think about the process and how they changed throughout the experience. The second is *analysis*, where the participants analyze what they did and think about how their actions connect to their own lives. This helps the participant push outside of the gamification system and seek connections; many times, a participant will make connections that a designer would never have considered. It is because of this that reflections need to come from the participant and not from what the designer thinks the player should reflect upon. Finally is *application*, where the participants are then urged to take action based upon what they have explored. This is where the long-term change can come into play, as it is the point where the behaviors learned in the gamification system are then taken outside of that system (Fanning & Gaba, 2007).

Nicholson (2012c) talks through the steps needed to incorporate these components into educational games. The first step is to shift the role of the user from a participant to someone reflecting about the experience. For reflection to be effective, the user has to shift out of the role of doing and reacting to thoughtful reflection. This requires the gamification design to change the stage upon which the game is presented. This could be done by having the player engage with a character or be given a task in the game that asks the player to recount his or her experiences, such as a reporter or an investigator. Another route is to break the fourth wall in the system and have the designer or a representative of the sponsoring organization engage directly with the player. This could also be tied into Engagement, as mentioned above, where participants are brought together to discuss what went on.

When changing the stage, it is also important that the players understand what their reflections will be used for. Reflections are most powerful when shared, but the players need to know that what they say will be shared with others before they write it. One way to do this is to share the reflections of others with the player first, and then ask what the player would like to share with other people who are engaged with the system. If the engagement is done in a forum-type space, then this will be clear, but if the engagement is done within the shell of a game, the players may not realize what they say will be shown to others.

Another way to enable reflection is to create a timeline of snapshots of the player's activity throughout the game. This can be done as the player engages with the activity, or can be done later by capturing some key element of an accomplishment and asking the player to later reflect upon that. *Nike+* does this after a run by showing participants a map of where they ran with their running speed, asking them how they feel on a scale of smiley to frowny faces, and asking them to log the running surface and their shoes. This information is then stored for the participant to look at later and can be easily shared to a social network. This moment of reflection after each run helps participants to think about what they are doing and how they are feeling after coming in from exercise.

Because each learner will connect an experience to different parts of his or her background, allowing that kind of reflection to be shared can be very powerful. *Librarygame* (http://librarygame.co.uk/) is a gamification platform for libraries that encourages readers to reflect upon books that they have read. This reflection also serves as a way for readers to find others who have similar interests. *World without Oil* (http://worldwithoutoil.com) had players reflect upon and share how their activities in the game would change the way they behaved in their local communities. If the gamification system has a reflection component focused on real-world impact built in as part of the experience, it will allow the gamification designers to demonstrate the impact their efforts are having on communities around the world; this justification is critical to demonstrate why these efforts matter and should continue to be funded.

1.4.2 Following the RECIPE for Meaningful Gamification

When creating a gamification system, designers should start by working with the sponsoring organization to determine what outcomes they wish to achieve with the system. This outcome should be first focused on the benefits to the player (instead of the benefits to the organization). By creating a player-focused gamification system, designers will be able to be more likely to avoid short-term rewards, as the benefits of the system are in line with benefits for the player. If the gamification system is designed first and foremost to benefit an organization, then it is much more likely to require rewards and have little long-term impact on the players. By focusing on benefits for the players, the organization is more likely to gain long term and loyal participants who do not need a continued string of increasing rewards to stay engaged.

Once the designer has determined the player-based outcomes, then he or she is ready to think about each of the components of the RECIPE for meaningful gamification. The designer should avoid starting with a system based on external rewards; if the outcomes are based on the needs of the players, then the rewards will already be a part of the project. Not all elements of this framework will be appropriate for a gamification system, but it is important to ensure that there are different ways that a user can engage with the system. If there is only a single path of engagement with a gamification system, then this will engage only a single type of user.

Bartle (1996) developed a framework of gamer psychology that can be useful in thinking about the different parts to support with a gamification system. Achievers are players who want to feel as though they have accomplished something significant; they highly value the Mastery element of Self-Determination theory. Explorers are those who wish to engage with breadth of the gamification system and poke around the boundaries of the system; they highly value the concept of Play as the freedom to explore boundaries and the Autonomy element of Self-Determination theory. Socializers are those who want to use the system to meet and engage with others; they are interested in the Relatedness concept of Self-Determination Theory. Finally, Killers are those who challenge and compete against others; they are interested in the competitive aspects and also value the Mastery element of Self-Determination theory. By ensuring that each of these player types has a way to enjoy exploring the system, a gamification designer greatly increases the chances of player engagement.

After considering these issues, the designer can think about how to use each part of the RECIPE to develop a robust system:

- What are the core Play elements in the gamification system?
- How can Exposition be used to help players connect the game activities to the real world?
- How are the players given a Choice of activities?

- What ways can the players be provided with Information about their actions?
- How can the players become Engaged with each other?
- How do players Reflect upon what they have done?

By following these steps, the designer can craft a game layer on a real-world setting that is much more likely to make a long-term and meaningful difference than if the designer simply provided treats for good behavior.

1.4.2.1 Using Reward-Based Gamification with Meaningful Gamification

All of that said, there can still be times when reward-based gamification is valuable. As was mentioned earlier, if the goal of the gamification is not long-term change, then offering rewards can be an easy way to achieve a short-term goal. If there are no player-based outcomes that can be developed because there is no intrinsic motivation for a player to engage with the real-world behaviors, then rewards may be the only way to get people engaged. This system already exists in the real world—money—which is a reward-based system that people use if they want to change the behavior of someone else.

If the goal is long-term change, rewards must be used sparingly. If the player sets his or her own goal, then rewards can be useful to help a player know when he or she has done something to move toward that goal. Badges can be useful as signposts to guide a player toward a goal that he or she previously set. Points can be useful to get people engaged with a system, but the point system needs to be designed such that the value of the points diminishes over time and is replaced by more meaningful ways of engaging with the system. If rewards are used, they should be designed from the beginning to be something that leads into more meaningful engagement, and not an ongoing way to bring people to the system.

Pink talked about when rewards are appropriate to use and when they hamper performance in his book *Drive*: *The Surprising Truth about What Motivates Us*. His book, also based in concepts of Self-Determination Theory, explores how rewards enhance performance when they are used for tasks that are algorithmic, which require little original thought and are about following a set of rules, but diminish performance when the tasks are heuristic, which require creativity and the creation of new solutions (2011). Bringing this over to gamification implies that reward-based gamification can be valuable during the onboarding experiences, where little creativity is allowed, but then those rewards need to be diminished if the player is challenged with tasks that require them to go outside the box. This is when meaningful gamification is useful in helping the player to continue on their exploration of the desired context.

1.5 Conclusion

While both reward-based gamification and meaningful gamification can be tools to get someone engaged in a context, they are only starting points. If the goal is to change someone in the long term, then the gamification system needs to be seen as a layer that can be removed so that the participant can be left in the authentic real-world setting. This isn't important for a short-term goal, such as getting people to purchase a specific product, or if the organization is willing to offer these rewards for an ongoing basis, such as frequent flyer rewards. But for true long-term change, the gamification system needs to be designed as a journey.

To create true long-term change, the entire gamification system should be designed to come to an end for an individual player. Many gamification systems are designed to engage players in an ongoing basis, offering them more points, levels, and rewards as they continue engaging with the real world. The result is that players stay with the system until they get bored, but if there is no transition element built into the gamification system, the player is not likely to make the switch into engaging directly with the real world.

Instead, for long term change, the long-goal of the gamification system should be to escort a player into deeper engagement with the real-world context and then to leave him or her in the real world. As the player gets more involved in the system, he or she should be spending more time engaged with directly with the real world and less time engaged with the gamification system. One way to do this is to build the gamification system such that it engages with a community of practice or affinity group that already exists. By using gamification to help the participant make connections with an authentic community of enthusiasts, designers can create systems that fade away and leave the participants as new members of this community.

One path of the gamification journey is to start with unmet needs and use a light reward-based layer as the tutorial to bring people into the system. These rewards should quickly be replaced with more meaningful elements, such as a narrative, freedom to choose paths to explore, playful activities, and opportunities to reflect. As the participant engages with this more meaningful elements, he or she should also begin to engage with the existing affinity groups that surround the context. The gamification systems should be designed as layers that are peeled back and create moments of authentic engagement between the participant, the external context, and the affinity groups. The goal of this journey is then to remove the gamification layers entirely. It is in this way that gamification should not be thought of as a cycle, but as a journey to bring about lifelong change.

References

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research, 1*(1). Available online at http://www.mud.co.uk/richard/hcds.htm.

Brand, J. E., Knight, S. J. (2005) The narrative and ludic nexus in computer games: Diverse worlds II. *Proceedings of the Digital Games Research Association Conference*, Vancouver, Canada. Retrieved from http://www.digra.org/wp-content/uploads/digital-library/06278.57359.pdf

Branigan, E. (2006). *Projecting a camera: Language games in film theory*. New York: Routledge.

Callois, R. (2001). *Man, play and games*. Champaign, IL: University of Illinois Press.

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life*. New York: Basic Books.

Deci, E., & Ryan, R. (2004). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Fanning, R., & Gaba, D. (2007). The role of debriefing in simulation-based learning. *Society for Simulation in Healthcare, 2*(2), 115–125.

Gwen, G. (2009). What is play? In search of a definition. *Children to Red Hatters: Diverse Images and Issues of Play: Play and Culture Studies.* 8. 1–13.

Huizinga, J. (1955). *Homo ludens: A study of the play element in culture*. Boston: Beacon.

Kohn, A. (1999). *Punished by rewards: The trouble with gold stars, incentive plans, A's, praise, and other bribes*. Boston: Houghton Mifflin.

Kolb, D. A., & Fry, R. (1975). Toward an applied theory of experiential learning. In C. Cooper (Ed.), *Theories of group process*. London: Wiley.

Kolb, A., & Kolb, D. (2010). Learning to play, playing to learn: A case study of a ludic learning space. *Journal of Organizational Change Management, 23*(1), 26–50.

Kramlinger, T., & Huberty, T. (1990). Behaviorism versus humanism. *Training and Devleopment Journal, 44*(12), 41–45.

Lifelong Kindergarten Group (2013). *About SCRATCH*. Retrieved online from http://scratch.mit.edu/about/.

Maroney, K. (2001, May). My entire waking life. *The Games Journal*. Retrieved from http://www.thegamesjournal.com/articles/MyEntireWakingLife.shtml

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco: Josey-Bass.

Nicholson, S. (2012a, June). *A user-centered theoretical framework for meaningful gamification*. Paper Presented at *Games+Learning+Society 8.0*, Madison. Retrieved from online at http://scottnicholson.com/pubs/meaningfulframework.pdf

Nicholson, S. (2012b, October). *Strategies for meaningful gamification: Concepts behind transformative play and participatory museums*. Presented at *Meaningful Play 2012*. Lansing. Retrieved from online at http://scottnicholson.com/pubs/meaningfulstrategies.pdf

Nicholson, S. (2012c). Completing the experience: Debriefing in experiential educational games. In the *Proceedings of The 3rd International Conference on Society and Information Technologies*. Winter Garden: International Institute of Informatics and Systemics. 117–121. Retrieved from online at http://scottnicholson.com/pubs/completingexperience.pdf

Nicholson, S. (2013, June). Exploring gamification techniques for classroom management. Paper presented at *Games + Learning + Society 9.0*, Madison. Retrieved from online at http://scottnicholson.com/pubs/gamificationtechniquesclassroom.pdf

Pink, D. (2011). *Drive: The surprising truth about what motivates us*. New York: Riverhead Books.

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking. *Teachers College Record, 104*(4), 842–866.

Rose, D., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: ASCD.

Schamber, L. (1994). Relevance and information behavior. In M. E. Williams (Ed.), *Annual review of information science and technology 29* (pp. 3–48). Medford, NJ: American Society for Information Science.

Sheldon, L. (2011). *The multiplayer classroom: Designing coursework as a game*. Boston: Cengage Learning.

Simons, J. (2007). Narrative, games, and theory. *Game Studies, 7*(1). Retrieved from http://gamestudies.org/0701/articles/simons.

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. New York: Appleton-Century.

Sutton-Smith, B. (1997). *The ambiguity of play*. Cambridge, MA: Harvard University Press.

Thiagarajan, S. (2004, February). Six phases of debriefing. *Play for Performance.* Retrieved from http://www.thiagi.com/pfp/IE4H/february2004.html

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Chapter 2
Studying Gamification: The Effect of Rewards and Incentives on Motivation

Ganit Richter, Daphne R. Raban, and Sheizaf Rafaeli

2.1 Introduction

This chapter focuses on the intersection between two well-researched areas: motivation and game playing. While each area offers a wealth of research insight, the connection between them received modest research attention, a gap we wish to narrow. Interestingly, industry was quicker to identify this gap and offer the new buzzword, gamification. "Gamification" is the use of game elements in non-gaming systems to improve user experience and user engagement, loyalty and fun (Deterding, Khaled, Nacke, & Dixon, 2011; Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Lee & Hammer, 2011; Muntean, 2011). In recent years gamification systems were applied in marketing (Muntean, 2011; Shneiderman, 2004) as well as non-business contexts such as politics, health (Lee & Hammer, 2011), or interactive systems (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011) and education (Lee & Hammer, 2011; Raban & Geifman, 2009; Rafaeli, Raban, Ravid, & Noy, 2003; Ravid & Rafaeli, 2000). This rapid development has caught the interest of researchers as a potential to create engaging workplaces (Reeves & Read, 2009); facilitate mass-collaboration (McGonigal, 2011) or encourage knowledge contribution (Krause & Smeddinck, 2011; Shneiderman, 2004; von Ahn & Dabbish, 2008).

Gamification is a new concept which is gaining momentum. Fortune magazine capped gamification as the new business concept with a market forecasted to reach over $1.5 billion in 2015 from $97 million in 2011, a rapid increase over the 5 years

G. Richter (✉) • D.R. Raban • S. Rafaeli
The Center for Internet Research and LINKS I-CORE Program, Faculty of Management, University of Haifa, 199 Abba Khoushy Avenue, Mount Carmel, Haifa, Israel
e-mail: grichter@univ.haifa.ac.il; grichter@campus.haifa.ac.il; draban@univ.haifa.ac.il; sheizaf@rafaeli.net

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_2

2011–2015 (Konrad, 2011); technology industry research firm Gartner estimates that by 2014 gamified services for marketing and customer retention will become as important as Facebook, eBay or Amazon, and that by 2015, more than 50 % of organizations will gamify their innovation processes (Gartner Group, 2011). Gamification also made it into Oxford's Short List for Word of the Year 2011 (OUPblog, 2011).

In fact, gamification has already become subject to controversy and critique as some influential bloggers (McDonald, 2010; Robertson, 2010; Wu, 2012) emphasized the need for developing gamification systems that create intrinsic motivations rather than replacing them with extrinsic rewards (points and badges). Pointification (Robertson, 2010), gamification backlash (Wu, 2012) or exploitationware (Bogost, 2011) are examples of derogatory labeling.

Serious games are game-based activities designed to promote a desired action such as knowledge sharing (Deterding, Khaled et al., 2011; Deterding, Sicart et al., 2011; Krause & Smeddinck, 2011; von Ahn & Dabbish, 2008). One of the promising directions for the application of gamification is in serious games which is the focus of this chapter. Gamification may also be applied in other contexts such as learning and educational activities; however, our interest is in serious games and their organizational significance. Next we elaborate on the relationship between gamification and serious games.

2.2 Gamification and Serious Games

Recent years have seen a wealth of popular and academic publications on serious games and gamification. These terms can be distinct, as we define below, but they are also similar and used interchangeably. In this section we explain the overlap and the distinction between them.

The main goal of games is entertainment, but their universal applicability gave games extra functions in various aspects of everyday life such as training and knowledge sharing in all walks of life: defense, education, scientific exploration, health care, emergency management, city planning, engineering, religion, government and NGOs, business, marketing, communication and politics (Breuer & Bente, 2010; Muntean, 2011; Susi, Johannesson, & Backlund, 2007). This kind of games is known as serious games, and their main purpose is to train, investigate, or advertise (Breuer & Bente, 2010; Muntean, 2011; Susi et al., 2007).

Similarly to serious games, gamification is the application of game elements for purposes other than their expected use for entertainment (Deterding, Khaled et al., 2011; Deterding, Sicart et al., 2011). The boundary between game and artifact with game elements is blurry, personal, subjective and social (Deterding, Khaled et al., 2011). Fold-It[1] exemplifies the blurriness. Some reference it as a successful example of gamification in science. Others view it as a serious game in which players use a

[1] http://fold.it/portal/

graphical interface to predict protein structures, by using game play to help solve problems that computers cannot solve yet (Khatib et al., 2011; Krause & Smeddinck, 2011; Xu, 2011).

Gamification and serious games are related because both try to leverage aspects of games to achieve something beyond playfulness. Serious games offer an enjoyable way to solve real-world problems. Gamification is also used as a clever way to promote a business or product. For instance, players can earn badges, discounts, and other rewards for visiting real-world shops and “checking-in” to mobile phone applications such as FourSquare. Some other examples are EpicWin which encourages players to complete daily chores, and websites like Google Powermeter that promotes household energy saving through the use of progress bars and collectible badges (Lee & Hammer, 2011).

Gamification attempts to harness the motivational power of games in order to promote participation, persistence and achievements. Prior research on games focused on fun, enjoyment and flow as core components of game play (Garris, Ahlers, & Driskell, 2002; Hsu & Lu, 2004; Malone, 1980, 1981; Sweetser & Wyeth, 2005). Yet understanding how to promote motivation by carefully crafted achievements and rewards functions should be revisited especially in light of the current debate. Moreover, the idea of using game mechanics and dynamics to drive participation and engagement mostly by using extrinsic motivation is worth examination because research suggests that using an extrinsic reward may have a significant negative effect on motivation by undermining free-choice and self-reported interest in the given task (Bielik, 2012; Deci, 1972). In contrast, a recent study of badge systems suggests that negative aspects are mostly attributable to poor design (Antin & Churchill, 2011; Bielik, 2012). Hence, it is still not clear what effect these mostly extrinsic game mechanics have on intrinsic motivation and how exactly they affect motivation, both positively and negatively (Bielik, 2012).

In summary, serious games and gamification are sometimes distinct but often are interchangeable as indicated by the games mentioned in Fig. 2.1. In order to deepen our understanding of the role of rewards and interpretation of players’ motivations for engaging and playing, we offer a theoretical model containing a spectrum of motivation theories.

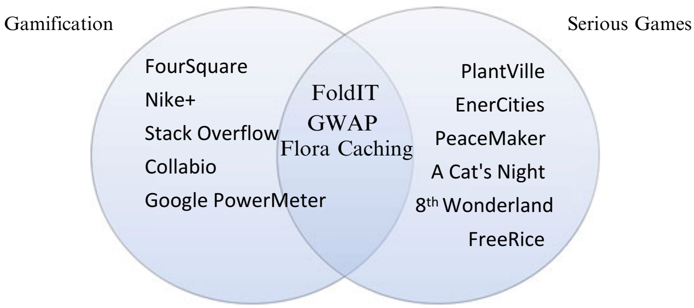


Fig. 2.1 Relation between gamification and serious games

2.3 The Proposed Model of Motivation in Games

Motivation to act has been studied in Social Psychology, Educational Psychology, and Organizational Science. These areas focus on motivation in particular types of environments. We propose to link gamification to these theories.

Motivation is demonstrated by an individual's choice to engage in an activity and the intensity of effort or persistence in that activity (Garris et al., 2002). Current approaches concern two dominant clusters that play a role in determining player's motivation: extrinsic and intrinsic motivation (Deci, Koestner, & Ryan, 1999; Ryan & Deci, 2000a). Gamification combines these two motivations; on one hand using extrinsic rewards such as levels, points, badges to improve engagement while striving to raise feelings of achieving mastery, autonomy, sense of belonging (Muntean, 2011).

Notably, the social aspect is important in games (Ling et al., 2005). Competition, social interaction, or cooperation may influence player behavior (Malone, 1981; Sweetser & Wyeth, 2005; Yee, 2006a, 2006b). Hence, following Vassileva (2012), the present approach covers a spectrum of motivations from extrinsic, through social, to intrinsic (Fig. 2.2). At one extreme of the spectrum, we place extrinsic motivation which is the focus of Expectancy Value Theory and Skinner's Reinforcement Theory. These theories explain the motivation to perform actions or behaviors that induce extrinsic rewards (Vassileva, 2012). On the other end of the spectrum, intrinsic motivations are the focus of Maslow's Hierarchy of Needs, Atkinson's Need Achievement Theory, as well as Bandura's Self-Efficacy Theory and Goal Setting Theory. All these are need-based theories. Theories in the middle of the spectrum explain the social motivation of games. In this context we identify Festinger's Social Comparison and Personal Investment Theory (PIT). Specific references for each theory are given in the following sections.

Additionally, we consider Deci and Ryan's (2008) Self-Determination Theory as a comprehensive theory since it encompasses both intrinsic and extrinsic motivations on a continuum from internal to external motivation (Ryan & Deci, 2000b).

The following brief overview provides the highlights of each theory together with its specific application in games. A complete review of these theories is outside the scope of this chapter. Further recommended reading can be found elsewhere

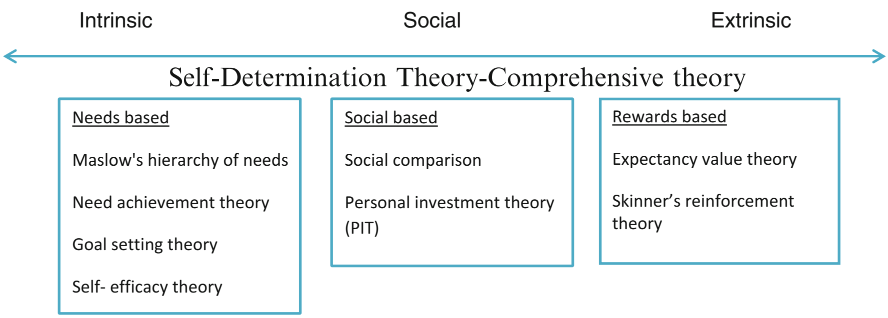


Fig. 2.2 Model of motivation in games (based on Ryan & Deci, 2000b and Vassileva, 2012)

(Bostan, 2009; Deci, 1972; Deci et al., 1999; Deci, Koestner, & Ryan, 2001; Garris et al., 2002; Malone, 1981; Raban & Harper, 2008; Rieber, 1996; Ryan & Deci, 2000a, 2000b; Vassileva, 2012).

2.4 Needs-Based Theories

Needs based theories relevant for studying intrinsic motivations in serious games include Maslow's hierarchy of needs, Need Achievement Theory, Goal Setting and Self Efficacy which are briefly described in the following.

2.4.1 Hierarchies of Needs

One of the earliest and best known theories of motivation comes from the psychologist Abraham Maslow. According to Maslow, human behaviors are driven by the desire to satisfy physical and psychological needs. Maslow proposes five levels of needs that drive human activities, ranging from physiological needs to the need for self-actualization (Lillienfeld, Lynn, Namy, & Woolf, 2009). According to the hierarchy of needs we must satisfy physiological needs and needs for safety and security before progressing to more complex needs such as desire for belongingness, self-esteem and finally self-actualization (Fig. 2.3a). As we progress up Maslow's hierarchy we move away from needs that are produced by deficiencies to needs produced by positive goals and incentives (Lillienfeld et al., 2009; Maslow, 1943).

Based on Maslow's hierarchy of needs, Siang et al. (2003) illustrate game players' needs where the lower levels need to be fulfilled before any of the higher levels in the pyramid (Fig. 2.3b).

At the bottom level, players seek information to understand the basic rules of game. Once the rules need is satisfied, players need safety, information for persisting and winning. The third level refers to belongingness need in which players need to feel comfortable with the game and eventually achieve the game goal. After knowing that winning is possible, there is a need to feel good when playing the game—a feeling of esteem. At the next level, players start to expect a greater challenge, they need to understand and know more about the game such as different strategies. The sixth level is an aesthetic need which reflects the call for good graphics, visual effects, appropriate music, sound effects, etc. Finally, players want to be able to do anything within the game rules and constraints (attaining a form of perfection in the virtual world) (Greitzer, Kuchar, & Huston, 2007; Siang & Rao, 2003).

2.4.2 Need Achievement Theory

Achievement behavior is directed at developing or demonstrating, to self or to others, high rather than low ability (Atkinson & Litwin, 1960; Nicholls, 1984). It implies that in achievement situations people desire success to the extent that it

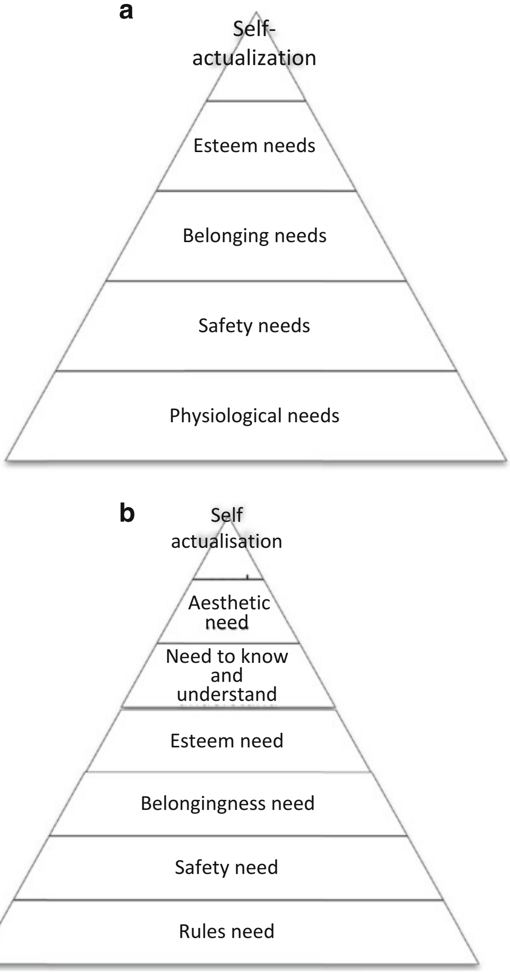


Fig. 2.3 (**a**) Maslow's hierarchy of needs, (**b**) Hierarchy of players' needs licensed from (Siang & Rao, 2003)

indicates high ability and seek to avoid failure which may be a signal of low ability (Nicholls, 1984). According to Atkinson, to achieve success and to avoid failure are two separate motives. These two motives affect the level of task difficulty people choose to undertake. People with high motivation to succeed prefer tasks of intermediate difficulty (Atkinson & Litwin, 1960). However, if the motive to avoid failure is stronger people prefer either very simple or very difficult tasks (Atkinson & Litwin, 1960).

Games often display achievement systems and status indicators. These systems aim to encourage game play and to monitor performance (Medler, 2011). According to Montola, Nummenmaa, Lucero, Boberg, and Korhonen (2009), achievements systems are reward structures providing additional goals for players and hence they trigger some friendly competition and comparison among users. These optional sub-goals can be easy, difficult, surprising, funny, and accomplished alone or as a group. Different achievement categories aim for different benefits. While tutorial achievements seek to motivate players to learn the game, special play style achievements can extend the playtime by providing new ways to experience the game, and virtuosity achievements serve as a communal status symbol (Montola et al., 2009). Many games allow adjustments of task difficulty to be achievable in order to regulate the probability of success and failure according to the player's skill (Vorderer, Hartmann, & Klimmt, 2003). Research suggests that offering a moderate challenge improves the level of mastery (Nicholls, 1984). Indeed, in most social and casual games players' levels are always going up, and enable relatively quick and visible progression (Hou, 2011).

The need achievement theory is the basis for the goal setting theory which claims that specific challenging goals lead to achieve more (Ling et al., 2005; Locke, Shaw, Saari, & Latham, 1981).

2.4.3 Goal Setting Theory

A goal is what the individual is trying to accomplish, the object or aim of an action (Locke et al., 1981). Goal setting theory claims that difficult, specific, context-appropriate, and immediate goals, rather than long-term goals, motivate to achieve more (Ling et al., 2005). Goals affect performance by directing attention, assembling effort, increasing persistence and belief in ability to complete a task (Locke et al., 1981). Goal setting is most likely to improve task performance when the goals are specific and sufficiently challenging, the subjects have sufficient ability, feedback is provided to show progress in relation to the goal, rewards are given for goal attainment, and the assigned goals are actually accepted by the individual (Locke et al., 1981).

Pairing between goals and ability to achieve those goals is aligned with the conditions for prompting flow state (Pavlas, 2010). The connection between flow, games, and intrinsic motivation is well known (Sweetser & Wyeth, 2005). The main determinant in creating a flow experience is finding a balance between perceived skills of the player and the challenge that goes together with game play (Chen, 2007; Sweetser & Wyeth, 2005). Task requirements that gradually increase in difficulty while appropriately challenging and scaffolding are a game feature that functions as motivational construct for engagement and self-efficacy (McNamara, Jackson, & Graesser, 2009). Self-efficacy which is the confidence in ability to complete a task will be expanded in the next section.

2.4.4 Self-Efficacy

Self-efficacy refers to perceived performance ability for a specific activity (Bandura, 1977). Judgment of self-efficacy determines choice of activities, select challenging settings, effort expended, persistence and task performance (Bandura, 1977, 1982; Schwarzer, Bäßler, Kwiatek, Schröder, & Zhang, 1997). Self-efficacy levels can enhance or impede motivation. People with high self-efficacy choose to perform more challenging tasks. They invest more effort; they persist; and when failure occurs they recover more quickly and maintain the commitment to their goals (Schwarzer et al., 1997).

Video game self-efficacy is the confidence in the ability to successfully play a video game (Pavlas, 2010). The construct of self-efficacy is often targeted towards specific tasks or contexts (Pavlas, 2010). Pavlas et al. (2010, 2012) argue that video game self-efficacy relates to the ability to achieve flow state.

Games often present many of the incentives described by Bandura. By making it possible to add and change elements quickly, explore different environments and influence and change the environment or the character, games encourage people to play and play them again (Bleumers et al., 2012).

Kraiger et al. (1993) assert that self-efficacy can be positively stimulated by dividing tasks of higher difficulty into smaller, less difficult tasks. They state that the more people believe they are able to bring a certain task to a successful ending the better they will perform at this task (Kraiger, Ford, & Salas, 1993). This is also implemented in games as complex tasks usually are broken down into small units, so larger accomplishments are recognized as smaller ones accumulate (Reeves & Read, 2009).

Judgments of self-efficacy are based on four types of experience. These include performance attainment, secondhand experience of observing the performance of others, verbal persuasion and social influences (Bandura, 1982). Performance experiences are the most influential; as successes heighten perceived self-efficacy and repeated failure lowers it (Bandura, 1982). Games provide immediate feedback on in-game actions and a general view on the progress one has made in a game and the position of the player towards their goal in the game (Bleumers et al., 2012). Games rank players according to their performance. Seeing similar others' behaviors and the consequential effects may also develop self-efficacy (Bandura, 1982; Peng, 2008; Schwarzer et al., 1997; Zimmerman, 2000). This enhances the social aspect of games.

The social aspect is important in games (Ling et al., 2005). Gaming applications integrated into social networking platforms such as Facebook and MySpace have enjoyed enormous popularity (Hou, 2011). These games serve as a unique setting for socialization in a playful manner, through encouraging social activates like trading, chatting, flirting, cooperation, competition and interaction with friends (Hou, 2011; Jackson, Boonthum, & McNamara, 2009). Games form communities with shared interests in and around gaming environments. In some cases this process is reinforced by offering in-game social interaction and discussion forums (Bleumers et al., 2012). The next section concerns social motivators.

2.5 Social-Based Theories

Social Comparison Theory and Personal Investment Theory elaborate the social side of games. Social comparison states that people seek to evaluate their beliefs, attitudes and abilities by comparing their reaction with others. Personal investment theory suggest that the level to which a person will invest personal resources of effort and time for an activity depends on personal incentives, beliefs regarding oneself, and comprehended alternatives.

2.5.1 The Social Comparison Theory

An important source of knowledge about oneself is comparisons with other people. This insight is the basis of The Social Comparison Theory presented by Festinger (Festinger, 1954; Wood, 1989). According to the theory we evaluate our beliefs, abilities, and reactions by comparing them with those of others (Gilbert, Giesler, & Morris, 1995; Lillienfeld et al., 2009). Festinger's "similarity hypothesis" predicts that people compare themselves with similar others (Festinger, 1954; Gilbert et al., 1995). The "unidirectional drive upward" asserts people wish to continually improve their abilities. Altogether people strive toward a better position than that of others they compare to (Wood, 1989).

Kruglanski (Kruglanski & Mayseless, 1990) claims that competitive persons have greater interest in social comparisons than less competitive individuals. The type of comparison to others is highly dependent on the context. Occasionally, it may come from a similar other, and at other times, from a dissimilar other. At some times, it is yielded by a downward comparison and, at other times, by an upward comparison (Kruglanski & Mayseless, 1990). Downward-comparison means comparing with others who are worse off than with others who are better off (Suls, Martin, & Wheeler, 2002). Wood (1989) proposes that there is a self-improvement motive, which directs comparisons. Exposure to upward targets increases self-evaluations of competence and motivation since it raises the belief in the possibility of changing status (Suls et al., 2002).

Games display feedback in the context of others' performance. Players earn points and are ordered based on the total number of points they have accumulated. The ranking may be in regard to the number of points earned relative to the highest scorer, or may be compared to other players within a certain area or age range (McNamara, Jackson, & Graesser, 2010). Comparing players along quantitative measurements provokes competition (Medler & Magerko, 2011). Competition can be introduced as the challenge to master given tasks. Limitations of the playing situation may also arise from a social situation in which the user competes against an opponent (Vorderer et al., 2003). Game play is monitored by ongoing evaluations. These evaluations include the perception about how the current position is in contrast to the positions of the others and what tendency is expected for the further process of the competition (Vorderer et al., 2003). Thus, the evaluations consist of different social comparisons related to the current situation (Gilbert et al., 1995; Vorderer et al., 2003). In accordance with the ongoing evaluations and social comparisons the player's self-esteem changes (Vorderer et al., 2003).

2.5.2 Personal Investment Theory (PIT)

Personal Investment Theory (PIT) integrates social influences with the examination of achievement motivation (Schilling & Hayashi, 2001). PIT holds that the meaning a person creates in the form of beliefs, perceptions, feelings, purposes, and goals motivates behavior. These cognitive elements are the key to understand and predict investment behavior such as participation, spending of time and effort (Granzin & Mason, 1999; Schilling & Hayashi, 2001).

The conceptual framework features three major segments: meaning, antecedents to meaning, and personal investment behavior (Granzin & Mason, 1999).

Specifically, the theory defines three basic components of meaning as critical to determining personal investment in specific situations: personal incentives, sense of self, and perceived options (Granzin & Mason, 1999; Schilling & Hayashi, 2001). Personal incentives may be intrinsic or extrinsic. Among these motivators are task incentives that reflect skill improvement and mastery; ego incentives that reflect a wish to perform better in comparison with others; social incentives as affiliation and solidarity with others, and extrinsic rewards in the form of monetary compensation or social recognition and approval from significant other persons (Granzin & Mason, 1999; Schilling & Hayashi, 2001). The sense of self refers to the perceptions, beliefs and feeling related to competence, goal-directedness, self-reliance and social identity (Granzin & Mason, 1999; Schilling & Hayashi, 2001). Finally, perceived options are alternative activities that participants identify as available and appropriate. These perceived options are often influenced by social aspects such as affiliation, opportunities to help and/or socialize with others, and family relationships (Granzin & Mason, 1999; Schilling & Hayashi, 2001).

Games use incentives as motivational hooks that maintain interest and help to stretch engagement and repeat usage. Generally, incentives are reliant on some aspect of performance (McNamara et al., 2009). These incentives can come in the form of points, badges leveling and user reputations (McNamara et al., 2009). This large variety of feedback mechanisms aids in monitoring game decisions and performance according to oneself and to others (McNamara et al., 2009).

2.6 Rewards-Based Theories

On the right side of the spectrum (Fig. 2.2) extrinsic motivations are created through external factors, rewards, or incentives (Pavlas, 2010). We refer to two main theories in this regard: Expectancy Value Theory and Skinner Reinforcement Theory.

2.6.1 Expectancy Value Theory (EVT)

Expectancy value theory relates to the strength of motivation to strive for a certain goal, to the expectations to attain the desired goal, and to the incentive value of that particular goal (Vansteenkiste, Lens, De Witte, & Feather, 2005). Expectancy value theory holds that goal-directed behavior is a function of the belief that efforts will lead to performance needed to attain the rewards; performance will determine the outcome; and the value attached to achieving the outcome (Shepperd, 2001).

The theory argues that expectancies and values influence achievement choices, persistence, effort, and performance (Eccles & Wigfield, 2002; Wigfield, 1994; Wigfield & Eccles, 2000). In turn they are influenced by task-specific beliefs such as ability, perceived difficulty, and individuals' goals, previous experiences and a variety of socialization influences (Eccles & Wigfield, 2002; Wigfield, 1994; Wigfield & Eccles, 2000).

Ability and expectancy beliefs are present in other theories as well. Bandura (1977) included expectancies in his discussion of self-efficacy and distinguished between efficacy expectations (the belief that one can successfully accomplish a task), and outcome expectancies (belief that a given action will lead to a given outcome) (Wigfield, 1994).

Theory recognizes internal versus external control which refers to whether the reinforcement or an outcome is a function of effort or personal characteristics versus chance, luck, or is simply unpredictable (Rotter, 1990). The effects of reinforcement on preceding behavior depend in part on whether the person perceives the reward as contingent on behavior or independent of it (Rotter, 1966). Internal locus of control was found to help progress through tasks more quickly and accurately.

Games provide a sense of control by including features that encourage user personalization and control (McNamara et al., 2009). Allowing users to control certain aspects provides opportunities to become invested in game environment and create identification with some aspect within it. McNamara et al. (2010) suggest two types of control. Affording control over aspects of the environment; for example, changing the color schemes, the background, or the avatar, or choosing a task, such as a mini-game. The second type is setting of personal goals or sub goals. For example, set the goal of obtaining a certain number of points or reaching the top level in the system (McNamara et al., 2009, 2010). Von Ahn and Dabbish (2008) state that using points increases motivation by providing a clear connection between effort in the game, performance and outcomes.

Skinner's Reinforcement Theory which we outline next explains the motivation to perform actions or behaviors that lead to extrinsic rewards. Skinner claims that behavior is the product of reinforcements. Behavior differs depending on the schedule of reinforcement, that is, the pattern of delivering it (Lillienfeld et al., 2009). For Skinner persistence is a consequence of being on a reinforcement schedule that is difficult to extinguish.

2.6.2 Skinner's Principle of Partial Reinforcement

Reinforcement as understood by Skinner constitutes outcomes that strengthen the probability of a response (Lillienfeld et al., 2009; Skinner, 1957). Skinner noted that continuous reinforcement establishes desired behaviors quicker than partial reinforcement. But once the continuous reinforcement is removed, the desired behaviors extinguish quickly. According to his principle of partial reinforcement occasional reinforcement of behaviors leads to a greater persistence to extinction than continuous reinforcement (Lillienfeld et al., 2009).

Behavioral studies suggest that different schedules of reinforcement yield distinctive patterns of responding (Lillienfeld et al., 2009; Skinner, 1957): ratio schedules tend to yield higher rates of responding than interval schedules; variable schedules tend to yield more consistent rates than fixed schedules (Lillienfeld et al., 2009). Variable ratio schedules are more effective than fixed ratio in sustaining desired behaviors (Jablonsky & DeVries, 1972). Gambling and lottery games are good examples of a reward based on a variable ratio schedule.

Malone applied the same idea stating that in order to engage a learner, feedback should be surprising, and he proposed to do this by using randomness (Malone, 1981). Hacker and Von Ahn (2009) studied several variations of score keeping functions, and showed that different functions yielded different game behaviors (Hacker & Von Ahn, 2009). This awaits further research.

To conclude this overview of existing approaches and theories related to motivating participation in gamification systems we refer to self-determination theory which encompasses both intrinsic and extrinsic motivation. Many researchers consider intrinsic and extrinsic motivations as two distinguishable and separable motivations. In contrast, Self-Determination Theory (SDT) defines intrinsic and varied extrinsic sources of motivation on a continuum from internal to external motivation (Ryan & Deci, 2000b). The next segment elaborates on this.

2.7 Self-Determination Theory

Self-Determination Theory (SDT) focuses on types, rather than amount, of motivation, paying particular attention to autonomous motivation, controlled motivation, and amotivation as predictors of performance and well-being (Fig. 2.4). SDT proposes that motivation is multidimensional and resides along a continuum of self-determination ranging from intrinsic motivation through extrinsic motivation to amotivation (Gillison, Standage, & Skevington, 2006; Ryan & Deci, 2000b).

SDT discusses three psychological needs: autonomy, competence, and relatedness (Rigby & Przybylski, 2009; Ryan & Deci, 2000b; Wang, Khoo, Liu, & Divaharan, 2008). Autonomy is the ownership of one's behavior. Competence is the

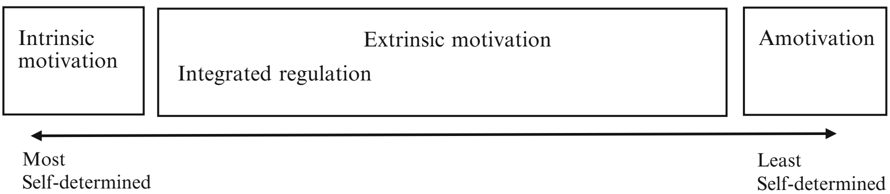


Fig. 2.4 The concept of a continuum from internal to external motivation (based on Ryan & Deci, 2000b)

ability to produce desired outcomes and to experience mastery and effectiveness. Relatedness is the feeling of being connected with others. If these three needs are satisfied, growth and development results, and intrinsic motivation for the task increases. When the three needs are not met, negative emotions (anxiety and anger) may result, and intrinsic motivation is undermined (Wang et al., 2008).

According to the SDT theory there are six classifications of distinct types of motivation: intrinsic motivation, amotivation and four extrinsically motivated behaviors which are external regulation, introjected regulation, identified regulation and integrated regulation (Ryan & Deci, 2000b). Integrated regulation and intrinsic motivation are both forms of autonomous self-regulation. Accordingly, qualities that are associated with intrinsically motivated behavior can be used as markers of the extent that an extrinsic regulation has become integrated (Deci, Vallerand, Pelletier, & Ryan, 1991). Studies show that more autonomous extrinsic motivation is associated with more engagement, better performance, lower dropout, and higher quality learning (Ryan & Deci, 2000b).

Studies of SDT and education have shown that supporting intrinsic needs of autonomy, competence, and relatedness facilitates deeper and more internalized learning (Rigby & Przybylski, 2009), and that from the self-determination perspective, the fundamental principles that support enjoyable games and learning are well synchronized (Rigby & Przybylski, 2009). Recent studies confirmed that experiences of competence, autonomy, and relatedness were major contributors to game enjoyment, regardless of the specific content, complexity, or genre of games (Przybylski, Rigby, & Ryan, 2010; Wang et al., 2008).

Research demonstrates a close link between autonomy satisfaction, intrinsic motivation, and the experience of play (Bleumers et al., 2012; Deterding, 2011; Pavlas, 2010). The choice to volunteer to play provides a strong experience of autonomy, which is intrinsically motivating; this is further supported by the lack of external consequences. Games foster feeling of competence (i.e., self-efficacy) through feedback and rewards, and support feeling of relatedness through social connection, competition and cooperation (Bleumers et al., 2012; Ryan, Rigby, & Przybylski, 2006).

In the next section we further our discussion on gamification by linking the theoretical background to reward mechanisms. This will deepen our understanding on how rewards become compelling and how they satisfy players' desires.

2.8 The Theoretical Base of Game Incentives and Rewards

The integration of game elements in non-game systems to incentivize repeat usage, increase contributions, and establish user reputations, can come in many different forms such as points, badges and levels. Common implementations include: ownership (such as points, tokens and badges); achievements (a representation of accomplishment); status (computing and displaying a rank or level); collaboration (challenges that can be resolved by working together) (Vassileva, 2012).

People consider different things as rewarding, depending on their intrinsic needs, values and goals. This invites research on mechanisms imbedded in games in light of the comprehensive model we introduce in the previous section. For example, Social Comparison Theory can explain the motivational effect of the leaderboard since it states that people tend to compare themselves with others, who they perceive as similar to them, in order to evaluate or enhance some aspects of the self (Vassileva, 2012). Social Comparison Theory explains the motivational aspect of status and reputation assessments, in line with needs-based theories. These theories point to the human need to socialize and seek social recognition and status (Fu, 2011). Social status and reputation can be also explained by Bandura's Self-Efficacy theory since they are usually a result of recognized mastery (Vassileva, 2012).

One way to gain reputation is by collecting badges. Badges advertise one's achievements and past accomplishments (Antin & Churchill, 2011). In addition, badges also function as a goal-setting device; they signal progression by being rewarded for the completion of distinct goals; they represent achievements and success; and they leverage the drive of collecting (Gnauk, Dannecker, & Hahmann, 2012). Badges provide a kind of social shaping as they represent social norms through illustrating types of activities and interactions that are valued (Antin & Churchill, 2011; Halavais, 2012). Therefore, we can sketch the motivational aspect of badges with the help of social motivations as well as needs based theories. Badges also serve as reminders of past achievements; they mark significant milestones and provide evidence of past successes. These characteristics build self-competence and self-efficacy. The interplay between status and affirmation highlights how badges can be engaging from either an individual or a group point of view (Antin & Churchill, 2011). Some users are likely to attend more to the individual benefits of badges while others are more likely to attend to the social aspect.

Games present social incentives such as gifting (Vaijayanthi & Marur, 2012). Gift giving can be a strong motivator, where it functions as an altruistic expression (Fu, 2011). Virtual items and gifting foster relationships and personal investment and thus stimulate motivation according to social and personal investment theory (Fu, 2011). Virtual items are oriented towards self-expression while social exchanges collecting scarce resources point to needs theories (Fu, 2011). Levels fuse these two kinds of motivation. Levels reflect status since it indicates proficiency in the overall gaming experience over time. But they also function as a goal setting tool; they mark progression of difficulty thus increase self-efficacy (Fu, 2011; Gnauk et al., 2012; Jackson et al., 2009).

Each theory or a combination thereof, needs achievement, expectancy, goal setting and social comparison, may explain the motivational effect of achievements. Players enjoy exploring their data while being encouraged to collect new achievements and compete with other players (Medler, 2011; Medler, John, & Lane, 2011; Medler & Magerko, 2011). Different achievement categories aim for different benefits. Achievements promote social status; some players become collectors playing thoroughly in order to maximize achievements; they trigger competition and comparison among users due to the rarity of some achievements. In addition, achievements allow to measure progression and establish sub-goals (Medler & Magerko, 2011; Montola et al., 2009). Specific games such as World of Warcraft have an internal achievements system that enables unique identifiers which allows players to build reputations and enhance self-efficacy (Medler, 2009).

We end this discussion with one of the most commonly used patterns of feedback in games, accumulation of points. Feedback mechanisms stimulate self-regulation and self-efficacy by providing direct input on performance, and thus afford regulating and monitoring performance more accurately (McNamara et al., 2009). Points are a flexible form of feedback. Points are used as a scoring system, a progression indicator, a scale of rank, a goal setting tool or even as a currency (Fu, 2011; Garris et al., 2002; McNamara et al., 2009; Vassileva, 2012; von Ahn, 2009). Points encourage mastery of the game (Federoff, 2002). They trigger competition which eventually results in a change of players' status (Fu, 2011; Leemkuil, Jong, & Ootes, 2000; Liu, Alexandrova, & Nakajima, 2011). Point systems measure progression and performance which provoke self-efficacy (Gnauk et al., 2012). The social effect of points ranges from status earned by performing certain actions up to reputation that is based on ratings received by others (Gnauk et al., 2012; Vassileva, 2012). A secondary contribution emerges by engagement of lurkers through ratings and comments (Farzan et al., 2008; Vukovic, Laredo, & Rajagopal, 2010). Therefore, the motivational aspect of points is outlined with the help of social motivations as well as needs based theories and rewards based theory. Table 2.1 summarizes the above discussion while tying rewards and incentives used in games into the motivation model that was offered in the previous section.

Table 2.1 Theoretical base of incentives and rewards

Motivation theory	Incentives/rewards	Role
Self efficacy	Audio/verbal/visual/music/ sounds effect	Feedback
	Progress bar	Feedback, achievements
Self-efficacy, goal-setting, PIT, expectancy value, need achievement	Points/bonus/divident	Feedback, reward, status, achievements, competition, progression, ownership
	Mini games/challenges/quests	Reward, status, competition, achievements
Self-efficacy, goal-setting, PIT, expectancy value, social comparison	Badges	Status and reputation, achievements and past accomplishments, collection, competition, ownership
	Virtual goods	Reward, social, status, achievements, ownership, self-expression
	Leaderboard	Status and reputation, achievements, competition
	Rewards-choosing colors, power	Achievements
Self-efficacy, goal-setting, PIT, expectancy value, need achievement, social comparison	Achievements	Collection, status, competition, discovering, progression
	Levels	Feedback, status and reputation, achievements, competition, moderate challenge
Social comparison, personal investment theory, expectancy value	Avatar	Social, self-expression, ownership

The right column denotes the way in which the specific incentive is related to motivation. Incentive and rewards mechanisms are rarely grounded on a single theory; usually they rely on motivations along several theories in combination.

In the next section we refer to rewards attributes and present our conceptual analysis.

2.9 Mapping Game Elements

To conclude, we map the most commonly used rewards (such as points, badges, ranks, virtual goods etc.) according to various characteristics, such as: tangibility, exchangeability, immediacy, effect on progression. For instance, looking at points and badges reveals that badges operate on a different level from points. Whereas points create direct competition, badges afford mostly indirect relationships. Badges are more personal and usually not exchangeable, while points operate as means of exchange, a virtual currency that can be exchanged for something of value, tangible or virtual (Fu, 2011; McNamara et al., 2009). Users may spend points in order to purchase virtual items that reflect their personal identity in a community (Fu, 2011). Virtual items, in turn, have both value in use (using a virtual sword to win a game) and value in exchange (Fu, 2011). Virtual items, badges and achievements create loyalty and raise exit barriers as they are generally limited to the system on which they are issued (Liu et al., 2011)

Achievement systems can provide players with rewards that are usable in the game in contrast to having rewards that are related to accumulating achievements and unlocking badges (Hamari & Eranti, 2011; Hamari & Lehdonvirta, 2010). This implies that some achievements are optional in the sense they do not affect the progress of the player in the core game (Hamari & Eranti, 2011; Hamari & Lehdonvirta, 2010; Montola et al., 2009). Future work may elaborate further the relationship between achievements and core game as well as other classifications that were introduced above.

2.10 Conclusions and Future Work

Gamification aims to create a sense of playfulness in non-game environments so that participation becomes enjoyable and desirable (Thom, Millen, & DiMicco, 2012). This idea is worth further examination in light of the increased use of gamification systems in the workplace (Farzan et al., 2008), learning processes and educational environments (Jackson et al., 2009; McNamara et al., 2010; Muntean, 2011; Raban & Geifman, 2009; Rafaeli et al., 2003; Ravid & Rafaeli, 2000). Table 2.2, which appears in the Appendix, lists some gamification systems in business and education. While Table 2.2 supplies a wealth of successful implementations of gamification, developers should carefully consider the human aspect explicated in this chapter to avoid unexpected results such as the cases of Google News badges as well as prevent user fatigue. The gamification elements in Table 2.2 provide examples of the commercial implementation of some of the theories outlined here. For example, the use of badges corresponds to several theories including self-efficacy, goal-setting, PIT, expectancy value, social comparison—these were listed in Table 2.1. So by integrating both tables a rich matrix of theories and their applications emerges.

Game elements and rewards serve as a starting point to understand gamification effectiveness. We suggest understanding them within a broader context. The model of player motivations provides the basis to understand and consider how players differ from one another and how motivations of play relate to rewards patterns and in-game behaviors. By this we strengthen the link between gamification and other established disciplines. Maslow's hierarchy of needs provides an anchor to the study of player's motivation, while the proposed model offers higher level needs and broadens and deepens them. Thus, for example, as illustrated in Table 2.1, leaderboards, badges and levels support the need for status, recognition, prestige and also strengthen competence and mastery. Understanding human drivers, beliefs, and emotions is important to the design of reward systems in order to achieve desired outcomes. Our proposed framework classifies achievements according to their attributes.

More and more applications use game design elements to motivate user behavior in non-game contexts, yet there is to date little empirical research on how gamification works and whether it succeeds in promoting user motivation (Deterding, 2011). Additionally, success in one non-game context does not guarantee that the same mechanism will be successful in another non game context. Research is needed to describe the essential game mechanics in different contexts such as in the enterprise or in educational and learning environments. There is much to be asked about the relationship between game behavior and distinct game design elements. Existing motivational models for video game play focus on how a game as a whole creates experiences of fun (Deterding, 2011; Sweetser & Wyeth, 2005). They are not linked to the more granular level of single game pattern. A closer examination may provide more insights regarding desired type of behavior and participation.

The broad spectrum of theories we cite can serve as a basis for research opportunities investigating how a more inclusive model of motivation theories can be applied to guide the design of incentive mechanisms. A conceptual consolidation of theories may aid to carefully craft reward and incentive mechanism to increase short-term and long term performance and promote game persistence. Eventually, by introducing different game elements and combining different types of motivators new challenges arise. For example, combining a leaderboard with points adds a social dimension with an unknown effect on motivation: it may either promote intrinsic motivation by experiencing competence, or reduce intrinsic motivation, if perceived as controlling. Another aspect we need to take a closer look at is how these rewards affect the design of different kinds of games; serious games versus casual games versus social games or educational games etc.

Understanding game rewards and motivation offers interesting implications in various fields such as business, game design, collaborative design environments and education.

While the goal is to create and maintain intrinsic motivation, gamification is the application of extrinsic motivators. Careful selection and implementation of these motivators will trigger internal motivation and aid in maintaining it. For example, a combination of a progress bar and a leaderboard is likely to generate excitement, commitment, a will to finish a gamified activity in a successful manner, and even to repeat the experience.

Acknowledgement Partial support for this research was provided by the I-CORE Program of the Planning and Budgeting Committee and the Israel Science Foundation 1716/12, by IBM Open Collaborative Research, and by The Center for Internet Research, University of Haifa, Israel.

Appendix

Table 2.2 Examples of some gamification systems in business and education

Platform	Description	Gamification elements	Uniqueness	Website
FourSquare	Location-based application	Badges, levels, points, progression, social, leaderboards. "Major" of a place	Virtual rewards such as the "mayors" of Starbucks or certain badges could be converted into real products (free coffee)	https://foursquare.com/
Nike+	A social running game-like service	Challenges, daily goals, support from friends, compare results over time, rewards, visual progress rich graphs and charts, unlock awards, trophies and surprises	Nike + devices measure every move and turn them into NikeFuel	http://nikeplus.nike.com/plus/
Club Psych	TV series	Points, mini games, prizes for completing the weekly challenge. Rewards, avatars, leaderboard, badges.		http://clubpsych.usanetwork.com/

(continued)

Table 2.2 (continued)

Platform	Description	Gamification elements	Uniqueness	Website
Stack Overflow	A question and answer site for programmers	Badges (gold, silver and bronze) for participation, profile page of a user, levels, reputation points, helping others. As you earn reputation, you'll unlock new privileges like the ability to vote, comment, and edit other people's posts. Highest levels get access to special moderation tools	Reputation score—when others vote up your questions, answers and edits	http://stackoverflow.com/
Peekaboom	Improves on the data collected by the ESP Game. Locate objects in images	Points, leaderboards. Bonus points, bonus round is time limit, levels, time, hints, partial feedback (hot/cold), visual ping	Displays the cumulative top scores of the day as well as the top scores of all time. Ranking players based on the total number of points they have accumulated throughout time. Single/two-player game	(www.peekaboom.org)
The ESP Game	Human computation. Image tagging	Points, levels, feedback, time limit, progress bar	Taboo words. Two-player game	www.espgame.org
Floracaching	A search-and-discover game inspired by the idea of geocaching	Points, levels, badges, progression	Spend points to make a floracache	http://www.gamesfornature.org/games-review/floracaching/
Collabio	Social tagging game within an online social network	Points, leaderboard, hints, My Tags page	Individual leaderboards and global leaderboards	
Google PowerMeter	Energy monitoring tool	Visualizations of energy usage, share information with others, personalized recommendations, compare over time		http://www.google.com/powermeter/about/

(continued)

Table 2.2 (continued)

Platform	Description	Gamification elements	Uniqueness	Website
FoldIT	Protein structure prediction	Categories, scores, leaderboard, contests, goals	Soloist/groups	http://fold.it/portal/
Khan Academy	A free world-class education	Visual feedback-information about everything and whether or not you've been reaching the goals. Challenges, badges and points. Special awards for completing topic challenges, global classrooms	Legendary badges might require years of work	http://www.khanacademy.org/
CAPTCHAs	Colorful images with distorted text in them at the bottom of registration forms	Guess 3 out of 7 distorted image. Solve a visual pattern recognition problem. After seeing two series of blocks, the user is presented with a single block and is asked to determine the side to which the block belongs. Choose a word that relates to all the images	Use by most popular web sites to prevent automated registrations similar to the Turing Test—distinguish humans from computers, but differ in that the judge is now a computer	
Coursera	Learning-courses from the top universities, for free to everyone	Badges, community, voting (points, forum), sharing, ranking (color point), status (TA), Coursera Store (Coursera's Financial Aid program for Signature Track), token of appreciation, special E4E sticker, meetup		http://blog.coursera.org/post/52856244062/the-coursera-store-supporting-education-for-everyone
Duolingo	Learning languages	Levels, vote, time, weekly progress, progress bar, skill tree, skill points, rank, counting, daily progress, badges, reminders/triggers, tips, sharing, leaderboard	webpage translation	http://www.duolingo.com/info

References

Antin, J., & Churchill, E. F. (2011). *Badges in social media: A social psychological perspective*. Paper presented at the CHI 2011 Gamification Workshop Proceedings, Vancouver, BC, Canada.

Atkinson, J. W., & Litwin, G. H. (1960). Achievement motive and test anxiety conceived as motive to approach success and motive to avoid failure. *The Journal of Abnormal and Social Psychology, 60*(1), 52–63.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122–147.

Bielik, P. (2012). Integration and adaptation of motivational factors into software systems. In M. Barla, M. Šimko, J. Tvarozek (Ed.), *Personalized Web - Science, Technologies and Engineering: 11th Spring 2012 PeWe Workshop Modra - Piesok, Slovakia April 1, 2012 Proceedings* (pp. 31–32). Bratislava: Nakladateľstvo.

Bleumers, L., All, A., Mariën, I., Schurmans, D., Van Looy, J., Jacobs, A., et al. (2012). *State of play of digital games for empowerment and inclusion: A review of the literature and empirical cases No. JRC77655*. Spain: JRC Technical Reports Institute for Prospective Technological Studies.

Bogost, I. (2011). Gamification is bullshit: My position statement at the Wharton Gamification Symposium. Retrieved January 24, 2014, from http://www.bogost.com/blog/gamification_is_bullshit.shtml

Bostan, B. (2009). Player motivations: A psychological perspective. *Computers in Entertainment (CIE), 7*(2). Article 22.

Breuer, J. S., & Bente, G. (2010). Why so serious? On the relation of serious games and learning. *Eludamos: Journal for Computer Game Culture, 4*(1), 7–24.

Chen, J. (2007). Flow in games (and everything else). *Communications of the ACM, 50*(4), 31–34.

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology, 22*(1), 113–120.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627–668.

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research, 71*(1), 1–27.

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne, 49*(3), 182–185.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3–4), 325–346.

Deterding, S. (2011). *Situated motivational affordances of game elements: A conceptual model*. Presented at Gamification: Using Game Design Elements in Non-Gaming Contexts, a workshop at *CHI 2011*. Retrieved January 24, 2014, from http://gamification-research.org/wp-content/uploads/2011/04/09-Deterding.pdf

Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011). *Gamification: Toward a definition*. Paper presented at the CHI 2011 Gamification Workshop Proceedings, Vancouver, BC, Canada. Retrieved January 24, 2014, from http://hci.usask.ca/publications/view.php?id=219

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification: Using Game Design Elements in Non-Gaming Contexts. In *Proceedings of the 2011 Annual Conference Extended Abstracts on Human Factors in Computing Systems, CHI EA '11* (pp. 2425–2428). New York: ACM.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*(1), 109–132.

Farzan, R., DiMicco, J. M., Millen, D. R., Dugan, C., Geyer, W., & Brownholtz, E. A. (2008). Results from deploying a participation incentive mechanism within the enterprise. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 563–572), Florence, Italy.

Federoff, M. A. (2002). *Heuristics and usability guidelines for the creation and evaluation of fun in video games*. Doctoral dissertation, Department of Telecommunications, Indiana University, Bloomington.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*(2), 117–140.

Flatla, D., Gutwin, C., Nacke, L., Bateman, S., & Mandryk, R. (2011). Calibration games: Making calibration tasks enjoyable by adding motivating game elements. *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology* (pp. 403–412), Santa Barbara, CA.

Fu, Y. C. (2011). *The game of life: Designing a gamification system to increase current volunteer participation and retention in volunteer-based nonprofit organizations*. Undergraduate Student Research Awards. Paper 2. Retrieved January 24, 2014, from http://digitalcommons.trinity.edu/infolit_usra/2]

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation and Gaming, 33*(4), 441–472.

Gartner Group. (2011). *Gartner says by 2015, more than 50 percent of organizations that manage innovation processes will gamify those processes*. Retrieved January 24, 2014, from http://www.gartner.com/newsroom/id/1629214

Gilbert, D. T., Giesler, R. B., & Morris, K. A. (1995). When comparisons arise. *Journal of Personality and Social Psychology, 69*(2), 227–236.

Gillison, F., Standage, M., & Skevington, S. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: A self-determination theory approach. *Health Education Research, 21*(6), 836–847.

Gnauk, B., Dannecker, L., & Hahmann, M. (2012). Leveraging gamification in demand dispatch systems. *Proceedings of the 2012 Joint EDBT/ICDT Workshops* (pp. 103–110).

Granzin, K. L., & Mason, M. J. (1999). Motivating participation in exercise: Using personal investment theory. *Advances in Consumer Research, 26*, 101–106.

Greitzer, F. L., Kuchar, O. A., & Huston, K. (2007). Cognitive science implications for enhancing training effectiveness in a serious gaming context. *Journal on Educational Resources in Computing (JERIC), 7*(3). Article 2.

Hacker, S., & Von Ahn, L. (2009). Matchin: Eliciting user preferences with an online game. *CHI '09: Proceedings of the 27th International Conference on Human Factors in Computing Systems*, New York (pp. 1207–1216).

Halavais, A. M. C. (2012). A genealogy of badges. *Information, Communication & Society, 15*(3), 354–373.

Hamari, J., & Eranti, V. (2011). Framework for designing and evaluating game achievements. *Think Design Play: The Fifth International Conference of the Digital Research Association (DIGRA)* (pp. 122–134), Hilversum, The Netherlands.

Hamari, J., & Lehdonvirta, V. (2010). Game design as marketing: How game mechanics create demand for virtual goods. *International Journal of Business Science & Applied Management, 5*(1), 14–29.

Hou, J. (2011). Uses and gratifications of social games: Blending social networking and game play. *First Monday, 16*(7). Retrieved January 24, 2014, from http://firstmonday.org/article/view/3517/3020.

Hsu, C. L., & Lu, H. P. (2004). Why do people play on-line games? An extended TAM with social influences and flow experience. *Information & Management, 41*(7), 853–868.

Jablonsky, S. F., & DeVries, D. L. (1972). Operant conditioning principles extrapolated to the theory of management. *Organizational Behavior and Human Performance, 7*(2), 340–358.

Jackson, G. T., Boonthum, C., & McNamara, D. S. (2009). iSTART-ME: Situating extended learning within a game-based environment. *In Proceedings of the Workshop on Intelligent Educational Games at the 14th Annual Conference on Artificial Intelligence in Education AIED 09* (pp. 59–68). Brighton, UK.

Khatib, F., DiMaio, F., Cooper, S., Kazmierczyk, M., Gilski, M., Krzywda, S., et al. (2011). Crystal structure of a monomeric retroviral protease solved by protein folding game players. *Nature Structural & Molecular Biology, 18*(10), 1175–1177.

Konrad, A. (2011). *Inside the gamification gold rush*. Retrieved January 24, 2014, from http://tech.fortune.cnn.com/2011/10/17/gamification/

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology, 78*(2), 311–328.

Krause, M., & Smeddinck, J. (2011). Human computation games: A survey. *Proceedings of 19th European Signal Processing Conference (EUSIPCO 2011)* (pp. 754–758). Barcelona, Spain.

Kruglanski, A. W., & Mayseless, O. (1990). Classic and current social comparison research: Expanding the perspective. *Psychological Bulletin, 108*(2), 195–208.

Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*(2). Retrieved January 24, 2014, from http://www.gamifyingeducation.org/files/Lee-Hammer-AEQ-2011.pdf.

Leemkuil, H., Jong, T., & Ootes, S. (2000). *Review of educational use of games and simulations* No. Project number IST-1999-13078. University of Twente: KITS consortium, IST fifth framework programme.

Lillienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2009). *Psychology: From inquiry to understanding*. Boston: Pearson/Allyn and Bacon.

Ling, K., Beenen, G., Ludford, P., Wang, X., Chang, K., Li, X., et al. (2005). Using social psychology to motivate contributions to online communities. *Proceedings of the 2004 ACM conference on Computer supported cooperative work* (pp. 212–221).

Liu, Y., Alexandrova, T., & Nakajima, T. (2011). Gamifying intelligent environments. *Proceedings of the 2011 International ACM Workshop on Ubiquitous Meta User Interfaces* (pp. 7–12). Scottsdale, AZ.

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal setting and task performance: 1969–1980. *Psychological Bulletin, 90*(1), 125–152.

Malone, T. W. (1980). What makes things fun to learn? heuristics for designing instructional computer games. *Proceedings of the 3rd ACM SIGSMALL Symposium and the First SIGPC Symposium on Small Systems* (pp. 162–169), Palo Alto, CA.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 5*(4), 333–369.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396.

McDonald, P. (2010). *Game over? When play becomes mechanical.* Retrieved January 25, 2014, from http://planninginhighheels.com/2010/11/25/game-over-when-play-becomes-mechanical/

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York, NY, Pinguin Press.

McNamara, D. S., Jackson, G. T., & Graesser, A. C. (2009). Intelligent tutoring and games (ITaG). *Proceedings of the Workshop on Intelligent Educational Games at the 14th Annual Conference on Artificial Intelligence in Education* (pp. 1–10), Brighton, UK.

McNamara, D. S., Jackson, G. T., & Graesser, A. (2010). Intelligent tutoring and games (| TaG). Y. Baek (Ed.) *Gaming for classroom-based learning: Digital role playing as a motivator of study* (pp. 44–65). Hershey, PA: IGI Global.

Medler, B. (2009). Generations of game analytics, achievements and high scores. *Eludamos. Journal for Computer Game Culture, 3*(2), 177–194.

Medler, B. (2011). Player dossiers: Analyzing gameplay data as a reward. *Game Studies Journal, 11*(1). Retrieved January 25, 2014, from http://gamestudies.org/1101/articles/medler.

Medler, B., John, M., & Lane, J. (2011). Data cracker: Developing a visual game analytic tool for analyzing online gameplay. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)* (pp. 2365–2374), Vancouver, BC, Canada.

Medler, B., & Magerko, B. (2011). Analytics of play: Using information visualization and gameplay practices for visualizing video game data. *Parsons Journal for Information Mapping, 3*(1), 1–12.

Montola, M., Nummenmaa, T., Lucero, A., Boberg, M., & Korhonen, H. (2009). Applying game achievement systems to enhance user experience in a photo sharing service. *Proceedings of the 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era* (pp. 94–97), Tampere, Finland.

Muntean, C. I. (2011). Raising engagement in e-learning through gamification. *Proceedings 6th International Conference on Virtual Learning ICVL* (pp. 323–329), Cluj-Napoca, Romania, Europe.

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*(3), 328–346.

OUPblog. (2011). *Oxford dictionaries word of the year 2011: Squeezed middle.* Retrieved January 25, 2014, from http://blog.oup.com/2011/11/squeezed-middle/

Pavlas, D. (2010). *A model of flow and play in game-based learning: The impact of game characteristics, player traits, and player states*. Doctoral Dissertation, University of Central Florida, Orlando, FL.

Pavlas, D., Heyne, K., Bedwell, W., Lazzara, E., & Salas, E. (2010). Game-based learning: The impact of flow state and videogame self-efficacy. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* San Francisco, CA. *54*(28), 2398–2402.

Pavlas, D., Jentsch, F., Salas, E., Fiore, S. M., & Sims, V. (2012). The play experience scale development and validation of a measure of play. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 54*(2), 214–225.

Peng, W. (2008). The mediational role of identification in the relationship between experience mode and self-efficacy: Enactive role-playing versus passive observation. *Cyberpsychology and Behavior, 11*(6), 649–652.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology, 14*(2), 154–166.

Raban, D. R., & Geifman, D. (2009). Place your bets! information aggregation and prediction markets in MBA courses. *Proceedings of the Chais Conference on Instructional Technologies Research 2009: Learning in the Technological Era* (pp. 153–158), Raanana, Israel: The Open University of Israel.

Raban, D. R., & Harper, F. (2008). Motivations for answering questions online. In D. Caspi & T. Azran (Eds.), *New media and innovative technologies* (pp. 73–97). Israel: Ben- Gurion University press.

Rafaeli, S., Raban, D., Ravid, G., & Noy, A. (2003). Online simulations in management education about information and its uses. In C. Wankel, & R. DeFillippi (Eds.), *Educating managers with tomorrow's technologies* (pp. 53–80). Greenwich, CT: Information Age.

Ravid, G., & Rafaeli, S. (2000). Multi player, internet and java-based simulation games: Learning and research in implementing a computerized version of the "beer-distribution supply chain game". *Simulation Series, 32*(2), 15–22.

Reeves, B., & Read, J. L. (2009). *Total engagement: Using games and virtual worlds to change the way people work and businesses compete*. Boston: Harvard Business School Press.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development, 44*(2), 43–58.

Rigby, C. S., & Przybylski, A. K. (2009). Virtual worlds and the learner hero: How today's video games can inform tomorrow's digital learning environments. *Theory and Research in Education, 7*(2), 214–223.

Robertson, M. (2010). *Can't play, won't play.* Retrieved January 25, 2014, from http://hideandseek.net/2010/10/06/cant-play-wont-play/

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied, 80*(1), 1–28.

Rotter, J. B. (1990). Internal versus external control of reinforcement: A case history of a variable. *American Psychologist, 45*(4), 489–493.

Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54–67.

Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion, 30*(4), 347–363.

Schilling, T. A., & Hayashi, C. T. (2001). Achievement motivation among high school basketball and cross-country athletes: A personal investment perspective. *Journal of Applied Sport Psychology, 13*(1), 103–128.

Schwarzer, R., Bäßler, J., Kwiatek, P., Schröder, K., & Zhang, J. X. (1997). The assessment of optimistic self-beliefs: Comparison of the german, spanish, and chinese versions of the general self-efficacy scale. *Applied Psychology: An International Review, 46*(1), 69–88.

Shepperd, J. A. (2001). Social loafing and expectancy-value theory. In S. G. Harkins (Ed.), *Multiple perspectives on the effects of evaluation on performance* (pp. 1–24). New York: Kluwer.

Shneiderman, B. (2004). Designing for fun: How can we design user interfaces to be more fun? *Interactions, 11*(5), 48–50.

Siang, A. C., & Rao, R. K. (2003). Theories of learning: A computer game perspective. *Proceedings of the IEEE Fifth International Symposium on Multimedia Software Engineering (ISMSE'03)* (pp. 239–245). Taichung, Taiwan.

Skinner, B. F. (1957). The experimental analysis of behavior. *American Scientist, 45*(4), 343–371.

Suls, J., Martin, R., & Wheeler, L. (2002). Social comparison: Why, with whom, and with what effect? *Current Directions in Psychological Science, 11*(5), 159–163.

Susi, T., Johannesson, M., & Backlund, P. (2007). *Serious games—An overview* (Technical Report No. HS- IKI -TR-07-001). Skövde, Sweden: School of Humanities and Informatics, University of Skövde.

Sweetser, P., & Wyeth, P. (2005). GameFlow: A model for evaluating player enjoyment in games. *Computers in Entertainment (CIE), 3*(3), 1–24.

Thom, J., Millen, D., & DiMicco, J. (2012). Removing gamification from an enterprise SNS. *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (pp. 1067–1070). Seattle, WA.

Vaijayanthi, I., & Marur, M. (2012). *Persuasive design for energy saving behavior through social gaming*. Design and Semantics of Form and Movement (DeSForM) Conference, Victoria University of Wellington, New Zealand. pp. 33–42.

Vansteenkiste, M., Lens, W., De Witte, H., & Feather, N. T. (2005). Understanding unemployed people's job search behaviour, unemployment experience and well-being: A comparison of expectancy-value theory and self-determination theory. *British Journal of Social Psychology, 44*(2), 269–287.

Vassileva, J. (2012). Motivating participation in social computing applications: A user modeling perspective. *User Modeling and User-Adapted Interaction, 22*(1), 177–201.

von Ahn, L. (2009). Human computation. *Proceedings of the 46th Annual Design Automation Conference* (pp. 418–419), San Francisco.

von Ahn, L., & Dabbish, L. (2008). Designing games with a purpose. *Communications of the ACM, 51*(8), 58–67.

Vorderer, P., Hartmann, T., & Klimmt, C. (2003). Explaining the enjoyment of playing video games: The role of competition. *Proceedings of the Second International Conference on Entertainment Computing* (pp. 1–9), Pittsburgh, PA.

Vukovic, M., Laredo, J., & Rajagopal, S. (2010). Challenges and experiences in deploying enterprise crowdsourcing service. *Proceedings of the 10th International Conference on Web Engineering* (pp. 460–467), Vienna.

Wang, C. K. J., Khoo, A., Liu, W. C., & Divaharan, S. (2008). Passion and intrinsic motivation in digital gaming. *CyberPsychology & Behavior, 11*(1), 39–45.

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review, 6*(1), 49–78.

Wigfield, A., & Eccles, J. S. (2000). Expectancy—value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81.

Wood, J. V. (1989). Theory and research concerning social comparisons of personal attributes. *Psychological Bulletin, 106*(2), 231–248.

Wu, M. (2012). *The gamification backlash + two long term business strategies.* Retrieved January 25, 2014, from http://lithosphere.lithium.com/t5/science-of-social-blog/The-Gamification-Backlash-Two-Long-Term-Business-Strategies/ba-p/30891

Xu, Y. (2011). *Literature review on web application gamification and analytics* (Technical Report No. 11-05). University of Hawai'i, Honolulu, HI: CSDL Technical Report. Retrieved January 25, 2014, from https://csdl-techreports.googlecode.com/svn/trunk/techreports/2011/11-05/11-05.pdf

Yee, N. (2006a). The labor of fun: How video games blur the boundaries of work and play. *Games and Culture: A Journal of Interactive Media, 1*(1), 68–71.

Yee, N. (2006b). Motivations for play in online games. *CyberPsychology & Behavior, 9*(6), 772–775.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82–91.

Chapter 3
A Conceptual Framework for Gamification Measurement

Ronald Dyer

3.1 Introduction

This chapter's focus is on contributing to the body of knowledge as it relates to the measurement of gamification outcomes, i.e. a methodology for the assessment of gamification implementation within organizations. The term gamification has come to the forefront with much fanfare and receptivity by both educators and corporate training professionals. One only has to look online to see the myriad number of conferences, publications and blogs devoted to the topic and perpetuation of its perceived benefits. Figure 3.1, below indicated the number of titles on the topic illustrating continuous increases in the subject matter over the last four years. Yet despite the large amount of hits on the topic, there still remains a lack of coherent understanding on what kinds of studies and results gamification has yielded (Hanari, Koivisto, & Sarsa, 2014). Moreover, understanding the effectiveness of gamification remains a pertinent issue.

The term gamification as defined by Huotari and Hamari (2012a, 2012b) is as follows:

> A process of enhancing a service with (motivational) affordance in order to invoke gameful experiences and further behavioral outcomes.

As such the use of gamification involves the utilization of several of the concepts inherent in games such as level design, tokens, badges and other rewards to incentivize learning during play. What makes the use of gamification unique when pitted

R. Dyer (✉)
Grenoble Ecole de Management, 12-Rue Pierre Semard,
Grenoble France 38000
e-mail: ronald.dyer@grenoble-em.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_3

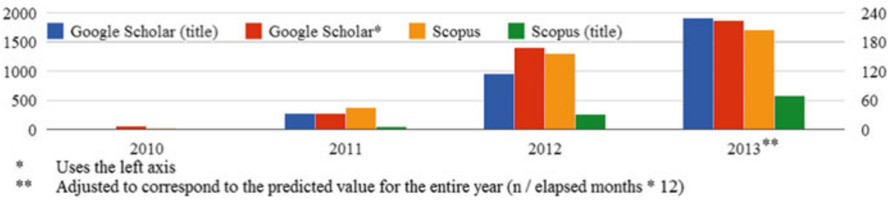


Fig. 3.1 Search hits for "gamification"

against traditional learning and development methodologies both in education and business is the element of play. According to Weisberg, Hirsh-Pasek, and Golinkoff (2013) play is ubiquitous and linked to positive social behaviours. Hirsh-Pasek, Golinkoff, Berk, and Singer (2009) building on the works of Vygotsky (1978) and Piaget (1962) further state that "play is not only important for encouraging the development of socially relevant skills like self-regulation and empathy but also assisting in both academic and social learning," Weisberg et al. (2013). As with most learning frameworks play has long been considered *non-relevant* as an engagement factor for fostering improved cognition within education. However, recent advanced in the areas of game-based learning and serious games respectively have demonstrated clearly that this is no longer an applicable approach and that play has an integral role in learner retention and engagement.

While we herald the up-surge of gamification as a *tour de force* in education and business there remains a fundamental issue which needs to be addressed, i.e. measurement. For all the hype associated with gamification, for buy-in and adoption continuity to persist there must be robust assessment and measurement of its outcomes if communities of practice are to successfully sustain present momentum. Failure to provide empirical approaches to measurement of gamification will eventually result in dissipation of its relevance and at best relegation to the archives of education and business as another fad.

The question becomes, how do we measure the benefits of gamification? The use of traditional metrics in their existing format cannot be as easily applied to this field as historical assessment of student performance has focused on teacher evaluations, with testing as one of the primary instruments. Gamification caters to a cadre of learners dubbed "Millennials" or the Net Generation, Oblinger (2004) whose preferences tend towards teamwork, experiential activities, structure and the use of technology. Traditional pedagogical practices are still constrained by their traditionalist nature/thinking with the teacher as leader and the student as passive recipient, as such they require significant re-tooling to even attempt preliminary assessment(s). On the other hand, few if any measurements are readily available to would be educators and trainers wishing to assess learner performance specifically utilizing gamification.

The chapter provides insight on the integration of a proposed measurement framework for gamification into organizations (new and existing) to support successful implementation and sustainable adoption of gamification based approaches.

The proposed outcome of this chapter from the author's perspective will be a measurement framework for educators and business persons alike charged with responsibility for integration to better approach the area and provide clear sign-post to guide them in their individual efforts as practitioners contributing to the learning and development ecosystem.

3.2 What is Gamification

Deterding, Dixon, Khaled, and Nacke (2011), provide a further definition of gamification as "the use of game design elements in non-game contexts." In tracing the historical context of gamification and its place in the digital media industry its emergence dates back to 2008. The popularity effectively commenced around 2010 and has since 2010 managed to institutionalize itself as a common household term. How did we arrive at a gamified universe? From a conceptual perspective the notion that user interface design can be informed by other design practices has its roots in the Human Computer Interaction (HCI) movement. Carroll (1982) analysed the design of early text adventures leading him to suggest research programs on fun and games in relation to ease of use.

Deterding et al. (2011) indicated that the maturation and expansion of the field has led to further research into areas like motivational affordance and pleasurable products. These approaches take into consideration the aspirational phenomenon that is today branded gamification. Gamification falls into the potential category of games with a purpose in which game-play is piggybacked upon as a means to solve human tasks. It is within this context that the "playfulness" aspect of games has given rise to a gamification movement as a mode of interaction inculcating the aspects of game mechanics. In its present form gamification demarcates itself through complexity, given the delicate balancing act of game design and motivational theories which provide the aspects of gamefulness, gameful interaction and gameful design all requisite elements of play. These aspects feed into the definition provided above and differentiate gamification from play. Gamification relates to games not play, where play can be conceived as the broader, looser category containing different elements of games, Caillois (1961). Gamification is predicated by structured rules and competitive strife towards goals. Hence the term gamification and its linkages to the concepts of:

1. **Gamefulness (the experiential and behavioral quality)**
2. **Gameful Interaction (artifacts affording that quality), and**
3. **Gameful Design (designing for gamefulness, typically by using game design elements).**

These terms/concepts in defining gamification provide a clear distinction between games and play/playfulness and as such attributes to the novelty that is gamification. Gamification can inherently give rise to playfulness but the inverse does not necessarily apply given the requisite structures and mindset required for the former? Thus gamification applies to the incorporation of elements of games, Braithwaite and Schreiber (2008) and as such places consideration on the artifactual and social elements of games without delving deeper into the software application element more akin to game studies etc. In essence a game is rule based, where outcomes are assigned varying values and the player exerts effort in order to influence the outcome. From a terminology perspective, the term gamification gains better clarity when associated with game-design and not the wide game eco-system associated with game-based technologies. Therefore, in situating gamification and its role, we must understand its use in relation to an extension of design, (not within the context of technology), the elements requisite for play (vs. a full game), characteristics of the game rather than playfulness and its non-game context regardless of usage, context or media associated with implementation. This broader context allows for an understanding of the workings of gamification within the broader framework of ludification. As such its role as a lever in playfulness' integration within the larger game eco-system such as game-based learning and serious games is critical.

There is however another school of thought on the gamification definition as presented by Huotari and Hamari (2012a, 2012b). They define gamification as "service packaging where a core service is enhanced by rule-based service systems that provides feedback and interaction mechanisms to the user with an aim to facilitate and support the users overall value creation." This definitional approach highlights the goals of gamification from an experience perspective and as such move away from the notion that it is purely based on game elements. However, gamification is not always executed within the context of concrete game elements but is more of a process. As such gamification is supposedly imbued with gameful experiences which seek to improve service delivery within an affordance context. Huotari and Hamari (2012a, 2012b), referring to affordance here as *any qualities of the service which contribute to the emergence of the gameful experience*. This is where we can now introduce the nexus of our discussion on the benefits of measurement of gamification as current thinking on the subject seeks to eke out a measurement context based on a formulary of sales increases, clicks and general learner retention. The benefits of gamification cannot be measured on the axis of these metrics nor can we expect the integration of existing theories of learning to provide a cookie cutter measurement ethos. Let us commence our measurement discussion by first examining three of the most widely utilized learner evaluation metrics and their value within a gamification context.

3.3 Traditional Measures of Learning

When we think of learning within the parameters of assessment the familiar approach of assessment rubrics, portfolios and other examination-based methods immediately come to mind. What all of these approaches have in common is the use of the same underlying theories or schools of thought as it relates to how to measure the progress of learners and or/individual improvement. In the field of learning there are three theories that standout:

1. *Kirkpatrick's Four Levels of Evaluation Theory*
2. *Kolbs' Experiential Learning Theory and*
3. *Sweller's Theory on Cognitive Load*

Each of these has earned their rightful place in the arena of learning and are amongst the most widely used evaluative metrics in the field. While their value cannot be underscored the question remains as to their applicability to an emerging field such as gamification. Based on present trajectory, gamification represents a hybrid approach to learning reinforcement and retention and given the long history of these three theoretical approaches may be challenged in measurement as a result. If gamification is to be taken much more seriously, especially to convince its detractors there needs to be either the development of new measurement theories or modification of existing to allow for better evaluation of the benefits in line with further adoption. Let us first examine these three underlying theories and the potential value that may exist for integration into gamification measurement.

3.4 Kirkpatrick's Four Levels

The Kirkpatrick four-level framework is one of the most widely utilized evaluative models for training employees specifically with sales force practitioners. Originally developed by Donald Kirkpatrick (1994) cited by Tan and Newman (2013) it consist of four evaluation levels (viz., reaction, learning, behavior and results) arranged in ascending order and varying degree of difficulty to accomplish. Each level seeks to measure or evaluate as follows:

Level 1—Reaction: Measures how participants have reacted to the training
Level 2—Learning: Measures what participants have learned from the training
Level 3—Behaviour: Measures whether what was learned is being applied on the job
Level 4—Results: Measures whether the application of training is achieving results

The levels are layered in such a way that the success of one builds on the previous adding to the precision of measurement. Delving further into each level, their value lies firstly in the learner's perception and reaction towards a training event and the benefit of learning (positive or negative) that occurs. Secondly, it measures what advanced knowledge has been gained from training and the extent to which skills/attitudes are impacted. Thirdly, it focuses on what was learnt and whether is it being applied on the job. The third level focuses strongly on knowledge transfer specifically in-line with real world circumstances. Finally, level four examines the application of training in achieving quantifiable financial results. It careful examines the success of training in relation to increases in production, sales, decreased costs and improved quality etc. requisite for positive return on investment (ROI).

This framework augurs well for the potential scope of gamification as it has clear linkages with trainee performance and effectiveness to accentuate the importance of aligning training interventions with gamefulness and by extension the strategic focus of performance improvement in organizations. The evaluation of gamification needs to start with a rigorous process of data collection in order to analyze its effectiveness and benefits within a Return on Investment (ROI) context. Kirkpatrick's approach possesses some of the requisite elements to afford such an evaluation via its levels. The question remains as to whether the impact on gamification would be formative (focused on the actual process of training/performance improvement) or summative (focusing on the final product or result of the process), Rahimic and Vuk (2012) and the value proposition which this approach would provide to assessors. Gamification represents a form of tool and as such, justification of the cost and effectiveness for sustainability requires a thorough analysis to ascertain the impact on training design and ultimately the possible benefits for enterprise. At the cursory level, Kirkpatrick's framework brings to gamification some components of a scorecard model with the requisite elements for evaluation of gamification generating evaluative criteria along six potential elements:

1. *Reaction*
2. *Learning*
3. *Application/Impact*
4. *Organizational Impact*
5. *Return on Investment and*
6. *Non-quantifiable benefits*

Leveraging these foundational elements of Kirkpatrick's model into gamification measurement can provide some clues as to the linkage between the design/game mechanics components and training results by collecting data within the framework of the (6) defined elements as proposed. However, this is but only one of the theories on learning evaluation and we must examine the others prior to formulation of a proposed framework for measuring gamification in a holistic way. We shall now take a look at Kolbs' Experimental Theory.

3.5 Kolbs' Experiential Theory

Experiential Learning Theory (ELT), Kolb (1984) has its roots in the work of John Dewey (philosopher and psychologist), Kurt Lewin (psychologist) and Jean Piaget (psychologist). It is intended to provide a holistic adaptive process on learning which merges experience, perception, cognition and behavior, citing McCarthy (2010). ELT defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" Kolb (1984). The learning model is cyclical in process consisting of four components, concrete experience (CE), reflective observation (RE), abstract conceptualization (AC) and active experimentation (AE).

The learner must continuously choose which set(s) of learning abilities to use within specific learning situations and successfully perceive new information through the experiences. These experiences can be concrete, tangible and felt or abstract conceptualizations bearing in mind that learners can enter the model at any stage. Given that the learning style preference akin to this model tends to lend towards perception and grasping of new information through symbolic representation (thinking about, analyzing or systematically planning), how/where does gamification fit in from a measurement perspective? The answer to that questions lies somewhere in the Learning Styles Inventory (LSI) citing McCarthy (2010) an instrument used to assess the individual learning styles, identifying four types of learners based on their approaches to obtaining knowledge through one or more of the following methods:

Divergers: Those who prefer to approach learning through concrete experience (CE)

Accommodators: Those who prefer to learn hands-on

Assimilators: Those who prefer to approach knowledge through abstract conceptualization and

Convergers: Those who prefer to approach knowledge through active experimentation

The development of Learning Styles Inventory (LSI) Kolb (1971) as cited by McCarthy (2010) provides an individual understanding of the learning process through experience and their individual approach to learning. Therein lays the potential value to gamification as it represents a unique baseline for not only how individuals learn best but serves as an investigative tool into specific characteristics of individual learning style infused with gamification methodologies. Hence, a Kolb based approach to measurement of gamification may provide some preliminary insight between experience and conceptualization as a learning reward system which provides the value added of incentivized reflection post training.

3.6 Sweller's Theory of Cognitive Load

Cognitive load theory (CLT) Sweller (1988, 1989) as cited by Chandler and Sweller (1991) is concerned with the manner in which cognitive resources are focused and used during learning and problem solving. Many learning and problem solving procedures encouraged by instructional formats results in activities by participants far removed from the task at hand or lost soon thereafter post training. This theory's relevance to the topic of gamification and its adoption are important in that cognitive load represents an integral measurement tool for investigating individual performance. Measuring the impact of cognitive load on gamification goes a long way in presenting robust evidence to skeptics whose present thinking on the topic requires further convincing.

The basic premise of (CLT) is reduction of the load for difficult task so that it becomes easier to remember within a working memory context. Cognitive load can be broken down into three types Intrinsic, Germane & Extraneous Sweller (1999, 2005) and Mayer (2005a); Mayer and Moreno (2003). DeLeeuw and Mayer (2008) explain each as follows: *extraneous processing*, in which the learner engages in *cognitive* processing that does not support the learning objective (and that is increased by poor layout such as having printed words on a page and their corresponding graphics on another page); (b) *intrinsic (or essential) processing*, in which the learner engages in cognitive processing that is essential for comprehending the material (and that depends on the complexity of material, namely the number of interacting elements that must be kept in mind at any one time); and (c) *germane (or generative) processing*, in which the learner engages in deep cognitive processing such as mentally organizing the material and relating it to prior knowledge (and that depends on the learner's motivation and prior knowledge, as well as prompts and support in the lesson). Cognitive load is a valuable measurement variable for facilitating the intrinsic learning reinforcement goals of gamification as they present a strong foundation for learner retention. The effectiveness of training rests in its ability for guided instruction and facilitation of learner's mental integration of disparate sources of mutually referring information. For example such as when instructors use separate text and diagrams to validate or emphasize and participants have to reflect on each element separately. These instruction(s) generate a heavy degree of cognitive load, because material must be mentally integrated before learning can commence. Processing and analysis therefore takes a greater time creating a lag of taught knowledge transfer back into the work environment. This choice of theory rest with prior success of testing experiments Chandler and Sweller (1991) where content of a split-source nature (content & diagrams) and integrated information were designed for comparison using conventional instruction integrated over a period of several months in an industrial training setting. The value here of gamification, is adding through rewards and incentive a further motivation to "get it." Therefore, learning takes on a more focused/commoditized value to the learner through incentives.

Moreover, it can assist in discerning whether the learners are more focused on the reward/incentive than gestation of knowledge. Choi and Lee (2009), applied the concept of cognitive load to enhance student's problem solving abilities as well as assist in implementing a model to improve teacher education with students' real-world problem solving abilities. The result was the use of this theoretical approach to provide a framework to deal with dilemmas faced by practicing teachers in elementary classrooms. If an incentive-driven component via gamification is added then perhaps the approach can provide richer results more in-line with results anticipated in real-life situations as life decisions are very much incentivized.

Gamification holds potential to support O'Neil, Baker, and Wainessa (2005) theory on the effectiveness of game environments documentation in terms of intensity and longevity of engagement as well as their commercial success. It allows for the capturing of performance variables that would not normally be tracked but do add value to the overall learning process. However, since there is much less solid information about which outcomes are systematically achieved using individual and multiplayer games to train participants in acquiring knowledge and skills gamification's performance imperative remains questionable. The lack of clearly presented measurement metrics required to measure the degree to which their design fosters the desired knowledge and skills transference is still debatable. Secondly, the impact of game play needs to be studied to determine what works. Cognitive load measurement within a gamification context allows for evaluation and accumulation of clear evidence of impact. Failing to apply robust measurement metrics as stated can result in a tendency to dismiss game environments and gamification as motivational fluff.

3.7 Towards a Unified Framework for Gamification Measurement

The question becomes, given the challenges of a robust system to effect measurement, how do we find a way to integrate existing theories of learner evaluation to provide a comprehensive system of metrics? It is unlikely at this time given the relative novelty of gamification that a complete system of measurement will arise in the near future. However, there exist more than enough measurement tools between gaming and learner development to create a hybrid methodology, which may provide better metrics for overall assessment.

To develop such a framework we need four key ingredients that will assist in assessing each stage of the gamification process and provide an integrative model. They are as follows:

1. *Play Assessment Diagnostic*
2. *A Gamification Scorecard*
3. *Pre/Post Knowledge Assessment*
4. *Gamification Performance Assessment Review*

3.8 Play Assessment Diagnostics

In order to better understand the context within which gamification can best be measured readers must first understand how to assess play specifically within androgogical environments. Social development is an integral component of early childhood and similary are critical to the ability to interact inter-organizationally in later life. Play assessment represents a way to identify which students/employees may be developmentally behind their peers and as such at risk. In essense it makes screening students/employees easier, time efficient, and cheaper through comprehensive interaction in a "live" environment. Like many other game environments and formats of play, gamification assessment is rooted in observation. While much data can be gathered via the process of game analytics systems they may not tell the entire story. As such measurement of gamification requires a caliber of metrics that are both data driven and observational. As a first stage in the gamification measurement process, we must first observe and measure the element of play interaction. One of the better ways to approach this is through the utilization of stealth assessment.

Stealth assessment is woven directly into the fabric of instructional environments to support learning of important content and key competencies, Shute (2011). The power of stealth assessment lies in the performance data gathered through the course of play/learning and the inferences which can be made Shute, Ventura, Bauer, and Zapata-Rivera (2009)). To measure gamification effectively we must create an environment of inference which are stored in the dynamic models of learners and are a direct function of *flow* i.e. the state of optimal experience, where a person is so engaged in the activity at hand that self-consciousness disappears, sense of time is lost and the person engages in complex, goal-directed activity not for external reward, but simply the exhilaration of doing, Csikszentmihalyi (1990). The key elements of the approach include:

- **Evidence-Centered Assessment: which systematically analyses the assessment argument concerning claims about the learner and evidence that supports those claims, Mislevy, Steinberg, and Almond (2003) and**
- **Formative Assessment: a range of formal and informal assessment procedures employed during the learning process in order to modify teaching and learning activities to improve student attainment.**

The power of stealth within gamification rest in rethinking assessment not linked to the world of multiple choice answers but to the identification of new skills and standards and measuring them relevant to the twenty-first century. As such given that gamification is not a standardized academic or educational learning process embedding stealth assessment has great potential to increase learning given its existing history in game-based environments. This form of measurement for gamification presupposes two underlying assumptions, (1). learning by doing improves the process and its outcomes and (2). different types of learning and learners attributes may be verified and measured during game-play that would not otherwise be captured. So how would stealth assessment work to inform play assessment diagnostics?

Given that there remain a challenge to educators/trainers who desire to employ gamification and other game-design elements to support learning an evidence-centred design (ECD) process: Mislevy et al. (2003) is required for effectively measuring student retention and competence. The fundamental idea behind ECD originates from Messick (1994)) and formalized by Mislevy and Haertel (2006). The process commences with an identification of what knowledge, skills or other attributes should be measured. These variables are observed directly so behavior and performance can be aligned to the overall capture of relevant data. This should be followed by a determination of tasks/situations which would draw out such behaviours/performance. The nature of gamification lends to this process aptly as gamification elicits behaviours which bear evidence about key skills and knowledge through demonstration of the following as identified by Shute et al. (2010):

1. **What collection of knowledge and skills should be incentivized within an assessment context? That is Competency Models (CM), which supports grading, certification and diagnostic for further instructional support.**

2. **What behaviours or performance should reveal the relevant constructs associated with a reward system? That is Evidence Models (EM) which expresses how learner's interaction and responsiveness to a given problem constitutes evidence about their competence and by extension receipt of a reward for positive performance.**
3. **What task should elicit the behaviours which comprise the evidence, i.e. (TM)? This component provides a framework for the construction of situations which provide interaction evidence targeting aspects of knowledge related to the specific competence(s).**

However, there remains an additional component of the stealth process' induction into gamification measurement that provides the robust value added to ensure measurement effectiveness. Bayesian networks, Pearl (1988) cited by Shute (2011). These networks provide a useful model to handle uncertainty by using probabilistic inference to update and improve the data regarding learner competencies and gamification effectiveness. By using what-if scenarios in the observance of evidence which describes particular situations from a predictive perspective coupled with the ECD view allows propagation of information on the achieved behaviours. The Bayesian approach allows a comparative between the what-if and what-is so that the resulting probabilities inform future decision making on which elements of gamification work, where "*incentivization*" should be focused and selection of the best content chunks which had relevant impact from a delivery perspective. The combination of this built-in play assessment diagnostic into the gamification measurement framework permits all measurement stakeholders to examine the evidence/success of gamification under the lens of approximate competency levels (present & future state). It also has potential for validation of what the student/participant can do without disruption of the play experience and consequently their flow.

3.9 A Gamification Scorecard

The complexity of gamification measurement requires more than one system in place to effectively analyse the impact of gamification interventions. As such to effectively collect data from the play assessment diagnostics we require a requisite instrument. The Game Performance Assessment Instrument in the author's opinion represents a unique opportunity for modification, capture and representation of data on gamification performance and effectiveness.

The Game Performance Assessment Instrument (GPAI), Oslin et al. (1998) cited by Memmert and Harvey (2008) was developed to measure game performance behaviours that demonstrate tactical understanding, as well as player ability to solve tactical problems by selecting and applying the appropriate skills. It is most commonly used with assessment of physical sports but the author felt that given its robust performance metrics and ability to identify nonspecific observation components it can potentially be expanded for gamification measurement. GPAI examines such

Table 3.1 Game components observed in GPAI—*Source*: (Memmert & Harvey, 2008)

Game component	Description
Decision Making	Player makes appropriate decisions about what to do during the game
Skill Execution	Player efficiently executes selected skills
Adjust	Player movements offensive or defensive are necessitated by the flow of the game
Cover	Player provides appropriate defensive cover to help, backup or challenge opponents
Support	Player provides appropriate support to teammates
Guard/Mark	Player engages appropriate strategy(s) to ward off opponents who may threaten present position
Base	Player appropriately return to a recovery position between skill attempts

tactical components as base, adjust, decision(s) made, skill execution, support, guard/mark and cover (i.e. assistance & support to team) all of which have a tremendous impact on game play performance and requisite elements of evaluation in gamification. Table 3.1, below provides a detailed description of each tactical element.

Depending on the degree of gamification involved assessors can select one or more categories for evaluation of performance. The benefits of this approach to a gamified environment being (a) it can be adapted to various activities and (b) it has the ability to not only measure psycho-motor skills but skills which would not be effectively measured using traditional approaches, Mitchell et al. (2006) cited by Memmert and Harvey (2008). These would include skills such as adjustment and cover as it relates to team performance all of which are requisite components for gamification activities. From a measurement perspective the process also lends well to gamification through its scoring method utilizing a tally method based on a Likert scale, Memmert and Harvey (2008). The use of such a scale would provide categorical descriptors which provide easier metrics for performance scoring as well as a wider variety but not so wide that reliability of measurement would become difficult. An example of a rating system based on GPAI for gamification could look something like the example listed below:

The value of implementing such a system in gamification allows for both peer-review of performance as well as codification of game-mechanic components using an effective tally system. Furthermore, components of GPAI (such as decisions made, skill execution, support and adjust) approaches have already been validated as effective in some physical sports and as such form the basis of a framework with a track record which can be modified for gamification assessment. The use of this coding system allows each coder responsible the ability to individually observe behaviours, assess as appropriate/effective or inappropriate/ineffective then tally responses and create indices for decision making across a single component or multiple environments Memmert and Harvey (2008). The impact of tallying these components on an index for gamification measurement can then be disaggregated into two index measures game performance (GP) and game involvement (GI) and effectively correlated to provide an overall assessment of the gamification experience. While there are inherent limitations of GPAI such as calculation of individual and overall game performance indices, use of game involvement vs. game performance index, observer reliability, nonlinearity and finally usefulness of action there is value to the approach. A closer examination of learning time using GPAI both before during and after data coding will result in more stringent levels of observation reliability especially if two independent observers/coders are utilized thus reducing the problem of nonlinearity. Furthermore, it reinforces the GPAI validation process and reduces the level of subject biases and uselessness of action through an assessment planning cycle (the before, during and after process) that makes the gamification process more congruent with the overall learning objectives.

3.10 Pre and Post Knowledge and Skills Assessment

The success of any learning intervention hinges on the ability to assess participant's knowledge and skill both at the beginning and end of a process. The value of this methodology is to design effective intervention to close the relevant learning gaps. This methodology's perspective, for pre and post knowledge/skills assessment either summative or formative assist learning designers/delivers to better ascertain course effectiveness.

We have explored both play assessment diagnostics and GPAI; we now add a third component for measuring gamification the knowledge assessment. According to Balakrishnan, Bengasamy, and Aman (2011) traditional skills approaches are widely used in teaching games as the direct instructional method citing Metzler (2000). The emphasis has primarily been on skills and drills assessment without a clear consideration for the games themselves. Given that learning is an active discovery activity with learners engaged in construction of tactical understanding an assessment process needs to have clear sign post as it relates to its perceived problem solving and decision making activities. As such for gamification to be successful and the determinants of its success measurable, a pre/post assessment component should be integrated. Therefore the learning environment inculcated through the gamification design process must be identified and assessed prior to implementation. Additionally, prior to implementation of gamification assessment parties should first understand and gauge:

1. **The player(s) depth of understanding of the knowledge to be gained through the gamification experience. That is such factors as the degree of metacognition, and the conditions under which knowledge would be utilized.**
2. **The meaningful concepts the player(s) understands within the content domain. That is strategic knowledge which are memorized and used either to solve problems or effect new knowledge.**
3. **The degree to which the player(s) is already transferring knowledge amongst other members of their existing team(s). That is assessment of transactive**

memory responsible for the encoding, storing, retrieving and communication of group knowledge and develops over time as group members communicate, Lewis, Lange, and Gillis (2005).

Hence, a constructivist approach is required where an active learning approach takes place with participants personally constructing and interpreting the information based on their experiences, which will consists of the eventual gamification output. Moreover, given that constructivism is a participant- centred approach based on learner's perspectives (single & multiple) there is a need to assess these realities both prior to and upon completion of the gamification experience. The pre/post assessment process must consider the development of understanding the learning activities as identified by Fig. 3.1 below:

What the above figure tells us is that as participants confront new, unfamiliar features of their environment which do not fit with their existing view of reality Piaget and Inhelder (1969) cited by Balakrishnan et al. (2011) a disequilibrium occurs. The author suggest pre/post assessment to first understand the disequilibrium (pre-assessment), design the gamification experience within this context and post assess to ascertain if the gamification experience fits with the new experiences. Additionally, if their cognitive structures (also associated to Cognitive Load) have changed how do they accommodate these experiences. The entire pre/post assessment experience falls within the constructivist learning constructs allowing participants to engage in activities which require higher level thinking but with designers/ assessment professionals having a clear understanding of how to apply gamification to the knowledge building activities. Finally, since participants will try to assimilate all stimuli associated with the mechanics of gamification into their existing schemas a pre/post assessment methodology provides designers/assessors with an answer as to "what do they require to succeed in this situation and if their existing knowledge schemas can sufficiently address the question. The pre/post approach tells us from a constructivist perspective how participants will learn best and connect that process to the design and ultimate measurement of gamification through the combination of prior and new knowledge Fig. 3.2.

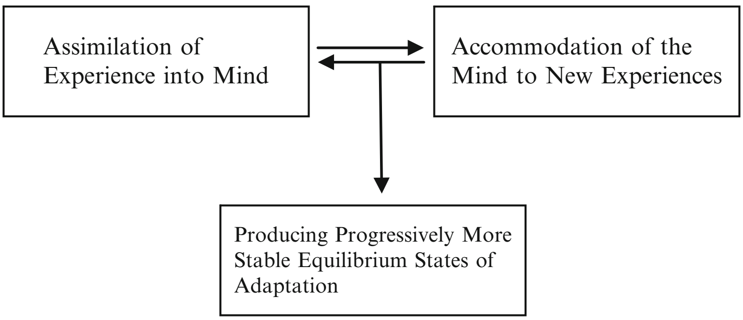


Fig. 3.2 Development of understanding (*Source*: J. Piaget & B. Inhelder, 1969)

3.11 Gamification Performance Assessment Review (GPAR)

The final stage in the assessment process is the Gamification Performance Assessment Review (GPAR). We have explored various measures of assessment which have so far focused primarily on the player(s). There remains however a need to also assess the gamification from a high-level so as to ascertain the effectiveness of gamification as the chosen strategic tool to improve performance of targeted participants. With the growing attention that gamification has received there is also a need to ascertain their value proposition (i.e. the value gained by customers/participants for using the product or service). Thus far gamification is spreading like a wildfire, perhaps to some extent without significant controls. One only has to do a web search and look at the number of hits, new feeds and media events associated with the term. Few theories exist as to an appropriate proposition for a comprehensive framework for evaluation and even fewer operationalized models to examine their causality. The considerable number of publications on the subject of gamification though burgeoning only further propel the hype leaving detractors more suspect and requesting measurable evidence to support its largess. Taking a page from the proposed evaluation framework proposed by Mayer (2012) with some modifications we can ask the following questions of gamification:

1. **What are the requirements and design principles for a comprehensive methodology for its evaluation?**
2. **To what extent does gamification contribute to learning in a real context?**
3. **What are the factors/components in gamification, which contribute to this learning?**
4. **To what extent are the "learnings" purported by gamification transferrable?**

These are all valid questions, which a GPAR analysis akin to a performance audit may possibly answer. Core to the deconstruction of gamification is the need to understand the conditions which make gamification and acceptable intervention, the quality of the intervention, the population demographics, mediating variables and relevant background elements which attribute to the game-mechanics associated with design. A GPAR Analysis therefore requires the following, Fig. 3.3 refers:

1. **Contextualization**: gathering of data as it relates to the special features of gamification, the environment within which it operates and the observations/assumptions which can be made when it is in action. For this contextualization of GPAR to take place there needs to be an underlying hypothesis which entails the design-orientation (artifacts), domain-orientation (the effectiveness of the use of gamification, its complexity and dynamics) and the disciplinary-orientation (the culture, ethics, politics etc.).
2. **Operationalization**: This event needs to occur both pre/post game. At the pre-game stage the review will examine such factors as demographics, prior experience with gamification, attitudes towards game-play, pre-existing skills sets (game-play) and group/team characteristics so as to determine its effectiveness. In-game GPAR will examine player-performance, game-play as it relates to

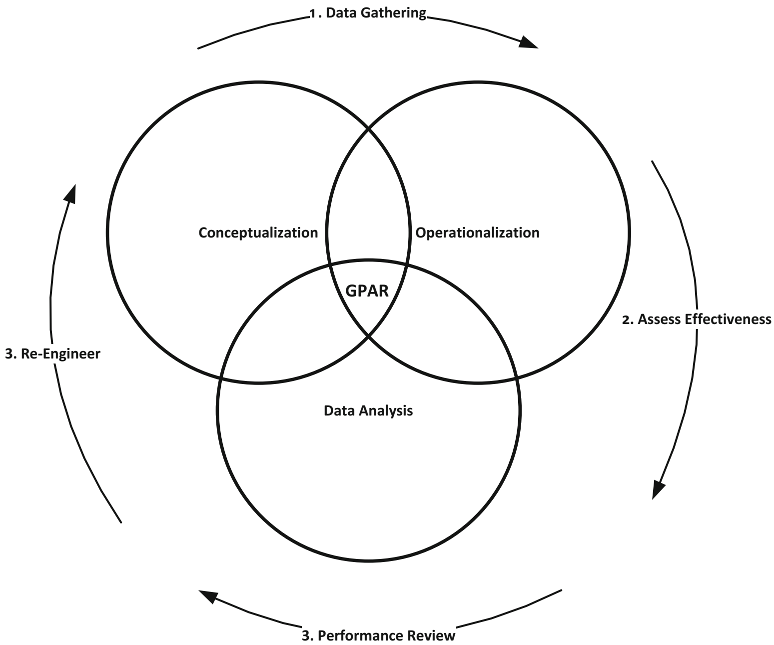


Fig. 3.3 Game performance assessment review process

effort, influence, power etc., and game experience, i.e. flow, immersion and presence. Finally at the post-game stage GPAR will again review the game experience (was it fun/beneficial), degree of player satisfaction, first order learning (individual/participant and short-term in nature), second order learning (longer-term, group, knowledge reconstructions).

3. **Data Analysis**: This is concerned with the analysis of data from the contextualization and operationalized review to ascertain the degree of influence of gamification and distinguish its impact. The analysis will test the overall efficacy of gamification within a group as well as comparatively across several groups.

GPAR is a necessary and final element in the review process as it allows for a strategic view of gamification which does not examine individual player performance but examines the overall performance of the game allowing us to find the influencing factors regarding the efficacy of gamification, improve the gamification constructs for future designs and provide the requisite empirical data to better convince/reinforce adoption Table 3.2.

3.12 Framework Application Process Methodology

To ensure the success of the gamification measurement framework an integrated process approach which brings together all the components must be illustrated i.e.

Table 3.2 Likert scale ratings for gamification assessment

Rating	Definition
5. Very Effective Performance	Player always attempting to utilize training/learning(s) and communicates learning(s) effectively with teammates
4. Effective performance	Player attempts most times to utilize training/learning(s) and communicates learning(s) effectively most times with teammates
3. Moderately Effective	Player begins to demonstrate communication of training/ learning(s) effectively with teammates
2. Weak Performance	Player rarely utilize training/learning(s) and communicates learning(s) effectively with teammates
1. Very Weak Performance	Player never utilizes training/learning(s) and communicates learning(s) effectively with teammates

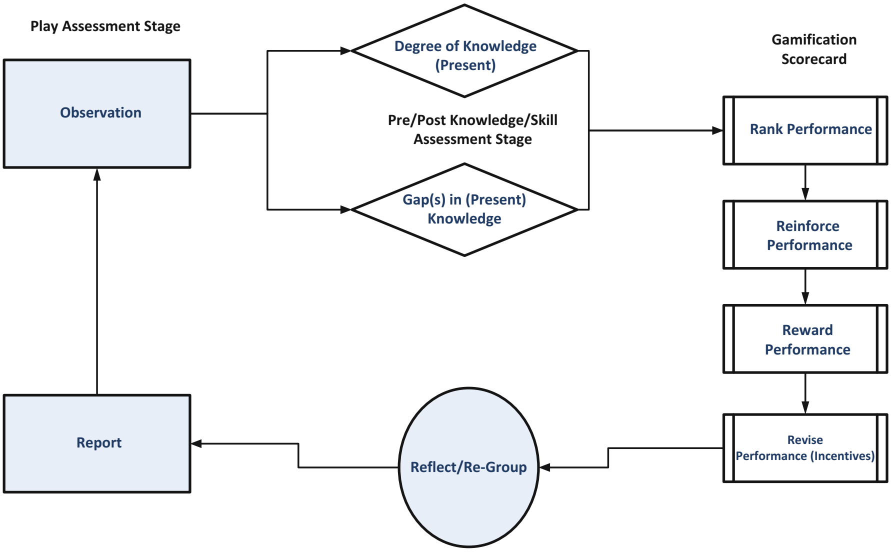


Fig. 3.4 Gamification measurement framework (Vers 1.0)

1. *Play Assessment*
2. *Gamification Scorecard*
3. *Pre-Post Knowledge Assessment*
4. *Gamification Performance Assessment review*

To better understand the integration of the proposed framework, the following model is proposed to support implementation, Fig. 3.4. At the initial stage, Play Assessment integrators of gamification methodologies must engage in passive observation. The approach allows for ability to gauge and document specific reactions/behaviours inherent with the Gamification methodology and ascertain acceptance. At this stage it is also suggested that integrators keep some form of learning journal which clearly documents player performance. The second stage encompasses assessment of knowledge/skills (pre/post). As indicated earlier in the relevant section this represents a discovery process and as such the aim is to understand the depth of knowledge/skill associated with task performance as well as the degree to which participants understand the knowledge they gain through the gamification process.

Thirdly, as data is gathered on participants the integrators need to develop a scorecard so as to rank performance eby individual/groups and further ascertain the degree of reinforcement as well as reward associated with same. Moreover, it is integral to the scorecard process that integrators assess prior reward criteria and revise accordingly in anticipation of new performance expectation. This ensures that the degree of motivation associated with the gamification process does not become monotonous. Once the scorecard has been effectively developed they must now take time to reflect on the data gathered and its results to ascertain impact and requisite retooling/re-engineering for the next instance of engagement or intervention.

Integrators need to bear in mind that the model describes is a developmental in nature and as such subject to modifications as it evolves. Given the momentum of the gamification movement a revision of this model is inherent. However, despite the evolutionary nature of the concept the model can ascertain that adoption of each stage will provide an effective starting point to gauge the benefits of a gamified universe within education and training.

3.13 Conclusion and Final Thoughts

The opportunity to explore gamification from a conceptual measurement framework is essential to foster a better understanding of this phenomenon and allows for the development of a framework for assessment. While no empirical testing of these proposed measures articulated have yet been undertaken within a gamification context to effectively validate the measures proposed, the author believes that the approaches put forward bear validity given that they can all build on and integrate the underlying theories of Kirkpatrick, Kolb and Sweller in the overall assessment process. In fact an ideal situation will be to incorporate the work of these seminal theorists in the GPAR review to add a much richer evaluation audit that incorporates reflection, cognition and knowledge transference. Furthermore, the context of assessing/measuring the performance of gamification utilizing such a robust measurement process (i.e. Play Assessment, GPAI, Pre/Post Assessment & GPAR) allows for a 360° feedback approach to measurement which covers gamification at the player, knowledge, behavioural and strategic level, a much needed approach for validation. The approach is further supported by codification and multiple observational foci to limit bias and provide multiple views as to the potential outcomes of measurement through robust statistical analysis.

What we know thus far is that gamification is an emerging and rapidly growing trend. It may have in its short existence become an overused perhaps even abused term which makes some naysayers cringe at the thought of incentivized learning with badges, rewards and other trinkets to support implementation. The undeniable fact is, we live in a digital age, with digital natives whose perception of learning far differs from those of us who may have been recipients of Kolb, Kirkpatrick and Sweller's theoretical assessments in traditional brick based instructional environments. The reality is those days are long behind us and unlikely to return. As learning professionals we owe it to ourselves and our emergent class of digital natives to be receptive to new methodologies of learner engagement while sticking to our philosophy of ensuring the robustness and validity of the desired learning outcomes.

References

Balakrishnan, M., Bengasamy, S., Aman, M. (2011). Teaching games for understanding in physical education: A theoretical framework and implication. Jurnal Atikan.

Braithwaite, B., & Schreiber, I. (2008). *Challenges for game designers*. Boston: Charles River Media.

Caillois, R. (1961). *Man, play and games*. New York: Free Press of Glencoe Inc.

Carroll, J. (1982). The adventure of getting to know a computer. *Computer, 15*, 49–58.

Chandler, P., & Sweller, J. (1991). Cognitive load and the format of instruction. *Cognition and Instruction, 8*, 293–332.

Choi, I., & Lee, K. (2009). Designing and implementing case-based learning environments fror enhancing ill-strutured problem solving: Classroom management probles for prospective teachers. *Education Tech Research Dev, 57*, 99–129.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper Perrennial.

DeLeeuw, K., & Mayer, R. (2008). A comparison of three measures of cognitive load: Evidence for separable measures of intrinsic, extraneous, and germane load. *Journal of Educational Psychology, 100*, 223–234.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining "Gamification". *MindTrek'11 Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9-15). New York: ACM Digital Library.

Hanari, J., Koivisto, J., Sarsa, H. (2014). Does gamification work?—A literature review of empirical studies on gamification. *47th Hawaii International Conference on Systems Science.* Hawaii, USA.

Hirsh-Pasek, K., Golinkoff, M., Berk, E., Singer, G. (2009). A mandate for playful learning in school: Presenting the evidence. New York, NY. Oxford University Press.

Huotari, K., Hamari, J. (2012a). Defining gamification: A service marketing perspective. *MindTrek'12 Proceeding of the 16th International Academic MindTrek Conference* (pp. 17-22). New York: ACM Digital Library.

Huotari, K., Hamari, J. (2012b). "Defining Gamification: a service marketing perspective." *16th International Academic MindTrek Conference* (pp. 17-22). Tampere, Finland: ACM.

Kolb, D. (1984). *Experiential learning: Experience as the source of learning & development*. Englewood Cliffs, NJ: Prentice-Hall.

Lewis, K., Lange, D., & Gillis, L. (2005). Transactive memory systems, learning, and learning transfer. *Organizational Science, 16*, 581–598.

Mayer, I. (2012). Towards a comprehensive methodology for research and evaluation of serious games. *Procedia Computer Science* (pp. 233-247). Elsevier.

Mayer, R. E. (2005a). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), Cambridge handbook of multimedia learning (pp. 31–48). New York: Cambridge University Press.

McCarthy, M. (2010). Experiential learning theory: from theory to practice. Journal of Business & Economic Research, Vol 8 No. 5.
Memmert, D., & Harvey, S. (2008). The game performance assessment instrument 9GPAI): Some concerns and solutions for further development. *Journal of Teaching in Physical Education, 17*, 220–240.
Messick, S. (1994). The interplay of evidence and consequences in the validation of performance. *Educational Researcher, 23*, 13–23.
Metzler, M. (2000). Instructional models for physical education. Boston, MA: Allyn and Bacon.
Mislevy, J., & Haertel, D. (2006). Implications for evidence-centered design for educational testing. *Educational Measurement: Issues and Practice, 25*, 6–20.
Mislevy, J., Steinberg, S., & Almond, G. (2003). On the structure of educational assessment. *Measurement: Interdisciplinary Research and Perspective, 1*, 3–62.
O'Neil, H., Baker, E., & Wainessa, R. (2005). Classification of learning outcomes: evidence from the computer games literature. *The Curriculum Journal., 16*.
Oblinger, D. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education., 8*.
Rahimic, Z., Vuk, S. (2012). Evaluating the effects of employee education in B&H companies. *Conference Proceedings: International Conference of the Faculty of Economics Sarajevo (ICES)* (pp. 1044-1057). Sarajevo: University of Sarajevo, Faculty of Economics.
Shute, V. (2011). Computer games & publishing. Charlotte, NC: Information Age.
Shute, V., Masduki, I., & Donmez, O. (2010). Conceptual framework for modeling, assessing and supporting competencies within game environments. *Cognition and Learning, 8*(2), 137–161.
Shute, V., Ventura, M., Bauer, M., Zapata-Rivera, D. (2009). Melding the power of serious games and embedded assessment to monitor and foster learning: Flow and grow. In M. C. U. Ritterfeld, *Serious games: Mechanisms and effects* (pp. 295-321). MaHwah, NJ: Routledge.
Sweller, J. (1999). Instructional design in technical areas. Camberwell, Victoria, Australia: Australian Council for Educational Research.
Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), Cambridge handbook of multimedia learning (pp. 19–30). New York: Cambridge University Press.
Tan, K., & Newman, E. (2013). The evaluation of sales force training in retail organizations: A test of Kirkpatrick's Four-level Model. *International Journal of Management, 30*.
Weisberg, D., Hirsh-Pasek, K., & Golinkoff, R. (2013). Embracing complexity: Rethinking the relation between play and. *Psychological Bulletin, 139*, 35–39.

Chapter 4
Implementing Game Design in Gamification

Federico Danelli

4.1 Gamification Miss the Game

Gamification is about identifying structures and behavioral procedures in “games” (video-games, board-games, party-games… or even sports!) and replicate them in educational or working, to manage audience behavior.

The most popular use of Gamification is within the Social/Marketing area, as standard solutions to increase audience engagement (Points/Badge/Leaderboard systems, or PBL). This solution boosts short-term engagement, but doesn’t have enough flexibility to impact audience on long-term (for an in-depth overview see Gartner’s market research on gamification Burke, 2012).

At the present time, gamification is food for marketing: it is very unlikely that gamification adopter is an excellence in game design. Actual gamification is a mix of web-based social strategies, not an high level application of game design (Burke, 2012).

Sometimes, marketing/social consultants think about gamification as “*social use of gaming to create revenue*”, rather than exploitation of people’s interests. I’ve personally observed that marketing consultant don’t notice the subtle red line between gamification and gaming. For example Rojo’s “Angry Birds” is seen as an example of gamification (rather than gaming with different revenue structure).

In this dynamic background, it’s quite difficult to exploit the “game” hidden within gamification, but this is of the utter importance. A confident knowledge about game design techniques and theories can make the difference between a standard solution and something innovative.

F. Danelli (✉)
Milan, Italy
e-mail: federico.danelli@gmail.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_4

This chapter will describe a game theory framework for gamification [based on the work of R. Caillois exposed in “Man, Play, Games” (Caillois, 1967)] that is useful to properly approach the game designing aspect in gamification. Some alternative game theories follows to give you different options to assess gamification solutions and strategies.

With the knowledge taken in this chapter, you will be able to make your own assessment on gamification project, to find possible issues and to exploit its limits. Without some design perspective, gamification offers no more than a standard array of solutions: used with game design, it gives you a path to achieve a wider objectives’ pool and to deeply influence audience’s behavior.

At the end of the chapter you will find a self-assessment test, intended to help you during the development of any gamification project. The test allows you to compare your expectations with the strategies you are deploying.

There are three preliminary key points to frame the gamification phenomena: gamification and web, gamification and serious game and direct and indirect gamification.

4.2 Gamification is not a Web-based Strategy

We know gamification mostly for its web applications. But, also if video-games and social technologies have a big importance in our lives, that has nothing to do with the inner structure of gamification itself.

Gamification, usually, is also applied in real-world: to collect points from cereal boxes or fly-miles (point collection), to be the first in line for buying a new high tech product (competition and social visibility), to get on the fly a home-run ball (successful use of skills). All those activities involve gamification layers.

Regardless of this evidences, actual gamification is intended as a web-based strategy (Burke, 2012). The size and detail of available analytics in web environment leads to the mistake of thinking gamification works <u>only</u> for short engagement on the Internet. Instead, that is the field in which gamification was recognized, but it’s not its birthplace. Gamification allows to engage players without a computer (badge for “employer of the month” used in fast-food company) even for a long time (shopping point collection and fidelity cards) in various everyday activities.

4.3 Gamification Differs from Serious and Training Game

There are some misunderstandings related to Gamification and Serious (or Training) Game. They are different: gamification is meant to be under the surface (using game techniques outside game), while a serious game is a simulation to test players’ skills and behaviors.

Despite of the fact that both may appear as "games", they require different skills to be successfully designed. Serious games need technical skills (if you create a fly simulator, you have to know aircraft) and doesn't have to be *fun*. Gamification instead requires game design skill and relies deeply on *fun factor* to engage players.

There are many shades of gray between this black and white taxonomy. For example, Jane McGonigal (McGonigal, 2011) means "gamification" as use of funny and stand-alone game to teach positive behaviors toward society, environment or themselves. In fact, she mix different feature from both to define a kind of game-based social training.

From a wider point of view: if Serious Game Design is a simulation, than gamification is a branch of Social Design that specifically use game design strategies (instead of behavioral and neurolinguistic studies) to impact on people.

4.4 Direct and Indirect Gamification

Another distinction has to be done about Gamification: Direct and Indirect gamification. This is a new definition, unknown to Caillois, useful to distinguish *pure games designed to achieve business objectives* from *activities empowered by a gamification layer*.

In the first case you have something that is fully a game (note that's not a Serious Game: it doesn't have to had training purposes). A Direct Gamification takes form of classical game, like a mahjong, re-branded to improve on-line presence [Blue Dog "*StartQ8 Mahjong*", (2011)]. Another, more subtle form of direct gamification is a game designed to achieve practical results during play [Univ. of Washington "*Fold It*", (2007)]. Indirect Gamification instead refers to activities improved by game-based motivational design: funneling, competition, cooperation and so on. Many examples of indirect gamification are presented on other chapters of the book.

You have to choose an approach consistent with your target and objectives. Direct and indirect gamification either require game design skill: a direct gamification solutions needs a stronger game-design to create a full stand-alone game that fit your needs. An indirect gamification solution is instead tailored on an existing task you have to improve: here you need game-design skill to properly choose a game fitted on goals. Choosing the wrong game may slow down, or even stop, your process.

4.5 Caillois' Theory and the Drivers of Engagement

The theory behind a good game design is very important. There is nothing so practical as a good theory. Roger Caillois (1913–1978) is the elder of ludologist. His theory, grounded on psychological and sociological background, offers a full array of drivers to engage players based on behavioral evidence. Its approach is useful for gamification because it's focused on *engagement*, rather than inner structures of gaming. Caillois' theory classify games[1] by four primary drivers resulting in four kinds of experience that you can achieve while playing.

- **Agon**, (or *competition*). Easy to understand, it's about competition (against others, themselves, or game itself—like a solitaire).
- **Alea** (or *chance*). It's about uncertain and chance. Anytime you make a bet or forecast (Blackjack, Texas Hold'Em) you're in Alea field.
- **Mimesis** (or *mimicry*). Also found in theaters or movies, this driver is about to feel emotion and sensation or to act fictionally in a fictional world.
- **Ilinx** (or *vertigo*). A state of altered perception, a roller coaster or a bungee-jumping is examples of Ilinx-based games. They are about a different perception of the world, usually connected with loss of control.

This classification applies to any experience we feel as "fun". The game environment, sum of the game structure and engagement driver used, can push any player to a different behavior.

4.6 Custom Engagement

Men react to situation using a combination of instinct, unconscious and logic reasoning (Wilson, 2002). Games follow the same rule: any game environment stimulate player to get their reactions. As guideline, any driver is attuned to a specific response in player's behaviors.

- **Competition** and **cooperation** is made by *Agon*. It's easy to foster a competition, while to achieve cooperation you need to to split your audience in teams. This kind of engagement is pretty common (eBay or Kickstarter have similar gamification layers).
- **Expectation about future** and **intellectual fulfillment** are products of an *Alea-based* game experience. Self-fulfillment is powerful, and it drives to a strong and long-term engagement (addicted gambler is caught in this). Self-fulfillment also is used (or *should be*) as driver in learning and education.
- **New feelings** or a **cathartic experience** is made by *Mimesis*. Movies and theaters are good examples. Few times Mimesis is a primary target for gamification, while it's very important in storytelling (marketing and viral campaign) and communication.
- **Strong emotions** and **lose of control** are connected with *Ilinx*. This driver allows a very deep connection with the game experience. As side effect, this driver requires an existing engagement to properly work.

[1] Caillois means, with "games", more than what we usually do. Anything beyond primary survival needs is a "game": dancing, performing arts, running… even assuming recreational drugs!

4.7 Mixed-up Experiences

Any good framework that operates on human product of intellect cannot mark heavy boundaries: human activities are smooth and can connect with each other in surprisingly ways. Any theory about product of intellect (like games) has to be somehow flexible.

In games, you can mix engagement drivers. As Caillois himself already pointed out, any "game" is a mix of drivers (Caillois, 1967). Even more important: players may shift between drivers during the *same* game, *regardless* of game itself. You can't force a player to have fun somehow: you can only *suggest* how to do that. You cannot completely control players: they always have a chance to drive the game they're playing with. Here follows some examples.

- An addicted gambler can shift **from *Alea* to *Ilinx*** making a huge bet (or directly playing a Russian Roulette). When your life depends on a single dice or card, you experience a state of Ilinx apart from Alea.
- ***Agon*** games can **became *Alea*** games. This happens when competition is at highest level, and little details make big differences (Olympic sport equipment management, or hardcore video gamers playing in a fraction of second).
- Many ***Mimetic*** experience often **involves *Agon***. Role-playing games (Skyrim or Dungeons & Dragons) are good examples. Competition is a natural behavior in men: so it's usual to has this involved in many fictional situations.

This shifting, anyway, may be used from any driver to everyone else. So, a preliminary good advice is to try supporting a wide array of experiences.

4.8 Paidia Against Ludus

The four driver of engagement are not enough to classify games. In Caillois there is a complementary axis, connecting the four drivers. This axis goes from Paidia to Ludus. They are, respectively: *behavioral games* created by attitude, with implicit or no rules; *fully organized games* with precise rules and strict boundaries. For example, dancing is a Paidia game, while chess is a good example of Ludus.

In Gamification, this axis is lesser useful to categorize games. Usually, you need to engage players in a specific experience: this means you need a Ludus. On the other side if you need something highly viral, if you need to add a gamification layers on an everyday activities, you need a Paidia. A Paidia activities may be, for example, a "flash mob" or a "meme": it allows to you to engage players fast, and it's extremely useful for brand management and marketing. On the other side, Paidia have a weaker grasp on player's experience if compared to Ludus.

4.9 Field Applications

The procedure to correctly use a theoretical framework is always the same (for either Caillois' theory and all those follow), and it's very similar to any other assessment analisys. First, identify your needs. Then, find a way to fulfill them using driver of engagement. Finally, try your solution to monitor its effectiveness and eventually empower it.

Caillois' theory find its best application in high level assessment. You may need an innovative game structures, or a multi-games campaign, or an alternate reality campaign, or to change player's behavior.

Using Caillois approach from draft allows you to effectively manage results and side effects of the game. Caillois' articulate framework allows you to take an overall picture on a complex game experience.

It's anyway less useful when you already have a good game and simply need to marginally fix it, or in comparing different games those involve player the same way.

4.10 Actual Gamification in Caillois' Framework

Supported by Caillois' theory, we can analyze actual gamification. As first statement, gamification today hasn't chased all the path to engagement (Burke, 2012).

Gamification actual solutions may be summarized as follows: gamification on social media (strongly Agon-based with a PBL strategy); recruitment and HR training that use Mimesis (mostly as serious and training game); on-line trading uses Alea while there are no evidence of Ilinx-based gamification case.

Alternate Reality Campaign deserves a separate quoting: it is an uprising form of gamification that strongly connect mimicry and competition. Those are usually big cross-medial, free to play campaign with some marketing target. From "The Beast" campaign by Microsoft for Spielberg "A.I" release in 2001 to the "Why So Serious" campaign by 42 Entertainment for Warner Bros "The Dark Knight" in 2007, an alternate reality campaign usually takes place in real world, where you have to compete or cooperate with other players to find clues, rewards and informations.

4.11 Alternative Frameworks

It's possible to use a wide arrays of game theory to assess games, exactly like different games may conduct to a similar engagement. Here follows some alternative game theories. An alternate theory still requires some level of game-design skills.

The theories described below offer different framework to assess games, but the process to apply them is the same. You have to determine what do you want from players, find out how to empower that, and then applying and appropriate game structure. Finally, to find out appropriate application field to any theory see last paragraph under any section.

4.12 8 Kinds of Fun

This framework is based upon feelings perceived by player. From this point of view, it's very similar to Caillois' theory. Instead of four drivers, according to Marc LeBlanc lectures at Northwestern University (LeBlanc, 2004), there are eight possible kinds of fun.

This framework is more specific than Caillois' one, but it classify both *feelings involved* in players, and *ways to express* those feeling without distinction. Those eight kinds of fun are:

- **Sensation**—games engage your target senses directly. Consider the audio and video "eye candy" of video games; or the physical movement involved in playing sports, or the feelings of wood and weight of a chess piece.
- **Fantasy**—games can provide a make-believe world, that is somehow more interesting than the real world.
- **Narrative**—games can involve stories (embedded by designers, or emergent created through player action) that can engage players even better than a book, or a movie.
- **Challenge**—some games derive their fun largely from the thrill of competition: with others, with themselves, with the game itself.
- **Fellowship**—in many games with a high social component, the social interaction (with family, friends or on line) in a strong motivator to keep playing.
- **Discovery**—many games rely on the sense of wonder connected to find out something new, as in in adventure and role-playing video games.
- **Expression**—the possibility to express yourself through game play, like in Rpg game or even in open-world video games like "The Sims" or "Fable".
- **Submission**—many games allow to build game interaction as an ongoing hobby, rather than an isolated event (a single play). Usually applied in *tournament* (Magic: the Gathering) or *guild* format (World of Warcraft), or even simply ritualized play of games at a weekly meeting. This last point, in fact, is lacking in Caillois while can be useful to improve your solutions simply changing its fruition by player.

LeBlanc's theory is particularly useful to frame relationship between players, and it's appropriate to assessment on a specific game or game experience. If you find a good game has some little issues you can't identify through Caillois' Framework, the 8 Kind of Fun provide a fair alternative sight over the game. This framework doesn't work well on narrow analysis, when specifically evaluate player's contribution and its engagement: accordingly to LeBlanc, some actions involves fun (like *Expression*), while for Caillois those need underneath driver to create fun.

4.13 4 Keys for fun

Another framework developed by Nicole Lazzaro of XeoDesign (Lazzaro, 2004) offers easy-to-use guidelines, but lacks of distinctions and details enough to be really useful is assessing your gamification activities. It is anyway interesting because focus on social engagement as a driver for participation itself (something Caillois don't analyze properly). The four keys for fun are:

- **Hard Fun**—the attractiveness of go through hard obstacle and difficult task. The player play for the satisfaction of winning, against the game or other players.
- **Easy Fun**—maintains focus with player attention rather than a winning condition. Usually obtained by immersion in a game ambient perceived like "living", and typical of many-options game, role playing games etc.
- **Altered State**—it used the feeling a player perceive when play, and focus on emotions. Having some easy time, clearing your mind, avoid boredom… all those are examples of using this key. This is far more wider than the Ilinx Caillois described, because include *mimesis* elements.
- **People Factor**—game is often social, and this factor is anything related to other people: teamwork, spending time with friend and any kind of possible social interaction is related to this key (except competition—see "Hard Fun" above).

This framework advantages in having four key to assess games, but it doesn't make difference between different game sharing the same engagement pattern. For example, if you want a game that involves *people factor and altered state by an easy fun environment*, "Ruzzle" and "Sims—Social" and "Candy Crush" fit description, but they are very different games.

This framework is useful for demonstration purpose and academic introduction, or to have another viewpoint upon a game or a strategy. It can be less useful if you have to design starting from sketch. Generally speaking, it is a lesser precise transcription of Caillois' framework.

4.14 Color Theory

The Color Theory (Ninoles, 2002) differs from framework above because it's simpler (three roots to categorize games), but even more accurate. It was develop with a focus on role-playing games (those are mimicry-based games), but it works also as a general framework. This theory focus on the *inner structure* of the game.

It considers a game as an output of three basic element (each named like an RGB color). You can assign a value to any component, resulting in a different *Color* for any different game. Needless to say, this is a pure comparative theory, but it's very accurate. If you need to create an high density comparative table, there is nothing better. The three color component are:

- *Red* for **coherence**: inner consistency of the system in relationship with setting. The more the system is consistent, brighter will be the red. Many of the most recent video games have an high red component, but also hide and seek rules fit perfectly with its setting and goals.

- *Green* for **easiness** and **simplicity**, related specifically to learning curve. The lower learning curve of an easier game will result in a more intense green component. This will not take in consideration engagement on a long period: chess has an intense green component cause to their low learning curve, not because of their long-term engagement.
- *Blue* for **realism**, which means consistency of the game with reality. The more the game represent reality as it is, the more vivid will be the blue. Chess, for example, have a low blue component. A training role-playing game has an higher blue component.

RGB theory is a simple way to compare games: composing the colors will create a mapping (this includes secondary color, like yellow, made by high green and high with red with low blue). This mapping is perfect to create an overview upon a gaming company offer, or over an alternate reality campaign. It will fit specifically in video-games industry, where you have to position your game in an free spot, and not to innovate game's structure.

The major issue with this framework is about long term engagement. Apart from *green*, this framework has no temporal reference, so it makes difficult to predict engagement during time.

4.15 Usefulness of a Game Design Theory

Gamification is the business-committed side of gaming. But it still remains gaming. Players approach your gamification solution with a "game attitude" (meaning by that: they're looking for fun). You have to play-tests, to prevent abusing the game, to analyze learning curve, to forecast engagement. You still need an array of skill in game design to successfully manage all these operations.

Anyway, this chapter wasn't about providing some specialty skills in game design. My target was giving enough knowledge to understand the chooses behind a gamification strategy.

As already said, there is no right or wrong in gaming: there is also *fit* and *unfit*. Also if you still need a game design advisor to properly set game features (length, difficulty, levels, rewards and so on), you should be able now to see the bigger picture: how gamification impact on user's experience, how it shifts brand perception, how it changes behavioral pattern.

Do not self-constrain yourselves: gamification above all is an opportunity to change processes and companies from within. There is literally tons of unexplored application: try to improve market share, to increase productivity, to get more streamlined process… Sky is the limit!

4.16 Self-Assessment Test

Here below there is a quick self-assessment test about gamification. It's designed to assess expectation in relationship with actual design, and it's based upon Caillois' framework.

It's a mix from different test, mainly from "Education & Leadership Toolkit" by US National School Board Association. The itself test is a derivation from a Q-test methodology, matched with an evaluation grid taken from behavioral test (Cohen, Swerdlik, & Smith, 1992).

This test measures *indirectly* your competence with a criterion references, allowing a *quantitative* measure of a *qualitative* discrepancies between your goal and your design.

4.16.1 Table Result

After completing the test (it can be a good idea to distribute them between teamwork, to check different concept visions), simply check any answers you choose in the table below. An answer count as "+1". Sum separately cells by white background (Target) and by gray background (Game).

The test will give you eight numeric key (four *Target* value and four *Game* value): you have to deduct any Target value from corresponding Game value.

A negative numbers represent a goal not fully supported by design. A positive number indicates a design choice oversizes your goal.

A balanced game should have a zero discrepancies (also if it's unlikely, a ±1 is acceptable): bigger the number, bigger the discrepancy. The maximum difference can be up to ±6, but you will face design troubles if there is a difference of ±3 or higher.

Self Assessment Test—Result Table													Target	Game
Agon	A2	B2	C3	D1	E2	F1	G4	H2	I2	J1	K4	L1		
Alea	A4	B2	C2	D1	E2	F2	G1	H4	I2	J1	K3	L3		
Mimesis	A3	B1	C4	D2	E1	F3	G2	H1	I1	J3	K2	L3		
Ilinx	A5	B2	C1	D2	E1	F1	G3	H3	I1	J4	K1	L2		

4.16.2 Self Assessment Test

4.16.2.1 Gaming Approach and Objectives

Answer to all question marking a single answers

A. **Why someone should play your game**?

1. It has a good graphic
2. It's very funny
3. It's realistic
4. Any play differs from another
5. It's very engaging and addictive

B. **Is the game settled in a fictional world**?

1. Yes
2. No

C. **How much a single play should last**?

1. Few minutes
2. No more than half an hour
3. Al least an hour
4. More time

D. **How do players should play your game**?

1. Strictly following the rules
2. Freely as they feel, what's important is the message I want to deliver

E. **The mechanics of the game are original**, **or inspired by something existing**?

1. Original
2. Inspired from existing games

F. **What is the lifespan you think your game will have**?

1. Short period (days)
2. Medium Period (weeks)
3. Long Period (years)

G. **Could a single play be interrupted**, **and finished later**?

1. Any play can be stopped and finished later
2. If you interrupt the game you lose your progress and have to restart
3. The game is real-time based
4. It's not relevant

H. **How many times an "average" player should try your game to fully complete it** (**also**: **how many lives you need to complete the game**)?

1. A single one
2. Around a dozen or two
3. Many times
4. Countless: some players will never finish it

I. **It is possible to "cheat"in your game**? **Here we mean to abuse the rules**, **not to crack the system** (**that**'**s up to IT men to avoid that**)

1. Yes
2. No

J. **Have you prepared a data collecting form**, **for analytics**?

1. It is integrated in the game
2. It is based upon voluntary feedback from players
3. No at all
4. No because the game doesn't involve business valuable information

K. **How much play testing have you done** (**or have you scheduled to do**)?

1. None at all
2. Few days with inner designers and corporate workers
3. Few days with selected audience
4. Many days, with wide audience

L. **Do you want that social sharing achievement is one of game**'**s focus**?

1. Yes
2. No
3. Maybe

Go back to Result Table and check your result

Bibliography

Atkins, B. (2003). *More than a game: The computer game as fictional form*. Manchester, UK: Manchester University Press.

Burke, B. Nov. 27 2012. Gamification trends and strategies to help prepare for the future. Available on line at http://www.gartner.com/newsroom/id/2251015.

Caillois, R. (1967). *Les jeux et les hommes: Le masque et le vertige*. Paris: Gallimard.

Cohen, R. J., Swerdlik, M. E., & Smith, D. K. (1992). *Psychological testing and assessment: An introduction to tests and measurement*. Mountain View, CA: Mayfield.

Costikyan, G. (1994). 'I have no words & I must design', in: Interactive Fantasy #2. Retrieved February 28, 2006, from http://www.costik.com/nowords.html.

Eskelinen, M. (2001). 'The gaming situation,' in Game Studies. 2(1). Retrieved March 22, 2006, http://www.gamestudies.org.

Huizinga, J. (1997). *Homo ludens: Proeve ener bepaling van het spelelement der cultuur*. Amsterdam: Pandora.
Hunicke R., LeBlanc M., Zubek R. (2005). MDA: A formal approach to game design and game research. http://www.cs.northwestern.edu/~hunicke/pubs/MDA.pdf.
Juul, J. (2001). 'Games telling stories?: A brief note on games and narratives,' in Game Studies, 1(1). http://www.gamestudies.org.
Koster, R. (2004). *A theory of fun for game design*. Phoenix, AZ: Paraglyph. Excerpt available http://www.theoryoffun.com/.
Lazzaro, N. (2004). *Why we play games: Four keys to more emotion without story*. Oakland, CA: XeoDesign. http://www.xeodesign.com/xeodesign_whyweplaygames.pdf.
LeBlanc, M. (2004). Mechanics, dynamics, aesthetics: a formal approach to game design. Lecture at Northwestern University. Retrieved April 2004, http://algorithmancy.8kindsoffun.com/MDAnwu.ppt
McGonigal, J. (2011). *Reality is broken*. London: Jonathan Cape.
Motterlini, M. (2008). *Trappole mentali*. Milano: Rizzoli. In Italian.
Ninoles, F. (2002). System color: A typology of RPG mechanics. http://harmonies.tzone.org/articles/colors/colors.html
Schreiber, I. (2009). Games design concept. http://gamedesignconcepts.wordpress.com/
Wilson, T. (2002). *Stranger to ourselves: Discovering the adaptative unconsious*. Cambridge: Harvard University Press.

Ludography

Blue Dog Web Agency. 2011. Mahjongg StarQ8. https://www.facebook.com/promoStarQ8/app_210599752312636
Bauer Rodrigues, H. (2013). *Harlem shake*. New York: Mad Decent.
42 Entertainment, 2007. "Why So Serious" marketing campaign for Warner Brothers. References available http://whysoserious.com/
Computer Science and Engineering Department, Univ. of Washington 2007. "Fold It". http://fold.it/portal/ Shea, A. 2012. The value of design disruption. The Design Observer Group. http://changeobserver.designobserver.com/feature/flies-in-urinals-the-value-of-design-disruptions/33108/

Chapter 5
Applied Behavioral Economics: A Game Designer's Perspective

Investigating the Gamification of Modern Games and How Similar Techniques Can be Leveraged in Non-Game Environments

Charles Butler

5.1 Introduction: A Game Designer's Perspective

From the outset, the reader should bear in mind that this paper is written from the perspective of someone who has spent time in the video game industry as a game designer, among other capacities, dealing with many of these issues on a day-to-day basis. Many of the included examples, anecdotes, and assumptions are based on that experience and are intended to describe one perception of the current state of the industry and how it relates to potential best practices.

5.1.1 A Different Set of Goals

It seems quite common these days to enter into an engaging discussion over the merits of gamification (or more likely, the lack thereof). The participants of these discussions seem to often be professionals who are in a business-oriented role in their respective companies. These individuals typically want to find a way to improve some aspect of their company's business. Occasionally, educators and academics will be lured into the fray, hoping, in a similar fashion, to either improve various things or to evaluate to what extent such improvement is possible.

C. Butler (✉)
The Norwegian School of Information Technology,
Schweigaardsgate 14, 0185, Oslo, Norway
e-mail: charlesabutler@gmail.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_5

Customers occasionally stumble into these discussions as well, though they tend to have an understandably negative view of what they perceive as malicious manipulation. These conversations often originate from (or occur in response to) talks or articles about (or by) companies utilizing (and sometimes selling) gamification services. This is understandable enough because who better to talk about gamification than people who deal with it on a daily basis?

The various types of participants all have quite valid and worthwhile viewpoints and can certainly contribute positively to the collective conversation, but strangely, the voices that seem to be missing are the traditional game designers. One might think that game designers would be on the forefront of any discussion concerning bringing game mechanics into real-world situations, but they seem to have a reaction similar to that of the players, often finding the attempts at behavior manipulation extremely distasteful. This distaste sometimes goes as far as considering some gamification techniques to be professionally irresponsible or even unethical.

While the video game industry may be young compared to many others, there are still multiple decades of history and tradition that inevitably shape the design tendencies of today's game designers. Though the more common trends could surely benefit from an outside influence, there are also a great many lessons and a collective wealth of knowledge that traditional game designers could bring to any attempt at gamification. However, these attempts at gamifying business or education are typically designed and implemented from the perspective of the businessman or the academic. These practitioners come to the world of game mechanics because they see the power that games wield over their respective players, and the gamifiers endeavor to bring some of that power into other aspects of life.

5.1.2 An Entertainment Focus

Seemingly unique among those interested in gamification, a traditional game designer's primary goal is typically the entertainment of the customer. The designer must take certain business-oriented aspects into consideration as well, such as marketability and accessibility. However, designing a great product is a game designer's primary method of contributing to a company's success. The standard (and seemingly logical) rationale is that a better game sells more copies, and even though other factors are also in play (marketing budget, for example), a correlation between game quality and sales does exist (at least as measured by the meta-review site MetaCritic's scores).

The point of this distinction is to highlight the concept that a game designer is primarily interested in creating a positive (or at least entertaining) experience for the player, while seemingly everyone else who might want to leverage the power of game mechanics has ulterior motives. Therefore, the game designer is best equipped to consider things from the perspective of the player and is best able to to shape the mechanics to both elicit the desired outcome and to ensure that doing so provides the best possible experience for the user.

5.2 Gamification

5.2.1 The Gamification of Games

5.2.1.1 Aren't They Games Already?

While much has been written recently about the advent of gamification, it is interesting that this advent was largely brought on by the wave of success experienced by social game companies, such as Zynga. Previous successes in the video game industry didn't bring this sort of interest to game mechanics, so why now? The gamification of games was really the lightning rod for all of the attention, but how can you gamify a game? Wasn't it already a game to begin with?

There were certainly gamification attempts long before the recent wave of social games (frequent flyer miles, for example), but this new breed of games brought about a change in paradigm that radically altered the way both games and gamification are designed and implemented.

Formalization

First was the notion that there really can be a formula for success. Traditionally, when one would talk of design rules or best practices, it always seemed implicit that such things were relatively general guidelines that one should thoughtfully consider based on the context at hand. These things seemed more like objectives to pursue (or avoid) than a literal blueprint for success. However, with the advent of social games and the meteoric rise in popularity of titles such as Farmville, the idea that there could be a dominant strategy seemed to take hold in the game industry. Scores of imitators began development on their own versions of the most popular social games, attempting to leverage what were perceived as the secrets to success.

Of course, very few games can actually rise to the top of the charts, practically by definition, but the idea that there are certain mechanics which can repeatedly elicit specific (and sometimes unintuitive or even irrational) behavior is likely closer to the truth than most players would like to think. The industry powerhouses have begun leveraging the expertise of different professions (utilizing mathematicians, statisticians, behavioral economists and psychologists, etc.) in an attempt to better define what does and doesn't work. By highlighting principles that have been shown to work in other contexts, game developers are able to create and rigorously test in-game implementations to find functional correlates to their real-world counterparts.

The (publicly) unstated goal of this is a formalization of certain designs or mechanics that can be used repeatedly, across multiple implementations and contexts, while retaining its effectiveness. This is incredibly desirable for a large game publisher, as it would effectively be a trade secret that would allow for more effective game development with considerably less risk. However, this is obviously complicated by the fact that these designs and mechanics are public (at least to some degree) because players interact with the products. This opens any game studio up to having their designs quickly and ruthlessly copied. Any formalization that hopes to avoid this is likely to be a meta-formalization, guiding the design at a high level (defining the general principles to be used) instead of directing specific implementations (specifying how to use those principles). While formalization at the tactical level seems to result from the various cloning attempts common to the game industry, formalization at the strategic level is likely the true benefit gained from gamification.

Optimization

Of course, even the best strategic vision can be undone by faulty implementation. One reason that cloning the details within other games isn't likely to be a highly successful long-term strategy is that the gestalt of a successful game is quite fragile, and even minor changes can have a dramatic effect on the experience. While a certain mechanic might be wonderfully effective in one game, reproducing the mechanic in another game might give significantly different results (even if the cloning attempt encompasses the entire game).

Because the effectiveness of any portion of a game is so specific to the individual implementation, optimization can be incredibly important to a game's success. Of course, video games, being software products, typically undergo extensive testing, covering a variety of different areas (testing for bugs, fun, usability, etc.). However, the rise of online, web-based games brought to the game industry (popularizing, if not introducing) a philosophy of testing methods from online marketing, most notably characterized by split-testing. In a split-testing scenario, two groups of players would play slightly different versions of the same game while the developers tracked whichever metrics were intended for optimization. A common example (applicable both in games and elsewhere) would be altering the pricing of an item and tracking which price level generates the most revenue.

This concept could take much of the guess-work or intuition out of game design. Instead of arguing over which design decision to make, a team could simply split-test the options and retain the one that produced the best results. With the most popular social games reaching tens of millions of users, the potential (and the potential benefit) for split-testing was immense. A large number of tests could be run simultaneously, evaluating a massive number of options and keeping only the top performers. The overall effect of fine-tuning practically every part of a game could have a dramatic effect on its profitability.

This very data-driven approach almost unquestionably produces results, though there are a number of downsides or counter-arguments. First and foremost is that these tactics need to be guided by an effective strategic vision. Mass split-testing can enable incredibly effective optimization, but knowing what to optimize for isn't always obvious. For example, optimizing for user acquisition or virality before a game is effective at retaining or monetizing its users could lead to unsustainable operating costs and churning, unprofitably, through the users in the game's target market.

An additional criticism of optimization-based development is that split-testing only allows the developers to find local maximums. In other words, it can help your team do what it's doing as effectively as possible, but it won't tell you if you're doing the right thing. Split-testing helps a team refine the details, but the high-level decisions remain in the hands of the developers.

5.2.1.2 Games as a Lens

Transparency

Even if the goal isn't to create a profitable video game company, examining games can still prove to be a very valuable learning experience. This can be true even if the goals have nothing to do with games at all. Games provide a lens through which one can examine user behavior in a vast array of environments, engaging with countless mechanics, and modified by a multitude of variables. The problem rarely involves a lack of information. Problems more often arise with the interpretation and subsequent action taken (or not taken). These difficulties often stem from the incredible amount of information at hand.

However, it's one thing to go diving through millions of lines of your own data to reach a conclusion about user behavior, but trying to come to the same conclusion when the project generating the data isn't your own (and may well be a competitor) is a very different problem. Luckily, when the project in question is a game, we have a great deal of information exposed to us. Anyone who wants to learn how games work has but to play, test, and analyze everything that the game exposes to its players. This may not be complete information, as the reasons and motivations behind certain decisions may not be readily apparent, but it is fairly straightforward to analyze what has been done and (to some degree) the effects of these decisions. We can look at various implementations of a similar mechanic, attempting to decipher the factors and contexts that led to success (or the lack thereof). We can also look at the evolution of mechanics over time, often within the same company's purview. It is even possible to track how a certain feature or mechanic changes over time within a single game, allowing us some degree of insight as to the effectiveness of various changes and the internal motivations of the development team. Few situations offer the chance to so easily gain this level of insight from other products on the market (especially without the consent, or even the knowledge, of the product owners).

Observing "Unfiltered" Behavior

One benefit of using games as a method of research is in the prevention of the interference by the experiment itself. Studying human behavior without inadvertently affecting the behavior of those humans being studied can be difficult to avoid at times, but by using a game as an intermediary, this becomes less of an issue. This is especially true if using a commercially available game (ideally in cooperation with its developers). In this way, players who are already playing the game of their own accord could potentially be tracked and studied. In a real-life context, there are innumerable social conventions that govern people's behavior to a very large extent, and while some of those tendencies likely map to in-game behavior, stepping out of reality removes a layer of potential interference. This can allow us to see behavior without many of the filters that subtly alter our behavior on a near-continuous basis.

An additional benefit is that games aren't necessarily encumbered by the same expectations (from the player's perspective) that are present in a reality-based context. In a real-world experiment, participants may not be aware of the specific nature of the study, but they may still be somewhat guarded or inauthentic due to the participation. This behavior may be further exacerbated if they are placed in an unusual situation or required to perform an unfamiliar task. However, within the bounds of a game, unusual situations and unfamiliar tasks are almost expected. Video games are so varied in their contexts and mechanics that players wouldn't be as likely to unnaturally alter their behavior just because of the uniqueness of the experience. However, it should be noted that caution is required when questioning players directly on how much they enjoyed the experience or their perceived quality of the game. Inquiries of this type can be among the most difficult questions for players to answer objectively, making it far more reliable to establish behavior-based metrics that can be objectively measured as the player interacts with the game (tracking the length of a play session, for example).

5.2.2 Bringing These Lessons into Non-Game Environments

5.2.2.1 The Customer as a Player

It might be difficult at times to equate certain business objectives with game mechanics, and it can even feel uncomfortable or unpleasant to think of your customer as a player, especially when that subject is an internal customer, such as your employees, co-workers, or even your supervisor/manager. Each situation is different and should be considered within its own context, so the designer of a gamification mechanic must decide how transparent the implementation should be. In other words, they must decide how much information about the mechanic should be exposed to the user. For a forum user who earns a higher post-count by participating, it may not matter that the intent behind the post-counting mechanic is to encourage forum users to post more frequently, thereby increasing the amount of content that is generated for free (and if the forum users were informed of this, it would be unlikely to change their behavior substantially). On the other hand, consider the potential fallout if a manager informed the staff that the purpose of their company's Employee of the Month program was to incite artificial competition thereby causing employees to expend more effort and work longer hours without costing the department more than a wooden plaque once per month.

In truth, certain implementations of the mechanics discussed here could be seen as manipulative or even coercive, and depending on the nature of the business, ethical concerns could come into play. It is beyond the scope of this paper to discuss the issues of user perception and ethics at a useful depth, but as with any business decision, it is important to consider the potential consequences (both direct and indirect). Consider also that individual perspectives can also paint gamification attempts in either a positive or negative light, regardless of the intent of the designer. In the Employee of the Month example above, a more humane (or tactful) manager could also truthfully say that the award allows for the recognition and reward of excellent employees and that such recognition is likely to lead to other rewards such as increases in pay and promotions.

5.2.2.2 The Risk of the Gamified Workplace

The potential human cost (in morale, productivity, turnover, etc.) can make internal gamification attempts a risky proposition. This is a very different environment from a game with millions of players where the developers often accept the risk of running tests that could potentially decrease the quality of the experience for some percentage of their player-base in order to find the better of two options. Though, luckily, it isn't necessary to split-test across the entire game population. To go even further, it is often the case that a change which makes the game worse for the vast majority of its players can still be seen as "positive" (from the perspective of the developer) if it increases the game's profitability. This situation is not at all rare in free-to-play games where majority of a game's revenue might come from a very small percentage of its player-base.

In addition to the potential human costs, there are also the practicalities of hiring that must be considered. In a game with a realistic target market of tens of millions of players, effectively "burning" (ruining the game for them, causing them to quit) a few thousand users might be an acceptable loss if the result is the further optimization of mechanics that affect the rest of the player-base. Essentially, if the cost of acquiring a similar number of users is less than the expected profit from the optimization, then it is a worthwhile loss. However, when considering the workplace, where the target market is the population of people qualified and willing to work in a position for a salary that the company is willing to pay, re-acquiring lost employees can be a very costly and time consuming process. Additionally, the smaller potential sample sizes and the longer testing cycles that would likely be required in a workplace setting would cause the optimization efforts to take longer and will involve far fewer data-points than would be found in a large-scale social game, making the process much more involved and risky. The key point here is that while the dramatic leaps of performance found in video games via optimization might be possible in the workplace, great care must be taken to mitigate the potential risks to the company.

5.3 Relevant Concepts from Behavioral Economics

Traditional economic theory relies on the concept of rationality, the idea that people are generally able to make decisions that are in their best interests (Ariely, 2008). However, there are some situations where people tend to act in ways that seem to be at odds with traditional economic rationality. To a large extent, the field of behavioral economics attempts to examine and explain various situations that seem to cause people to commonly display irrational behavior. Furthermore, these situations that lead to irrational behavior aren't random but can be engineered for studies and demonstrably predicted to occur in the wild, leading Ariely to describe people as *predictably irrational* (Ariely, 2008). This ties in closely with many gamification mechanics because many of the typical gamification techniques leverage (intentionally or not) people's tendency to act irrationally in response to certain situations or stimuli. By deliberately engineering certain elements, a gamification designer can potentially manipulate the behavior of a user, typically in order to achieve a certain business objective. A frank discussion of behavioral economics in terms of intentional user manipulation can, at times, sound malicious or at least distasteful. However, some of these mechanics are practically ubiquitous in today's society (for example, the practice of ending prices with the digit 9, as in $9.99 instead of $10.00 (Schindler, 2009)), making it useful to be aware of these concepts, even if one has no intention of using them personally.

5.3.1 Relevance

To select the concepts from behavioral economics that were most relevant to the games of today, lists of both these concepts and game mechanics were compared in order to map the motivations of each, attempting to find pairs with corresponding motivational triggers.

It should be noted that the presence of these concepts within a game should not necessarily imply that it was included to intentionally manipulate the players. Game design has evolved over time, with some conventions falling out of favor and others becoming increasingly entrenched. One could logically assume that the design conventions that achieved the desired results were retained while others were discarded. This evolution likely selected for many of the listed concepts even in cases where the designers in question were entirely unaware of the principles they themselves were making use of.

Listed below are nine concepts, further broken into three categories that mapped closely with frequently used types of game mechanics. Each concept is described briefly and accompanied by one or more general examples of a game mechanic utilizing similar motivations. Additionally, each of these is followed by one or more potential implementations of the mechanic in a workplace or non-game setting. This is in no way intended to be a complete list. The range of contexts and mechanics encompassed within the game industry is so vast that a comprehensive list could potentially include practically any cognitive bias. The selections were made based on the author's perception of their relevance and frequency of use (and of course, limited to some extent by the scope of this work), but there are certainly excellent arguments to be made for the inclusion of others.

5.3.2 Categorization

The concepts resulting from the selection process mentioned above were broken into five different categories based on the typical purpose or motivations behind their use. Most selections could incorporate multiple motivations and many types of potential implementations, so it would be justifiable to place the concepts in multiple categories. However, for the sake of length and clarity, an attempt was made to group them only in the category that seemed to fit best, based on the in-game uses of the concepts. A listing of the categories and a brief description follow.

Encouraging Engagement: The concepts listed here attempt to keep the player participating and returning to the game through either building obligation or preventing the sense of obligation from falling away. These mechanics can serve to increase a number of retention metrics, some effectively acting in a manner similar to a retargeting marketing campaign.

Guiding Action: The concepts listed in this category attempt to keep the player moving forward in the game, often by making clear what action should be taken, preventing decision fatigue from setting in. Many mechanics based on these concepts are meant to boost retention and session times, drawing players in, and imparting significance to in-game action and elements.

Identity Investment: These concepts help to build a player's sense of identity via the game. The players invest their thoughts and efforts into creating and achieving in a game, thereby developing some sense of ownership over the elements that they have interacted with. This can lead players to develop bonds with those elements, making them reluctant to abandon them, even if they would prefer not to play the game.

5.3.3 Concepts, Mechanics, Non-Game Uses, and Common Errors

5.3.3.1 Encouraging Engagement

Loss Aversion

Loss aversion is the tendency of the player to avoid losses or even chances at a loss. This tendency can be shown as irrationally strong when the aversion to loss overpowers a desire to acquire a disproportionate amount of gain (Kahneman & Tversky, 1984). This appears in a great many places within modern games and is often manifested in the form of the potential for lost opportunity.

In-Game Use

As mentioned, lost opportunity is one of the more common occurrences in games. Examples are often some form of chance at receiving an in-game reward. In context, this could be killing an enemy, completing a challenge, or playing another match versus a competitor. Other examples could include the loss of a reward and the materials invested based on a scheduling mechanic (harvesting a crop that the player has planted), losing the chance to purchase an item (either via a time-limited offer or a random shop mechanic), or even the risk of losing position on a leaderboard.

Non-Game Use

In a service or product, the risk of losing access to certain content or features can be used to promote action. This often occurs with demos and trial periods. Once a user has become accustomed to or reliant on a service or product, they could be much more likely to convert, either buying the product or subscribing to the service. Additionally, once they're signed up, the potential loss of the service makes cancelling a more difficult decision and increases the switching costs, making it harder for them to replace it with a competitor. Additionally, limited-time offers give the user an opportunity (usually for savings, but occasionally for special access) while simultaneously threatening to remove the opportunity if the user doesn't take advantage of it quickly.

Another way in which loss aversion appears is via the social ties that are formed in certain situations, such as the friends made while taking part in an organization, the relationships with coworkers made at a job, or even the customers encountered in the process of running a business. The potential loss of community and relationships can be a major factor in a user's or an employee's decision to leave a service or a job.

Common Errors

Common implementation errors include a reluctance to give users sufficient access to the service or product for them to value it enough to be concerned about losing it. This is evident in products and services without sufficient demonstrations or trial offerings. This also is apparent in cases where there are special offers, but the offers either don't seem attractive enough for the removal of the offer to be considered a loss or the users don't believe that the offer is really limited. An example might be a potential customer responding, "No thanks, I'll just wait until the next sale next week." In such cases, the users don't really have anything to lose. Another potential problem occurs when a business owner is reluctant to penalize users sufficiently enough to create a risk of loss. Many services with free offers likely give too much away in the interest of building a user base.

Maintaining Intrinsic Focus

This concept contends that the addition of a tangible reward to an activity previously performed for its own enjoyment replaces that enjoyment with a form of payment (Heyman & Ariely, 2004). This essentially turns an intrinsic motivation into an extrinsic one (Pink, 2009). A person might play a game because they find it fun, but if they were paid to play the same game, the original enjoyment would be largely replaced by the prospect of payment. This is very troublesome in video games because game designs frequently call for players to perform similar, repetitive actions in order to extract more playtime out of a given amount of content. It is a formidable design challenge to encourage a player to do this without the repetition beginning to feel like work.

In-Game Use

This concept is often implemented through the player being forced to repeatedly defeat very similar enemies or challenges for the purpose of driving progression in the game (often in order to gain experience points or currency). Games often attempt to disrupt (or at least mask) the repetitive nature by adding contextual variations to the encounters. These variations often take the form of altering the visual depiction of the enemies (while their appearance may be different, the encounters are often essentially identical) or having non-player characters send the player on a mission or quest while providing a snippet of narrative as a justification. However, when effectively done, these variations can help prevent the feeling that the players are "grinding" or "farming" content. Another manifestation of this is allowing players to purchase highly sought after items with in-game currency earned though a regular and predictable method. Instead of playing "for fun," the players are encouraged to "grind" for their currency if they want the prized item. Instead, providing a method to obtain the item via a form of randomness could help maintain the intrinsic quality of the experience.

One common criticism of microtransactions is the fear of the players' ability to spend money becoming more important than their skill or time invested into the game, effectively moving the motivator from intrinsic to extrinsic. This can be avoided to some extent by only allowing purchased bonuses to modify what the player has earned in-game, allowing the base of the effectiveness to remain in the realm of the intrinsic.

Non-Game Use

This concept can occur in any situation where a user is being rewarded for performing a desired behavior. A general defense would be only giving non-monetary rewards for the behavior, though even so, this can appear in something as simple as rewarding forum users for the number of posts they make (granting special access based on post-count, for example). Once users become accustomed to receiving a reward for a behavior, they may not continue the behavior once the reward is removed.

Following the in-game example, instead of allowing a user/employee to earn a reward through the repeated performance of an additional task, allow them a chance to win the reward. An example of this might be entering the user into a lottery each time an item is recycled. Even though the final reward might be monetary, being rewarded with a chance to win is psychologically removed from actual payment (even if the economic value of each entry is easily calculated).

Common Errors

In online communities, a commonly quoted ratio, 100-10-1 attempts to illustrate the ratio of users who consume (100 %), interact with (10 %), and create (1 %) content (Wilson, 2011). In an effort to encourage the behavior exhibited by the 1 %, community owners may attempt to incentivize that behavior in some way. However, those users already making up the 1 % are already exhibiting the desired behavior, so the encouragement attempts to draw the other users into participating as well. This is has the potential to drive away the users performing the activity with a high degree of quality and integrity because they felt intrinsically rewarded for doing so, replacing them with users who attempt to maximize the rewards they can extract (not an unreasonable expectation since the reward was what enticed them to participate). In short, it is replacing an altruistic behavior with one only done for payment.

Pseudocertainty

Pseudocertainty effect is present when someone makes a decision that treats an uncertain outcome as certain (Tversky & Kahneman, 1986). One implication of this concept is that normally risk-averse people can become risk-seeking when given the opportunity to gain a small chance at a large reward. Additionally, the value that they tend to place on the chance is often far greater than its actual economic value (Tversky & Kahneman, 1979).

In-Game Use

This is often used in games by giving players near constant chances at a reward. Random rewards are common in games, where you may defeat hundreds of enemies during a play session with each of them having a chance to reward the player with items or currency. Typically, there is a table of potential rewards, each with a certain chance to drop from a given encounter. Of course, the quality of these rewards is inversely proportional to the chance of the item appearing. Players are often given practically worthless items, while others are both incredibly rare and valuable. This can turn each encounter into a lottery or a pull of the slot machine handle, essentially setting up a potentially addictive intermittent reward schedule (Lee, Sturmey, & Fields, 2007).

This is also a very common mechanic in analog games such as collectable card games, where it typically takes the form of small packs of cards that must be purchased to play. Each pack has a certain number of cards, but the buyer has no way of knowing what cards are inside. Most are very common and not at all desirable, at least after forming a basic, usable collection. However, some are quite rare, making each pack a small gamble.

Non-Game Use

As in the recycling lottery example listed above, this type of mechanic can be used to incentivize any trackable behavior. For each performance of a desired behavior, enter the user into a periodic lottery. The prize doesn't need to be incredibly valuable to trigger the effect; it just needs to be large enough to be meaningful to the winning individual. The goal is to essentially enable a certain degree of uncertainty so that the users/employees will work to increase their chances. The fact that both the chances and the increases may be quite small is at the root of this cognitive bias. People will work to enhance their chances to an extent that is far out of proportion to the economically expected gain.

Common Errors

As with the intrinsic/extrinsic errors, enabling people to directly earn their rewards can cause problems. When "earning" a reward, people are much more likely to be cognizant of exactly how much gain they are getting from each unit of work provided. It is the introduction of uncertainty that short-circuits the logical analysis. Additionally, a reward system based on chance could still potentially run afoul of logical analysis if its rule set is too transparent or explained in a way that makes the motivational intent obvious.

5.3.3.2 Guiding Action

The Paradox of Choice

This is the concept that people almost universally see an increase in the number of available choices as a positive change even though making a choice becomes much more difficult as the number of choices increases. People tend to be fairly comfortable making a choice when presented with a relatively small number of options (between three different items, for example), but once that number increases beyond a certain limit, it is much easier to simply choose not to choose (Iyengar & Lepper, 2000).

In-Game Use

Even if unintentional, we can see increasingly limited choice in some games as they have progressed over time. Modern games often give the player a highly pre-defined, scripted experience, seemingly in imitation of a cinematic/theatrical experience. One may quibble with the design sensibilities of such games, but one upside to this is that players are actively pulled though the progression of the game. They have few meaningful choices to make, so they encounter little decision fatigue. The path forward is always clear and unambiguous, so less content is wasted (either by players quitting before finishing the game or by bypassing it, as could happen in a non-linear game).

Tutorials that guide the player though the beginning of a game are incredibly common, to the point of being expected. In open-world games, conspicuously marked non-player characters send players on simple quests, helping to ensure that there is never a question about what one should do next. Even achievements are structured to guide the player on to the next challenge. The less time a player spends deciding what to do, the less likely it is that the decision to stop playing comes up.

Non-Game Use

Similarly, in today's popular web services and social networks, it is common to have a very simple functional tutorial that walks a new user through setting up and using the service. The goal would be to help the player progress though the service's social loop as far as possible before having to make any difficult decisions. Similarly, some services use checklists and scores to guide new users along the preferred paths. Even when not rigidly enforced by a tutorial process, if a checklist is readily available, following it can often serve as the path of least resistance that a user can default to if lost or unsure of what to do next.

Sometimes a service or product may be quite complex, making this simplifying process seem untenable. However, the rigid tutorial path is really a mechanic that exposes complexity gradually. If complexity is actually required, it may be beneficial to only allow a user to access the various features one at a time until some level of knowledge or proficiency is reached. Additionally, presenting the user with only a small selection of possibilities is applicable almost any time a product or service is offered for sale. (In-game item shops could often benefit from learning this lesson!)

Common Errors

The most common errors here are simply dropping an inexperienced user into a product or shop with a dizzying array of options. In a shop (physical or online), it is advisable to offer as few items of a given type as possible and to ensure that the differences between the items are clear and unambiguous. Similarly, complex tools may need simplified views or robust tutorials to prevent novice users from being overwhelmed.

Scarcity/Urgency

When an item is seen as having limited availability or when the time to act is similarly limited, people irrationally value the object in question (Cialdini, 2006).

In-Game Use

Scarcity often appears in games via rarity of items. The items may be theoretically infinite in supply, but if there is only an infinitesimal chance of the item appearing at a given chance, it can effectively be quite rare and valuable. Additionally, layers of scarcity can rest atop one another as a means of increasing tension. An example could be a particular enemy who is very rare who has a similarly low chance of rewarding the player with a special item when defeated.

Scarcity of opportunity should also be considered. A player who is only allowed to undertake a certain number of missions per day is likely to undertake more missions on average than if there were no limit at all (assuming that the arbitrary limit is appropriate). Similarly, if a player is planting crops but only has a limited number of slots in which crops can be placed, the player is very likely to plant as many plants as possible. Urgency will also drive a player to attempt to capitalize on as many opportunities as possible in a given time period.

Multiplayer games are of special note here. When competing with other players, it is possible to make practically all resources scarce and their accumulation urgent. When players perceive that competition exists (even when the only competition is indirect), they often are driven to accumulate resources far beyond what they would otherwise deem necessary or desirable in order to prevent the competition from benefiting.

Non-Game Use

It is possible to introduce scarcity or urgency through the use of limited editions or with a limited-time offer. As an additional bonus, limited editions often have the ability to sell at a premium price. As with games, scarcity of opportunity can be introduced by only allowing users to take a certain number of actions per day. If a social network wanted to encourage messaging, it might limit the number of posts one could make per day, thus ensuring that users would want to make the most of their scarce posting slots. A new service might launch as invite-only to create a scarcity of availability. Then it could offer a limited number of invites to its userbase, who would be encouraged by their scarcity to invite others.

Introducing competition among customers or employees may seem counterintuitive, and it should likely be done with a certain amount of caution. However, a common way of doing so is via contests where people compete with each other, likely performing a valuable activity, with the most effective participant winning a meaningful award. The effect can be amplified with tight time limits, ensuring that the participants are acting under the effects of urgency.

Common Errors

Introducing scarcity or urgency in a way that appears excessively contrived or outright deceptive seems fairly common in these attempts, and this can backfire. On the other hand, the more common error may be not imposing any scarcity or urgency at all. Prospective buyers often want to be left to "just think about it for a little while." However, if a user feels no impetus to act upon first seeing an offer, the chances are that additional time will move the subject farther and farther from the transaction.

Variable Reinforcement Schedules

A variable reinforcement schedule rewards a user for a certain action or behavior, but does so in an irregular pattern. This causes the user to know that the action occasionally leads to a reward, but it prevents the user from knowing what, if any, pattern is behind the decision. This makes the reward mechanism largely a black box to the user and introduces a situation where the only variable that the user can control is the frequency of the action (naturally leading to a dramatic increase in the desire to perform the action) (Lee et al., 2007).

In-Game Use

This mechanic is incredibly common in the game industry, existing in some form in almost every game that allows players to receive rewards. One of the most direct implementations is the typical reward received from defeating an enemy. These normally have some random element associated with the reward they offer, making each kill a mini-lottery. There are a myriad of other implementations using this mechanic, being present in practically any feature that relies on randomly generated results. Even an individual attack within a combat can display these properties, as the success of an attack is often determined by chance (sometimes with a small chance to do extra damage, which is often accompanied by reward audio/visual feedback).

It should be noted that the “randomness” mentioned is typically more of a weighted distribution of outcomes and can, at times, be entirely predetermined. However, the key issue isn’t the randomness. The important issue is that the player remains unaware of the exact mechanism being used (especially if the mechanic is *not* randomness).

Non-Game Use

In a workplace setting, this could manifest itself in the form of bonuses or positive feedback distributed on some schedule that isn’t obvious to the employees. This type of reinforcement also presents itself naturally in some settings, such as user comments or feedback. Additionally, a product or service could create reminders or notifications that are sent to users at certain intervals, either with encouraging feedback or rewards.

Common Errors

A common error here would be a lack of planning for the introduction of a variable reinforcement schedule to any aspect of a business. Stability and consistency are seen as generally valuable traits in an environment, so workplaces seem eager to eliminate anything seen as unpredictable. However valuable they may be, consistency and predictability don’t seem like tremendous motivators.

5.3.3.3 Identity Investment

Commitment

Commitment is the concept that people tend to want to fulfill agreements that they have made in order to avoid the cognitive dissonance that occurs when breaking these commitments (Cialdini, 2006). The utility of this can be illustrated by asking users for a commitment to perform an action at a later time (which is easier to agree to than asking for immediate compliance, likely due to hyperbolic discounting) and then comparing compliance rates when the agreed upon time comes with the immediate compliance rates of a control group. This tendency to avoidance cognitive dissonance is further manifested when asking users to comply with a further request, increasingly the likelihood of compliance with each successive request.

In-Game Use

One of the most direct implementations of commitment is via the use of appointment mechanics recently popularized with social games. In these mechanics, a player might plant a crop or begin construction on a building, with the understanding that the growth or construction will complete at a certain time in the future. These times typically start quite low, at only a few minutes, encouraging the player to return to the game for frequent, short sessions. This can be very habit-forming due to the repetitive nature of the activities and because each time a player returns, the fulfillment of another commitment is registered, reinforcing the player's identity as a player of the game in question. Eventually, the timers extend, keeping the repetitiveness from becoming too extreme while at the same time, offering the player a feeling of progression, as now the full benefit of the mechanic can be achieved in only one session per day. However, the optimum session frequency is often kept at one day in order to maintain the habit by allowing it to conveniently fit within one's daily routine.

Additionally, multiplayer games make use of this though periodic events that required the simultaneous cooperation of multiple players to complete. This forces the players to self-organize, essentially making social commitments to each other. The commitment elicited increases as the required player skill and progression for the successful completion of the event increases due to the increased difficulty of finding replacement participants.

It's also worth mentioning that any tiered progression with rewards for advancement (even if the rewards are only feedback-based) can act to support commitment by helping to establish that the player is a person who is successful at progression in the game. Though it sounds a bit circular, with each successful step in a game's progression, the player is tacitly committing to continue playing (as with the increased compliance with multiple requests mentioned above).

Non-Game Use

This can be leveraged in non-game setting in a similar fashion by allowing people to commit themselves to a desired action at a future date, incentivizing them to do so with discounts or initial periods of reduced cost. Additionally, allowing the user to set certain appointments within the scope of the product can assist in retention. For example, a user might be able to choose which day a monthly charge should occur on, causing the arrival of the charge to be an action the user specifically scheduled. A user may also choose how or when notifications and reminders are sent, making their interruption more acceptable.

In terms of commitment increases, a user could be introduced to a product or service in a manner that is very low risk and potentially highly beneficial. For example, the user could be prompted to sign up to a newsletter containing valuable information. This is both quick and free for the user, making it an easy first commitment to make. Additional requests for compliance could gradually increase the cost of the commitment.

Enabling commitments between users or between employees of the company and the users can add the element of social commitment to a product or service as well. A company could offer free training webinars, instructing users on how to get the most out of their product. These webinars, while free, might only occur periodically and could require prior registration, creating a scheduling commitment. To further add social commitment, these events could be invitation only, with each existing customer receiving a limited number of invitations for their friends. This would allow them to give something valuable to their friends, who would then have a reciprocal commitment to attend.

Common Errors

The most common errors that businesses make in this area consist of only making one request from potential users and making that request at the very beginning of the relationship. At this point, it is incredibly easy for a user to end the relationship before it even begins. As a first step in avoiding this problem, businesses often entice users with trial periods, which is certainly a step in the right direction, but that carries a different psychological effect. Labeling an offer as a “trial” implies that the user will decide if they want the product at a later time, giving them an option to opt out without the corresponding cognitive dissonance. However, enabling the users to commit now and pay later can trigger the commitment effect even if they aren’t contractually obligated to continue the service after the introductory period.

IKEA Effect

The *IKEA effect* is Dan Ariely’s term for the concept that one’s valuation of an item is disproportionately increased by the personal labor one has invested into its creation (Ariely, 2010). By investing one’s time and effort creating something (and likely expending a considerable amount of cognitive energy making decisions during this process), people tend to develop an emotional attachment to the creation, causing them to value it much more than would be justifiable by the creation's actual economic value.

In-Game Use

This is highly relevant in many types of games, but none more so than persistent, online games. The persistence of online games along with the ability to share the experience with other people adds a sense of permanence to a player's creative efforts that typically exceeds the importance of creations found in other types of games.

It is common in many modern games to be able to create an avatar through which the game world is experienced. Avatar creation and customization can, at times, be incredibly complex and in-depth. While the process of doing so may be a slight barrier to entry, the resulting creation is one that the player can feel a great deal of ownership over. Additionally, many games are based around the advancement and progression of this avatar. Players may literally invest thousands (or even tens of thousands of hours in extreme cases) of hours of their time into the progression of their in-game avatars. This can obviously become a significant commitment on the part of the player, holding a great deal of personal value, even if the economic value is negligible.

Customizations and progress apart from an avatar are also relevant here. The ability of players to customize their environment is present in many games, giving the player some control over the world that their avatar inhabits. This can take the form of player housing or even simply the ability to place decorative flowers in a field. Some players are willing to spend vast amounts of time and effort customizing their environment to their preferences.

In-game pets are also worth mentioning here. Non-player characters within a game that take the form of a player's pet (often in the form traditional pet, such as a cat or a dog, but sometimes being very non-traditional and context based) can elicit strong bonds from a player. This is naturally amplified as the opportunities to customize and advance the pet increase.

Non-Game Use

In non-game settings, the obvious example is to follow the IKEA model of requiring some amount of choice in the selection of items and some further amount of assembly in order to garner an investment of time and effort from the user. However, non-game settings can also use the concept of online persistence and avatar customization. Almost any online product or service could potentially benefit from allowing users and their creations to be visible to one another in some way. Once visibility is possible, users have an extra incentive to spend time crafting their online presence and acquiring or developing any items that other users may encounter. Additionally, methods to advance or progress this online presence can be incorporated (unlocking additional features or access, for example).

The value of customizing an environment can easily carry over to a physical setting as well. If employees are given latitude or even encouraged to heavily customize their workspace, it could seem considerably more valuable to them than a very generic space. Additionally, if customization options exist in a product or service and are utilized by the users, this could raise significant switching costs, deterring users from swapping to a competitor.

Incorporating virtual pets into non-game settings may not be commonplace, but humans' tendency to become quickly attached to pets could make such attempts worthwhile. It's also worth noting that some offices have introduced pro-pet policies to great effect.

Common Errors

The most common error here is simply not providing sufficient opportunities for users to invest time and effort into customization or progression. However, when offering options of this nature, it is useful to consider whether or not the options are actually meaningful. A myriad of superficial decisions that don't make a substantial impact on a user's experience could easily drive people away.

Mass customization isn't for everyone, and some users won't want to invest the time and effort to do so until they are more familiar with a product or service. It can be beneficial to provide a solid set of default options and a few sets of pre-defined options to select from. Also, emphasizing that the customizations can be easily altered at a later point can remove some of the pressure from new users.

Sunk Costs

The concept of sunk costs implies that even though money or effort invested in the past has no bearing on future decisions, these past investments still carry significant weight when considering those decisions (Arkes & Blumer, 1985). This may overlap with the *IKEA effect* to some degree but differs in the motivations behind the concept, with sunk costs creating more of a feeling of obligation than of value.

In-Game Use

Many elements within games can trigger the sunk cost effect. As with the IKEA effect, these elements are most pronounced within persistent, online games for similar reasons. Players often spend great amounts of time and effort on in-game progression and achievements, creating a sense of obligation to continue playing the game even once the enjoyment has vanished. Players can feel like all of their previous time and energy has been wasted if they abandon their current game for a new one. Additionally, these games often encourage, or even require, the creation of social bonds with other players in order to progress past a certain point. Players can find it incredibly difficult to leave their friends and communities behind, often remaining an active user of a game simply to maintain the social ties. These aspects of persistent, online games lead to the potential for them to have very long lives and low churn-rates.

An additional manifestation of sunk costs within games is the development of mastery. In addition to progression through content, players may also have a significant feeling of progression their personal skill level. Some games can be quite complex, requiring a great amount of time and effort to simply learn to play the game at a high level. Once a player is accustomed to possessing a certain level of mastery in a particular game, the idea of beginning a new game, having to start from scratch and go through the long learning process again, can be incredibly daunting.

Non-Game Use

One way to enable the sunk cost effect to users is to again introduce some aspect of advancement or progression. However, unlike the IKEA effect, the point isn't to enable the feeling of ownership, it is to increase the potential switching costs involved in changing to a competitor. The more that the user feels that time and effort would be wasted upon discontinuing the service the less likely it will be. Building the opportunity for deep levels of progression can aid in this, as can gradually increasing the complexity. By acclimating to the increasing complexity over time, the learning curve is kept low enough that it doesn't push members away, but once it reaches a certain point, the idea of learning to replicate all of the desired functionality on an entirely new service can be overwhelming. In some cases, it can even be difficult to find out if all of the desired results are possible with another service. Additionally, enabling a community within the product or service can aid in this much in the same way as it does in-game.

An equivalent to in-game progression could be the storing or creation of content within a service or product, for example, uploading years of photos or contact information to a particular service. This service could dramatically increase switching costs by making this content difficult to move to a new service.

Common Errors

Common error here would be not providing the opportunity for progression or community ties of sufficient depth to trigger the feelings of obligation and wasted effort when considering leaving. It seems common for companies to add various progression or community features at a very superficial level, possibly in order to simply expand the feature-set on offer, without enough depth for players to find them meaningful.

5.4 Common Pitfalls

5.4.1 Implementation Errors

Errors of implementation are typically less serious than their counterparts listed below. They are often noticed with the gamification attempt in question simply isn't working. There could be countless potential errors here depending on the specific type of implementation being attempted. However, some common problems could include:

- Rewards that aren't meaningful to the users
- Obviously false or manipulative scarcity/urgency
- Excessive or irrelevant choices
- Allowing users to earn rewards (turning intrinsic behavior extrinsic)
- Aggressive or unwanted use of social sharing features

Regardless of the error, implementation problems can typically be identified and improved via split-testing and optimization. Occasionally, an error here can significantly damage the performance or reputation of company, but that's more likely an error stemming from insufficient testing than any specific gamification issue gone awry.

5.4.2 Design Errors

Design errors, on the other hand, can be particularly insidious, often stemming from a high-level problem with the company's strategy. As with many problems in business, a common source is the prioritization of short-term, financial results over the long-term sustainability of the business or project.

These errors often take the form of incentivizing the wrong behavior. Consider the simple (and not uncommon) example of a website wanting to increase the number of page-views in order to increase ad revenue. They might make an attempt to introduce a gamification mechanic that rewards the writers on the number of page views garnered. However, this plan may hinge on the leadership assuming that higher quality articles get more page-views, which could be an entirely faulty assumption. Writers, eagerly responding to the incentives, will likely attempt a number of strategies to increase their performance, obviously keeping the successful ones. Some successful ways of increasing views might include publishing a large volume of short, low-quality articles, using multiple pages or slideshows when unnecessary, or using excessively inflammatory or controversial titles in order to draw clicks from users who ultimately leave disappointed. These tactics may drive page views, but they may not take the web site in the direction that its management had envisioned.

The danger of starting with an erroneous gamification design is that your plan just might succeed. With the potential for optimization and split-testing to be so incredibly effective, if you want to increase a certain metric, you must be very sure that it is in your best interest to do so. Otherwise, your optimization efforts could lead to a destructive cycle where you could literally optimize your company out of business!

5.4.3 Assumption of Universal Applicability

A final problem that is somewhat different in character than the others is the assumption of universal applicability. Simply stated, this is the failure to realize that people can be very different and can react to a given situation in very different ways. It is very likely that some (if not all) of the previously discussed concepts and implementations elicit very different results from different types of people. However, it seems quite common (especially in the video game industry) for features (and even entire games, on occasion) to be copied wholesale. Just because one company is presumably achieving positive results with one feature in one game with one set of players does not mean that this success will automatically readily transfer to a different game by a different company with a different set of players. Though it may seem obvious, it bears mentioning based on the feature sets of many games on the market today.

5.5 Conclusion

5.5.1 Implications

Discussed above are a number of potentially powerful concepts, and typical businesses and game studios are likely using some of them on a day-to-day basis in both their products and their management processes without even realizing it. They turn out to be, as often as not, less a new tool in the management toolbox and more of an explanation about how your existing tools actually work. Even though gamification has gotten a great deal of attention recently and always seems to be a target for controversy, our lives are all gamified to some degree. Gamification in some form is likely to be an increasingly important factor in the direction and the formation of the world around us, so it behooves us to try and understand what's really happening inside the black box.

From a very general perspective, it would be useful for practically everyone to become familiar with the basic techniques of gamification, if for no other reason than for the awareness of the many different ways that outside parties might affect one's behavior. From the position of someone hoping to make use of gamification, whether in business or academia, developing an understanding of how these techniques work is key to making the best use of their effects, regardless of what the intended result may be.

Taking this a bit further, anyone in a position that reasonably calls for them to affect change in another person's behavior or knowledge stands to benefit from the well-considered use of some of the techniques mentioned in this paper. However, when trying to initiate a behavior modification, caution should always be exercised, as unintended (and often unfortunate) consequences are a frequent occurrence. The key to the effective design and implementation of these mechanics lies in understanding what exactly is being incentivized and what the long-term results will be.

5.5.2 Future Work

An area that currently seems lacking in the knowledge base of both gamification and behavioral economics is a thorough analysis of the affects of each on various segments of the population. With the advent of modern data-mining tools, segmentation itself is an increasingly useful concept, and combining this with a large-scale database of gamification and behavioral economics data could provide incredibly valuable insights. As a simple example, we might find the optimal number of choices that could be given to each segment of the population in a particular situation, which could potentially lead to improvements in practically all online shops. In addition to the typical demographic and economic population segments, it could also be useful to study these effects on segments based on personality type, market preferences, or even segments selected via data-mining for concentration of effect.

Additionally, as discussed earlier in this paper, when compared to the possibilities in consumer gamification, there are considerable difficulties in developing testing techniques that can be as effective in many enterprise applications, which are often geared towards some type of internal customer. It could be very beneficial to these enterprise attempts to explore how these difficulties could be overcome, most notably those of scale and test cycle times.

References

Ariely, D. (2008). *Predictably irrational: The hidden forces that shape our decisions*. New York: Harper Collins.

Ariely, D. (2010). *The upside of irrationality: The unexpected benefits of defying logic at work and at home*. New York: Harper Collins.

Arkes, H., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Process, 35*, 124–140.

Cialdini, R. B. (2006). *Influence: The psychology of persuasion*. New York: Harper Business.

Heyman, J., & Ariely, D. (2004). Effort for payment: A tale of two markets. *Psychological Science, 15*(11), 787–793.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology, 79*(6), 995–1006.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist, 39*(4), 341–350.

Lee, R., Sturmey, P., & Fields, L. (2007). Schedule-induced and operant mechanisms that influence response variability: A review and implications for future investigations. *The Psychological Record, 57*(3), A7.

Pink, D. H. (2009). *Drive: The surprising truth about what motivates us*. New York: Riverhead Books.

Schindler, R. M. (2009). Patterns of price endings used in U.S. and Japanese price advertising. *International Marketing Review, 26*(1), 17–29.

Tversky, A., & Kahneman, D. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–292.

Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *The Journal of Business, 59*, S251–S278.

Wilson, F. (2011). Don't forget your logged out users. Retrieved January 31, 2014 from http://www.avc.com/a_vc/2011/06/dont-forget-your-logged-out-users.html.

Chapter 6
Towards Leveraging Behavioral Economics in Mobile Application Design

Tobias Stockinger, Marion Koelle, Patrick Lindemann, Matthias Kranz, Stefan Diewald, Andreas Möller, and Luis Roalter

6.1 Introduction

Humans tend to believe that their actions are mostly rational and justifiable. However, psychology research from the last 40 years has produced a growing list of cognitive biases which impact our rationality. Cognitive biases affect all humans and lead to deviations in judgment regarding decision making about people or situations (Haselton, Nettle, & Andrews, 2005). Even the sheer belief that oneself does not show as many biases as other people is a cognitive bias (Pronin & Kugler, 2007). Most biases are usually harmless and do not affect mental health. However, some of them *do* become dangerous and reduce life quality, because cognitive biases can influence how we perceive e.g. stress, addictions or depression (Muran & Motta, 1993). Thus, in this chapter we argue that even reflecting on the more harmless cognitive biases might help us develop different behavior and eventually lead to an improved life.

T. Stockinger (✉) • M. Koelle • P. Lindemann • M. Kranz
University of Passau, Innstr. 43, 94032 Passau, Germany
e-mail: tobias.stockinger@uni-passau.de; marion.koelle@uni-passau.de; patrick.lindemann@uni-passau.de; matthias.kranz@uni-passau.de

S. Diewald • A. Möller • L. Roalter
Distributed Multimodal Interaction Group, Technische Universität München, Arcisstr. 21, 80333 Munich, Germany
e-mail: stefan.diewald@tum.de; andreas.moeller@tum.de; roalter@tum.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_6

6.1.1 Observations of Irrationality in Everyday HCI

Behavioral Economics (BE) is a rather novel field when applied to Human-Computer Interaction (HCI). In this chapter, we present a selected set of applications to highlight new opportunities that arise from this research direction. Designing for bounded rationality is a real challenge that we are only beginning to undertake. Yet, in interaction design we sometimes encounter situations in which designers cannot comprehend the users' behavior entirely. Norman (2007) emphasizes findings from Tractinsky (1997) showing the following: User interfaces that only differ in aesthetics, but not in functionality or number of elements, appear to be *easier to use* if they were only designed in a more beautiful way. Their studies evaluated multiple ATM designs with identical functionality. The subjects were blinded by the more beautiful layout which lead them to assess the general usability of the ATM higher. One could argue that this is a somewhat irrational judgment. Consequently, we can conclude from those findings that irrationality is not just the outcome of our inclination to act intuitively without further reflection (Kahneman, 2011, p. 96), but also results from emotion. More examples of apparent bounded rationality follow.

6.1.1.1 Notifications

In both desktop and mobile applications we often can opt to get notified on certain events: incoming emails, tweets and Facebook status updates, changes in a shared Dropbox folder or reminders for an upcoming football match in a calendar application are just a few examples of everyday notifications. Some of them are even "opt-out", meaning they are turned on by default and require user interaction to get rid of them. The problem is that activating many notification services disrupts people's work flow and distracts them very often. One question that we like to pose in this matter is: why do people believe that notifications are beneficial when in fact notifications are an enemy of productivity and concentration?

6.1.1.2 Progress Bars

From time to time, working with computers requires a waiting time during which progress bars give feedback of the current system status. This is in line with Nielsen's usability heuristics (Nielsen & Molich, 1990). However, is it not somewhat strange that many of us observe such progress bars even if they take more than just a few seconds? One could easily switch to another task. Hurter, Girouard, Riche, and Plaisant (2011) tried to augment progress bars with temporary tasks, such as tagging pictures in a media library. The need for progress bars could be explained with mental accounting theory (see Sect. 6.3.1).

6.1.1.3 App Return Policy

The Google Play Store has a 15 min return policy for paid Android apps[1] Theories from behavioral economics indicate that it is very unlikely that users decide on this refunding option, because it is difficult to return something once we have it (Ariely, Huber, & Wertenbroch, 2005; Kahneman & Tversky, 1979). Behavioral economists call this the *endowment effect* combined with *loss aversion* (more details in Sect. 6.3.2).

6.1.1.4 Computer Help

Being an expert in computer science (or simply having such reputation) eventually leads to phone calls asking for computer help ("*Can you fix this?*", "*I don't know how to set up my printer, can you do this the next time you're here?*"). However, novice users sometimes seem to forget that a little exercise and online research might eventually do the trick. They are biased by their own beliefs that they cannot achieve their goals. Once they fail, they attribute that failure more easily to their lack of knowledge. Psychologists call this the *confirmation bias* (Kahneman, 2011, pp. 81–82). In other words, people jump to conclusions very quickly if they find the slightest evidence supporting their attitude.

6.1.2 Chapter Overview

In the following section (Sect. 6.1.3), we clearly formulate the contributions of this chapter in the area of behavioral economics in HCI. In Sect. 6.2 we provide a review of related research and findings from the fields that are most relevant for this work: Persuasive Computing (Sect. 6.2.1), Gamification in mobile applications (Sect. 6.2.2) and our main topic Behavioral Economics (Sect. 6.2.3). Having discussed the theoretical aspects of our propositions, we present our prototypical "MoneySaver" app in more detail before we report and discuss its evaluation (Sects. 6.5 and 6.5.3). Finally, we conclude by summarizing the presented ideas and by giving an outlook to our future work (Sect. 6.6).

6.1.3 Contribution

In this book chapter, we contribute a thorough review of behavioral economics theories and their potential applicability to HCI in a mostly mobile scenario. We analyze allegedly irrational human behavior while using mobile applications. Based on this

[1] https://support.google.com/googleplay/answer/134336?hl=en, last accessed on August 06 2013.

analysis, we demonstrate how to implement paradigms from behavioral economics to create persuasive, gamified applications. Furthermore, we elaborate on the design rationale for financial planning apps.

Persuasive systems often assume that their users act rationally. This assumption leads to the design of triggers to which rational people might respond. However, we argue that persuasive computing needs to address the quirks of the human mind including irrational behavior and biases in cognition. Applying BE to HCI leads to a more holistic approach to persuasion methods. Not only is it possible to motivate long-term behavior change. We also are able to foster irrational behavior without wanting to turning it into rational behavior, never forgetting to design for the benefit of users. The simplest example for this effect are defaults. Designers do not want users to change the proposed parameters, i.e. the users can keep up with their behavior by following the default. We try to further illustrate the divergence between our work and traditional persuasive computing in the remainder of this chapter.

6.2 Literature Review

It is possible to categorize our work under persuasive computing. However, we add further elements from gamification and behavioral economics to generate a new idea of contemporary persuasive technology. In this section, we review related work in the corresponding fields to lay the basis for our research direction.

6.2.1 Persuasive Computing

Persuasive computing has had a long history and manifests in many dimensions. Back in 2002, Fogg became a vanguard to address persuasion through computers to nudge users towards a specific behavior. He defines persuasive technology "*as any interactive computing system designed to change people's attitudes or behaviors*" (Fogg, 2002, p. 1). Ever since then, many forms of persuasive systems have emerged. Such systems can motivate behavior change for the users' own good, e.g. in health and fitness ("self shaping" (Consolvo, Everitt, Smith, & Landay, 2006; Moraveji, Akasaka, Pea, & Fogg, 2011) or security (Maurer, De Luca, & Stockinger, 2011). Besides, other persuasive systems also nudge users to act more environmentally friendly (Meschtscherjakov, Wilfinger, Scherndl, & Tscheligi, 2009). Sometimes it is the same systems that use gamification to become more persuasive (further examples in Sect. 6.2.2).

Researchers have been trying to motivate behavior change for the benefit of the users. For example, Consolvo, McDonald, and Landay (2009) elaborated a set of design goals for Ubiquitous Computing (UbiComp) systems with the intention to help the users maintain a physically active lifestyle. They, too, relied on theories from psychology, such as the *Goal Setting Theory* and the *Cognitive Dissonance Theory*, to generate new design strategies. In a long-term experiment they report on their UbiFit Garden, a visualization of the user's physical activity measured through a fitness device, which could also be classified into a gamified mobile app. Their results indicate that such mobile systems were successful in motivating behavior change. Although their studies were carried out over 3 months, the long-term effects of this kind of persuasion remain questionable. Thus, such findings make way for further research using some of the proposed design strategies.

Some other, non-gamified persuasive systems, which intend to create benefits for the users, rely on subtle clues to nudge their users to a certain behavior. For example, Maurer et al. (2011) developed a system to subtly raise awareness of the SSL-encryption status of a website and thereby nudged people to act more cautiously in those situations. The SSLPersonas indicated the SSL status through changing the browser's skin when there is an active or broken SSL connection. In a long-term field study, they gathered evidence that such visualization methods are sufficient to fundamentally change the way people use the Internet.

An exemplary persuasive system, that engages for a greater goal than one's own, is UbiGreen by Froehlich et al. (2009) and Froehlich, Findlater, and Landay (2010). This mobile application semi-automatically tracks individual transport behavior. Also, it displays engaging imagery and context-based information to encourage the user to choose "green transportation" more often. Their qualitative results from the corresponding field studies indicate a positive user acceptance. However, the papers date back to 2009, respectively 2010. The researchers could not yet rely on smartphones as we know them today, which have become very powerful computing devices. In the very fast-paced area of mobile devices, the current state-of-the-art mobile technology could deliver further insights on green transportation behavior, because smartphones have drastically gained momentum since then. This leaves room for additional research in this area, which is already undertaken by various research groups.

Opposed to the systems described above, some persuasive systems go further such that they explicitly communicate their persuasive nature, almost as saying "we are here to help you change your behavior, because you should". "Commitment devices" fall into that category because they act as an external watchman to motivate self-discipline. Yet, Moraveji et al. (2011) mention an important concept which one must bear in mind when designing commitment devices: Users tend to attribute successful behavior changes mostly to their own self-discipline—and not to the tools that helped them with this achievement (*Fundamental Attribution Error* (Ross, 1977, p. 184ff)). This implies that it takes a high degree of self-reflection to acknowledge that a persuasive system has succeeded. Another persuasion bias comes into play when we take a look at interface design. Nice-looking graphical user interfaces (GUIs) are more likely to be perceived as usable (Norman, 2007; Tr actinsky, 1997) than their less stylish counterparts. Therefore, they seem to *persuade* people to use them instead of others. As a consequence, the designers of persuasive systems need to make strong efforts on their aesthetics to amplify persuasion.

In some aspects, our work differs from persuasive computing as it is generally understood to this point. Opposed to the notion that persuasive technology targets a change in people's attitudes or behavior, we focus on the reassurance and amplification of certain behavior. Hereby, we anticipate anomalies and biases in the users' actions and use them for the users' benefit. However, there is not necessarily an implied intention to motivate a change in those actions or attitudes as persuasive computing would try.

6.2.2 Gamification in Mobile Applications

First of all, we would like to shed light on the characteristics of gamification. Most often, one finds gamification to be "the use of game design elements in non-game context" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 10). Marczewski (2012) augments this description with the intentions behind gamification:

> "[Gamfication is] the application of gaming metaphors to real life tasks to influence behavior, improve motivation and enhance engagement." (Marczewski, 2012, p. 4)

From this definition, we can see that behavioral change appears to be a trait that persuasive computing and gamification share. The discriminatory power between persuasive systems and gamification is, therefore, very low. One might even say that gamified services are persuasive per se, which we are about to illustrate in this section.

The past decade, gamification has slowly started to intrigue both researchers and practitioners and it was not until 2010[2] that it has become a kind of buzz-word (Zichermann & Cunningham, 2011). In this section we take a quick look at the domains in which gamification is applied at the time of writing this chapter.[3]

6.2.2.1 Training and Exploration

A first theme that we found while reviewing relevant literature is training and (guided) exploration. Reading a manual is often cumbersome and time-consuming. However, using a particular feature-loaded device, like an in-car entertainment system, requires the user to quarrel with printed instructions, which may often decrease the user experience. Therefore, gamification appears to help in this kind of situations as suggested, for example by Diewald, Möller, Roalter, and Kranz (2012). They propose a novel way to increase the readiness to explore natural user

[2] http://www.google.com/trends/explore?q=gamification, last accessed on August 8 2013.

[3] Extrapolating the Google Trends Page for "Gamification" leaves us to believe that gamification will have an impact on even more domains in the future.

interfaces (NUI) in an automotive context. To achieve a certain user behavior, badges and level-ups are awarded on certain occasions without distracting the driver from the road. This approach is comparable to other tactics found in, e.g., Foursquare[4] and similar services. A second example for gamification in exploration is the OrientationPassport by Fitz-Walter, Tjondronegoro, and Wyeth (2011). It is a smartphone application targeted at students who are new to a university campus. It is not uncommon for universities to welcome their new students by organizing guided tours and distributing informative material to help them get around more quickly. The orientation passport application supports this initiation phase by engaging freshmen to explore the campus site and public transport system. Badges are awarded for certain activities, e.g. checking into certain events through the app. Preliminary results show that the design concept adds value to existing orientation phases but the chosen incentives were not entirely successful.

6.2.2.2 Self Shaping

Gamification is believed to be a strong motivator, because humans like competing, winning and comparing. Therefore, individual sports like jogging can also profit from such elements. That is why there are a few dozen gamified applications that target sports activities. Endomondo[5], Runtastic[6], Nike+[7] (just to name a few) all offer the users to track and compare their data with others. Some of those apps propose challenges to the (hobbyist) athletes to boost intrinsic motivation. With most apps, it is also possible to compare one's own achievements to those of friends for the same reason.

Other commercial apps take the users outside and reward - through gamification - physical activity in a more subtle way, i.e. the primary intention of those apps is not physical activity per se. Geocaching[8] is a classic example that falls into this category, while Ingress[9] is a very recent manifestation of an app that simply brings along physical activity. It is a location-based game that needs the users to walk around town to be able to play the game.

6.2.2.3 Research

Conducting HCI research requires testing with people. For user study participants, taking part often entails deliberately spending time in laboratories along with only moderate compensation. Testing prototypes in the field for research purposes is not

[4] https://foursquare.com/, last accessed on September 19 2013.

[5] http://www.endomondo.com/, last accessed on September 05 2013.

[6] http://www.runtastic.com/, last accessed on September 05 2013.

[7] http://nikeplus.nike.com, last accessed on September 05 2013.

[8] http://www.geocaching.com/, last accessed August 8 2013.

[9] http://www.ingress.com/, last accessed August 8 2013.

trivial either for similar reasons. A possible solution would be to recruit people by giving them ‘something to play’, i.e. exploiting gamification of research participation. One could call this a *meta-layer* for gamification research. Such an approach was undertaken by Kranz, Murmann, & Michahelles (2013). Their research topic was the large-scale acceptance of Near-Field Communication (NFC) applications among smartphone users. The researchers developed and deployed a game in the Google Play Store to investigate NFC adoption.

6.2.2.4 Education

Beside the need to physically shape oneself, gamification drives both self-education and knowledge transfer. In a mobile computing context, we can observe how certain apps utilize gamification to foster learning and exercising. For instance, DuoLingo[10] awards badges for successfully accomplished lessons. Also, it gradually reveals more lessons as the user earns points to unlock higher levels (which in fact are language-skill levels). Gamification here keeps the learners motivated and thus helps them get to their goal more comfortably. The “Read Faster” application, as the name suggests, trains reading skills. It uses scored exercises that resemble a competition against the clock. If one completes a set of exercises, bonus training sets are unlocked. Figure 6.1 shows screenshots of those two apps that reveal their gamified nature. Applications for gamification in knowledge transfer contexts are addressed in detail in this section of this book.

6.2.2.5 Gamification in Business Practice

A last area, in which gamification plays an increasingly significant role, is business practice. More and more services become gamified to create customer loyalty and to engage people. Foursquare is perhaps the paragon of a business model that utilizes gamification to market advertisement and coupons to customers. There are even ready-to-use frameworks, e.g. Badgeville[11] to integrate gamification into existing browser or mobile platforms, whatever they may be. This aspect of gamification, however, goes beyond the scope of this chapter. We therefore point the reader to the related chapters within this book.

6.2.3 Behavioral Economics and Psychological Computing

Behavioral economics has been a topic since the 1980s, but was only recently investigated in HCI as part of the psychological and persuasive computing movement. Bao, Gowda, Mahajan, and Choudhury (2013) look at the possibilities of

[10] http://www.duolingo.com/mobile, last accessed on August 14 2013.

[11] http://www.badgeville.com, last accessed August 8 2013.

Fig. 6.1 Gamified educational apps (**a**) duolingo (**b**) Heku.IT Reading Trainer. *Color* is used in (**a**) to visualize the progress in learning a language. In (**b**) the lock indicates that corresponding exercises are not available yet. Continuing with the training unlocks them

psychological computing to predict user behavior for mobile media usage. They investigated how paradigms from behavioral economics can be used to nudge users to pre-fetch videos on their smartphone while they are still connected to a WLAN. This way, they propose to reduce mobile network traffic in 3G and 4G networks, which is, despite novel communication technologies, still a major issue, as both content size and usage grow even faster. Another application for psychological computing they mention is intelligent driver assistance, sometimes referred to as advanced driver assistance systems (ADAS). Driving a car on highways is a monotonous task. If the driver shows signs of dozing off, an aware system could display intentional diversions, e.g. imagery of deer on a head-up display, to cautiously increase alertness. Performing another evaluation under different conditions with the Lane Change Test (LCT) (cf. Mattes & Hallén, 2009) could show us further evidence for the need of psychological computing in this domain.

Lee, Kiesler, and Forlizzi (2011) explicitly took a behavioral economics approach towards creating persuasive technology for healthy eating. In their work, they make use of a set of biases which are explained by behavioral economics: the *default bias*, *present-biased preferences* (O'Donoghue & Rabin, 1999) and *asymmetrically dominated choices* (we come back to these topics in Sect. 6.3). Their approach consisted of studying how people are influenced by certain biases when opting for healthy eating. In their first case study, they observed which food people chose if they had to either choose a couple of weeks in advance or 1 week at a time. Simonson (1990) explains that people seek more variety when choosing in advance, whereas they fall back to the same option when the same choice re-occurs after a while. This phenomenon was corroborated by the studies by Lee et al. (2011). Not only were subjects biased if they were asked by an experimenter about their food choice, but also if they had a robot deliver their food or when ordering on-line. The corresponding studies motivate further investigation of behavioral biases in interaction design.

6.2.3.1 Personal Finances

Our work utilizes examples from a personal finance context, where there are already numerous professional software solutions for the end user. Such tools allow us to both plan and analyze our monthly spendings. Prominent examples that exhibit constructs of behavioral economics are Quicken,[12] its cloud-based spin-off Mint[13] or Starmoney[14] Those services underline mental accounting techniques (see Sect. 6.3.1) to inform the users about their spending behavior. However, it is difficult to find a concrete call-to-action—the interpretation of data is mostly done by the users, even if transactions are already categorized automatically. Yet, Mint uses scores to rate the financial performance of the users and goes beyond categorizing in to budgets: it awards "Mint points" for good behavior (i.e. financially "responsible" transactions when users succeed to keep their self-set limits) which is also visualized to give feedback.[15] The responsible rating algorithms, however, remain intransparent.

6.2.3.2 Behavioral Economics Apps

The Duke Center for Advanced Hindsight[16] has started to build a couple of iOS applications which leverage behavioral economics. However, to this point we could not find scientific publications reporting on findings made via those apps.

[12] http://quicken.intuit.com/, last accessed August 08 2013.

[13] https://www.mint.com/, last accessed August 08 2013.

[14] http://www.starmoney.de, last accessed August 08 2013.

[15] Dole, A. (2010) 'Gaming for Behavior Change', http://method.com/pdf/10x10/Method_10x10_Gaming_for_Behavior_Change.pdf, last accessed September 05 2013.

[16] http://advanced-hindsight.com/, last accessed on August 14 2013.

6.2.3.3 Context Changes in Mobile Scenarios

The core topics in behavioral economics and the related psychology research are judgment and decision making, especially biased decisions. Kahneman (2011) informs us that decisions are made either intuitively (fast) or with mental effort (slow). But even after evaluating the parameters before making a judgment, the choice is biased by the surroundings, i.e. priming through the environment. Kahneman states that judgment is inconsistent and unreliable to a high degree. This implies that even small changes in the environment might lead to a different judgment, for example a small breeze on a hot day might make you feel better and induce a different behavior in that very moment (Kahneman, 2011, p. 225). Transferring this thought to mobile computing, where the context rapidly changes, means that we must rethink interaction design. We might do so by reacting to continuously changing priming and inducing reactions to changes in judgment in our systems.

6.3 Behavioral Economics in Mobile Experience Design

In this section, we first describe the principles of behavioral economics in detail, which afterwards allows us to present usage scenarios in a technology-driven environment. Thereby, we discuss how the findings transfer to the usage of computers and mobile devices in particular.

6.3.1 Mental Accounting

The first paradigm of decision making that we would like to address is *mental accounting*. It is one of the key principles of behavioral economics. Thaler (1999) defines mental accounting as follows:

> "Mental Accounting is the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities." (Thaler, 1999, p. 182)

Simply put, mental accounting deals with the fact that people tend to categorize their spendings (and earnings) into budgets (mental accounts) for example household, leisure, mobility, etc. On the one hand, this paradigm can be regarded as a way to positively enforce self-control, because it can avoid overspending. On the other hand, it might be considered as irrational behavior: In a wallet, money is just a collection of bills, coins or a simple number in a bank-account. It has no category and is a mere means of exchange, which is referred to as fungibility (Wilkinson & Klaes, 2008, p. 225). Thus, people can just take their money and spend it in the moment when they need it and on whatever they need—regardless of the mental account. It therefore makes no rational sense to stop spending in one category because the budget is exhausted though the absolute amount of money is positive. Therefore, one might interpret mental accounting as a simple variant of budgeting, but there is more to it. Thaler (1999) gives us an example for irrational budgeting as mentioned above. He describes a study in which the participants were asked to assess the likelihood to buy baseball tickets for $50. Half of the group was told that they had already gone to a baseball game the same week, the other half was told that they got a $50 parking ticket during that week. The latter group was significantly more likely to buy the baseball tickets, although their financial situation is identical to the first group. The only difference is the perceived "overspending" in that category, which can be thought of as irrational behavior.

Mental accounting can be explained using a number of psychological effects that impact rational behavior. In the following, we briefly describe some of those effects.

6.3.1.1 House Money

One situation in which mental accounting plays a role can be observed when people receive unforeseen gains. When people win a bet or a lottery, their financial situation immediately improves. Yet, the gain is treated differently compared to the rest of their budget. Often, people tend to spend this money differently or keep it in a different pocket, which is referred to as the "house money effect" (Thaler, 1985). The additional gain can be used to bulk up a mental account to rationalize overspending or a risky investment.

Humans learn mental accounting only by observing behavior (Thaler, 1999), most likely from our parents and surroundings. Opposed to industrial financial accounting there are no rules to follow in order to organize our budgets. Not only do we learn to budget our money, but also our time, which Saini and Monga (2008) showed.

6.3.1.2 Sunk Costs

Having invested in one mental account might not have led to returns. However, one has already committed to this investment and hopes to break even. Simply put, the rationale behind this behavior is thinking "I have already put so much into this, I might as well continue." In our context, we could exploit this effect in gamification or self-tracking applications. Let us assume a progress bar shows how the user is doing in saving up her money. By applying a non-linear scale, (e.g. a logarithmic scale) the progress bar could have a progress of 25 % in the center and scale the remaining 50 % on the right hand side. That way, we could convey the notion of having already invested into that and "that the end is not too far", so we would expect the users to keep up with this task falling prey to the sunk costs fallacy. Furthermore, it was shown that people are eager to use things more often if they had paid a lot for them (high sunk costs), thus potentially exceeding the budget of a mental account (Thaler, 1999). Trying to make more frequent usage seems to justify overspending but may be considered as irrational.

6.3.1.3 Payment Decoupling

Mental accounting is also influenced by payment modalities. It has been shown that people like to spend before rather than after consumption. If we pay in advance, we perceive consumption more enjoyable (Shafir & Thaler, 2006). Having made an investment, people have already booked it to a mental account, even if actual consumption comes much later. Thaler (1999) puts it like this:

> "Note that this mental accounting transforms a very expensive hobby into one that is 'free'." (Thaler, 1999, p. 192)

Beside temporal payment decoupling, paying by credit card has another impact on the perception of spending: Accumulation minimizes the "pain of paying",[17] i.e. credit card bills accumulate many transactions. As Thaler (1999) illustrates, paying $50 hurts more than seeing the same $50 appear in a $939 credit card bill. Paying a higher sum just once hurts less than spending smaller amounts again and again.

Generating ideas for applications in our field of interest, we can take a look at the temporal environment in which the users perform transactions. This follows the notion of Ariely's "Self-Control Credit Card" (Ariely, 2009). Let us assume the user finds herself at a ticket office purchasing two concert tickets by credit card. A linked service might instantly recognize the purchase and categorize it into "leisure" expenses. Via a push message, the smart phone displays a suggestion to save a random amount of money just at that moment. We expect the shopper to follow the advice and perceive the extra expense as less unpleasant.

6.3.2 Loss Aversion as Gamification Factor

Another factor which we believe to play a special role for gamification is loss aversion, which descends from Kahnemann & Tversky's prospect theory (Kahneman & Tversky, 1979). This phenomenon describes the discrepancy between perceived intensity in gain or loss of things people own (Ariely et al., 2005). In other words, people do not want to lose what they already have and keep the status quo (*status-quo bias*). It comes in another variant called the *endowment effect*. Here too, the theory indicates that once people own anything—a car, a house or even just a bottle of wine—they endow on that particular good. As a result, if asked to sell the respective belongings, people tend to exaggerate the price by overestimating the objective value for others. The latter are only willing to pay a fraction (e.g. in case of a car) of what the owners would like to receive. A similar principle occurs for investments: Losing 5 % in stock value has a higher emotional impact than gaining 5 % in stock revenue. As a last example, frequent flyers are awarded a "Gold Status" for their loyalty to an airline. This status only valid for a certain time. Presumably, the flyers choose the same airline all the more once they have reached this prestigious status.

[17] http://danariely.com/2013/02/05/the-pain-of-paying/, last accessed August 09 2013.

Furthermore, people endow on things that they have—it does not matter from where they received the goods. The mere fact of possession changes their perspective and the perceived value of the item is much higher than that of a neutral observer.

Trophies in games and gamified services might have a similar effect. Usually, only one user at a time owns a particular trophy. As soon as the trophy changes ownership, the *new* owner is likely to appreciate it more than the hundreds or thousands of users that do not really care or know about this reward. However, if that trophy allows users to unlock higher levels, it might become more valuable.

6.3.3 The "IKEA-Effect" in Gamification

Behavioral economists often investigate how humans overestimate and overvalue things. Norton, Mochon, and Ariely (2012) looked at how people become attached to things that they did not create from scratch but with a "box of bricks". Their results show that once it takes just a few steps to complete a project, e.g. building an IKEA wardrobe (hence the name), people overestimate its objective value. Bringing the IKEA effect to our studies, we can observe how some app developers utilize in-app purchases either to drive their earnings or to unlock additional functionality of an app. For example, if a specific game level is too tedious, some games offer to buy virtual currency to unlock achievements or to level-up. Such virtual currency can also be obtained simply by playing the game. Thus, combining "paid" and "earned" credits (note the mental accounting here) can help the player justify his or her cheating.

Successful gamification might take advantage of this knowledge and increase user experience by refraining from paid-only functionality, as it is already done in a number of apps. We assume that earning virtual currency, such as badges or reputation points, drives the IKEA effect and helps to get people attached to an application. This is especially important if it is a persuasive system for self-shaping and greater good, because it keeps up motivation and self control.

6.3.4 Framing Effects

Prospect theory forms the basis for the research of framing effects (Kahneman & Tversky, 1979, 1984). Framing effects explain why people make inconsistent choices when their information is presented in different ways. For example, in an experiment by Gächter, Orzen, Renner, and Starmer (2009) significantly more Ph.D. students signed up for a conference early if the "fee will **include a penalty** for late registration" compared to when there was "**discounted conference** fee for early registration". We continue by shortly describing two exemplary dimensions of framing.

6.3.4.1 Anchoring

The first type of framing effect that we try to address is *anchoring* (Kahneman, 2011, p. 119). Anchoring theory tells us that our choices in general and estimations in particular are influenced by almost any information that is present in the context. Thus, it can also be seen as a form of *priming* (Kahneman, 2011, p. 122). An anchor acts as a point of reference to base our decisions on and it does not have to be consciously processed or put into context. Asking a group of students to write down their social security number at the beginning of an experiment showed that this random piece of information was enough to create a reference during an anonymous, independent auction (Ariely, Loewenstein, & Prelec, 2003). Those students who had a higher number were inclined to make higher bids than the ones with lower numbers. Kahneman (2011, p. 122) gives us another simple example for anchoring:

> Was Gandhi more or less than 144 years old when he died?
> How old was Gandhi when he died?

Chances are that people overestimate Gandhi's age once they are asked these questions in this order.[18]

6.3.4.2 Asymmetric Choice in Settings-Menus

A special kind of framing effect is the *asymmetric choice effect*. It occurs for choices under uncertainty and can be described as follows. When presented with options, humans try to establish an association to previous choices. If this fails, some other anchor or point of relevance influences the choice. In an asymmetric choice, at least two of the options are more similar than others, making it easier to compare them - and harder to compare with other options. Let us look at the example that Dan Ariely provides (Ariely, 2009, p. 111). A newspaper offers three subscription models:

A Online subscription for $59 p.a.
B Print subscription for $125 p.a.
C Print + Online subscription for $125 p.a.

The print plus online subscription [C] is objectively a better bargain than the sole print subscription [B], because they both cost the same. However, the fact that they cost the same makes [B] and [C] more easily comparable and thus the print-only subscription [B] does not appear as attractive. In fact, option [B] becomes the negative version of [C], so we could say that the print plus online subscription is the real option [B] and the pure print subscription is [B-], which gives us an option set of [A, B-, B]. Now option B dominates and makes this choice asymmetric. Bringing this paradigm to persuasive computing immediately seems possible in options and settings menus. User experience designers can nudge their users by adding another, more easily comparable option which in turn is less attractive than the default.

[18] Just to resolve the puzzle: Gandhi died at the age of 78.

6.4 Implementation of Selected Concepts for a Case Study

To investigate our initial ideas how one could exploit cognitive biases as explained in behavioral economics, we developed a prototypical application. The chosen use case is personal finances. Our MoneySaver app utilizes behavioral economics theories to help people save up money in a novel way. The following short sections describe how the theories were implemented in the design.

6.4.1 General Functionality

The core functionality of our MoneySaver app is to keep track of multiple savings targets. The app reminds people to save money and suggests to put the money into a physical piggy bank. Mainly, the app was created as a proof of concept with a formal evaluation in mind.

6.4.2 Mental Accounting and Self Control

Mental accounting, as shown in Sect. 6.3.1, helps people to prevent themselves from overspending. In order to become successful, mental accounting could be leveraged by explicitly suggesting the accounts and visualizing them. In our app, we provide reminders to save money or put their money in a different pocket (see Sect. 6.3.1.1) until they return to their physical piggy bank. To support mental accounting, we empower users to set up multiple savings targets, which we called virtual piggy banks. Once the app reminds people to save now or when they decide to save at a particular moment, the users are required to choose in which piggy bank they wish to put their money. The current balance of each piggy bank (mental account) is displayed in the app, whilst the money simply accumulates in the physical piggy bank without any accounts. This somewhat resembles the "Money Savvy Piggy Bank"[19] (shown in Fig. 6.2), which has multiple slots assigned to a category. Parents can buy this to teach their children about money.

Besides, saving with a piggy bank could facilitate the sunk costs fallacy and payment decoupling. Since inserting money into a piggy bank adds a single step before spending the money, people could think that they "pay the piggy bank". Once the app tells them that they have saved up a certain amount, the users might be inclined to think that the piggy bank pays for their desired good and they get it "for free". That way, overspending in a single category can also be justified. The sunk costs nature of piggy banks becomes evident if we look at the hypothetical actions

[19] http://www.msgen.com/assembled/money_savvy_pig.html, last accessed August 14 2013.

Fig. 6.2 The Money Savvy Pig has multiple slots which make mental accounting apparent

after one has achieved a savings target. Does he/she continue to save money with an attitude like "*I've already saved up that much, I might as well keep going and buy something more expensive*"? Or, as we believe, the exact opposite might come to their minds: "*I might as well spend all that money, since I already saved it.*" We argue for the latter because short term benefits are more attractive than long-term gains (O'Donoghue & Rabin, 1999).

6.4.3 Loss Aversion

As stated above (Sect. 6.3.2), loss aversion can play a role in gamified applications. In our MoneySaver app, we introduced a standard gamification badge system (achievements). However, the app takes them from the user if she fails to respond to reminders or misses deadlines. We expect that people will try to continue saving to keep the badges because losses influence them more heavily than gains (Ariely et al., 2005; Kahneman, Knetsch, & Thaler, 1991). This principle has been addressed before by Hamari (2011) in the context of social online games.

6.4.4 Anchoring

We deliberately put anchors or points of relevance in the app. For example, the app can suggest to save a random amount for each reminder. Even if people decide to put a different amount of money into their piggy bank, we hypothesize that they were primed with the number, which the app had displayed. Furthermore, we let the user choose the range in which the reminders should suggest amounts. In this

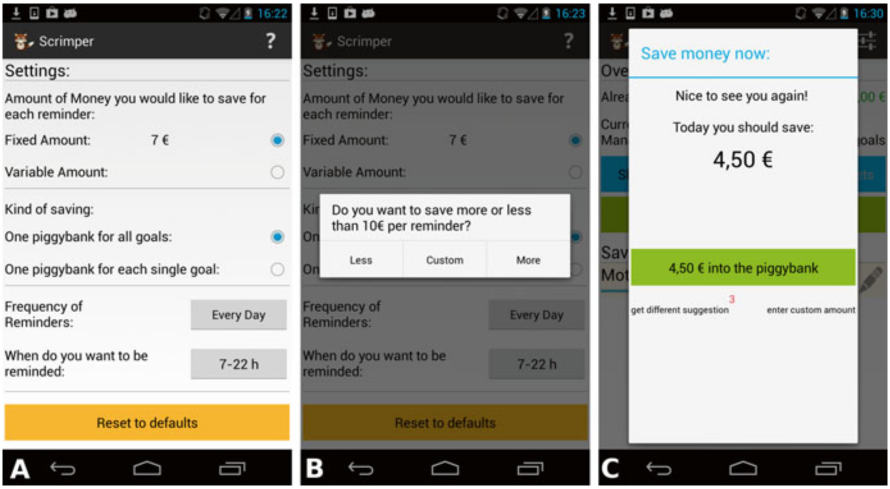


Fig. 6.3 (**a**) Settings menu. If the user clicks on "Variable Amount" she is taken to (**b**) the €10 Anchor. If she selects less than €10, the reminder looks something similar to (**c**)

dialog, too, we prime the users with €10 (see Fig. 6.3). Lastly, we "instantiate" the savings targets with the option to choose an image of the desired good. Coins and bills do not convey the notion of value as well as physical objects. Thus, users are able to assess the real value of the money in their piggy bank, if they are reminded through a picture of what they are saving for.

6.5 Evaluation of the MoneySaver Prototype

Having explained how behavioral economics influenced the design of a prototypical personal finances app, we come to evaluate the effectiveness of the design approach. In particular we evaluated the following research questions (RQ):

RQ1 Can saving be supported by triggering mental accounting through a mobile application?

RQ2 Can apps nudge people to save more through anchoring?

RQ3 Do default values in the settings of a mobile application impact behavior outside the pure interaction with the device?

In regard to those research questions we formulated a set of hypotheses (H):

H1 Mental accounting in saving is a strong success factor and can be supported through a mobile app.

H2 Anchors that are present in a user interface act as priming factors and therefore do influence the users' interactions.

H3 Random numbers work as anchors and therefore might bias answers in a questionnaire.
H4 Losing achievements motivates people to keep “playing” because of human *loss aversion*. It motivates users to pursue their behavior and consequently to succeed with their endeavor.
H5 Following default values in settings menus influences real-world behavior.

6.5.1 Methodology

After developing the app relying on the concepts presented in Sect. 6.4, we ran a user study in an office environment at the university. To test our hypotheses, we chose a “between-groups” setting (Field & Hole, 2003, p. 70) for the task-related part of the study. One reason for this choice was the fact that a within-subjects design would have required proper counterbalancing to avoid learning effects or—in our case—unintentional anchoring or priming.

6.5.1.1 Tasks

The study duration was approx. 20–30 min per participant, who were briefed by the experimenter and debriefed in an email after the study was complete. We asked people to perform a set of seven predefined tasks:

T1 Create a new savings target
T2 Look up your current achievements
T3 Put €7 into the (virtual) piggy bank
T4 Look up detailed information on the progress of the savings target
T5 Set up the notifications to display a random amount to which you have to commit
T6 Find out how to achieve your savings target (hypothetically)
T7 Mark your savings target as “Purchased”

Our independent variables were:

V1 Anchor. One group was presented an anchor in a dialog, the other was not.
V2 The last two digits of the participant’s telephone number, which we divided into the categories low (00–24), medium (25–74), and high (75–99).
V3 Context. The lab-study participants were primed with the topic of saving money during the experiment. Another group was asked a subset of the questions in an on-line survey.

On a quantitative scale, we measured the amount which people claim to save when using our prototype. Furthermore, we evaluated arbitrary anchors, as shown in one of numerous experiments from e.g. Ariely et al. (2003), through a questionnaire which formed the end of each session. Our intention was to evaluate whether

Table 6.1 Q1: Mental accounting of unexpected gains. Q2: Self-assessed mental accounting efforts

Q1	Suppose you win €200 at a raffle. What do you do with the won money? (a) I'm saving the money (b) I buy something, I normally would not. (c) I use it to do some maintenance investments (e.g. on my car) (d) I won't do anything special with that money (e) Something else:
Q2 (5 Point Likert Scale)	I thoroughly categorize my spendings (e.g. leisure, household, restaurants).

the last two digits of the telephone number of the subjects functioned as anchors and subsequently influenced their reported savings behavior.

Lastly, one of our final questions (see Table 6.1) in the survey evaluated mental accounting without making a reference to the app. At this point of the study, we had primed the subjects to reflect on their saving habits. As shown in Sect. 6.3.1, parts of the mental accounting theory suggest that people are likely to treat money differently if they received it unexpectedly. That is, they put it in a different mental account that is often referred to as "house money". Thus, the theory indicates a tendency towards answer (b) and that option (e) is the least favored (referring to Table 6.1). By asking this question very late in the experiment, we investigated if the priming on the topic of saving money moved the tendency from (b) to (a).

In order to test our hypotheses against a non-primed control group we put up an on-line questionnaire which contained two of the questions from the experiment (one of them was the question in Table 6.1), the other concerned a self-assessment on one's mental accounting efforts.

6.5.1.2 Participants

We recruited 26 participants through spreading a Doodle link on social media and personal invitations. There were 11 female and 15 male participants and the average age was 24 years ($standard\ deviation(SD) = 5.5$) (we did not ask the exact date of birth). 23 participants were university students, the other three participants did not agree to reveal their profession. Subjects did not receive any direct compensation for their participation except free soft-drinks and snacks during their attendance. Also, we raffled off a small Amazon gift card. The target group shows a rather homogenous monthly income structure (61 % make less than €500, 31 % report a monthly income between €500 and €1,499, the remaining 8 % earns more than €1,500). Thus, we regard the possibility to save money for each participant as almost equal.

Our control group was formed by 115 people who filled out an on-line questionnaire. We spread the link via social media and allowed the survey a time span of 3 days.

6.5.2 Results

We found the following in the data that we collected in the laboratory user study:

- 81 % of the participants wished a separate piggybank for each savings goal. This supports H1.
- 50 % would save the amount that was suggested to them, providing evidence for H5.
- 84 % of the subjects confirmed that a picture of the savings target is motivating.
- 53 % say that achievements would motivate them to keep up saving money. Furthermore, we asked the participants to asses their likelihood to share their achievements on social media on a 5-point Likert scale ranging from 1 (very likely) to 5 (not likely at all). Contradictory to Zichermann and Cunningham (2011, p. 67), we observed a strong tendency towards rejection of social media interaction ($Mean\ \ (M) = 4.38,\ \ SD = 1.06$).
- We asked participants to assess how they react upon the loss of achievements on a 5-point Likert scale ranging from 1 (I agree) to 5 (I disagree). When asked if they changed their savings behavior to keep their earned badges the statistics we observed an average score of $M = 3.04\ \ (SD = 0.96)$. The participants reported with $M = 3.58\ \ (SD = 0.90)$ that they would make a higher one-time saving to prevent the loss of a badge. Accordingly, this partly supports H4.
- Answering question Q1 (Table 6.1), we found that 46 % would buy something they normally would not have bought. 42 % would save their money. In order to find out if subjects in the experimental group had been primed by the topic of "saving up money" in our experiment, we performed a Chi-Squared test on the data. We could not run a *t*-test because the data was non-parametric (not normally distributed). At a significance-level of 0.05, the test showed that there were no significant differences in distributions of the participants' choices ($\chi^2(4) = 5.96,\ p > 0.1$). Since the control- and experimental group did not significantly differ, we conclude that priming was not sufficiently effective in our experiment. In the distribution that is shown in Fig. 6.4, however, we observe that a slightly higher percentage of the interviewees claim not to do anything special with an unforeseen gain.
- Finally, we investigated whether the last two digits of a participant's telephone number might serve as an anchor for their choice on how much to save at each reminder. Since we had three different measures, i.e., low, medium and high number, we performed analysis through a between-subjects ANOVA. This test, however, did not show any significant effects between the groups ($F(2) = 0.384,\ p > 0.1$, post-hoc tests were not necessary). Participants with lower numbers acted similar to the ones with higher numbers. Besides, the number of participants in each condition might have been too small to gather robust data. As a consequence, we reject H3.

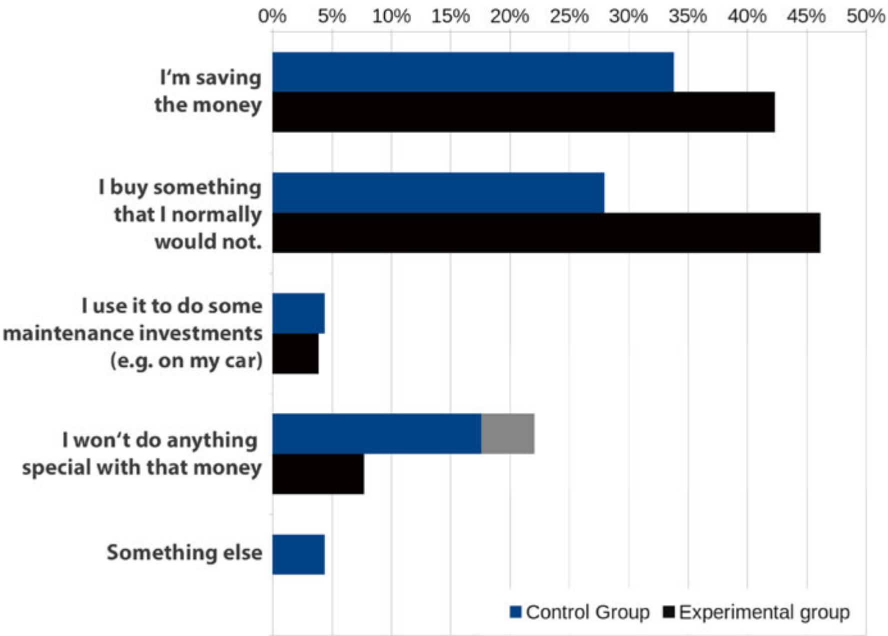


Fig. 6.4 Answer distribution for Q1. Only option *d* defies mental accounting efforts. Most people treat an unexpected gain differently than the rest of their money (*house money effect*, see Sect. 6.3.1.1). Answer (e) did not occur in the experimental group

6.5.3 Discussion

The main result of the study was that people favor an app that helps them save money. Mental accounting can help them achieve this goal, which we successfully implemented in a prototypical app. To a large part (77 %, $n = 89$), subjects in our control group relied on mental accounting strategies. In the experimental group, even more people (92 %, $n = 24$) treated the won money differently.[20] The fact that question Q1 in Table 6.1 was not answered with indifference by all the participants strongly suggests that people in both our control and experimental group (N > 120) rely on mental accounting. Both the lab study and the on-line questionnaire indicate that people *do* attribute unforeseen gains to a mental account. However, we did not see significant differences between our control and experimental groups when it comes to whether to save or spend the money.

We found more evidence that mental accounting can be supported through our app when we asked whether people wanted to have one piggy bank for all their savings targets or a separate piggy bank for each of the desired items. 81 % ($n = 21$) of

[20]A Chi-Square test did not reveal significant differences between the control and experimental group ($\chi^2(1) = 2.1015$, $p > 0.1$).

the lab study participants reported that they would prefer **a separate piggy bank** and that the app should continue to support that.

All this leads us to believe that H1 (mental accounting is useful and can be supported through an app) is partly confirmed.

6.5.3.1 More Gamification Elements

For many people, saving money is a challenge. They either choose it deliberately or because their financial situation demands it. This is why the gamification elements in the MoneySaver app could make further use of the "challenge" paradigm. In a future version we will display a number of challenges to the user, that are clearly labeled, e.g. *"Challenge for the next week: Save €25 to achieve the badge 'super-saver'"*. A possible promising way is the '52 week money challenge'.[21] It is a simple strategy where the weekly saved amount is doubled after each week. This way, 1,378$ can be saved up within a year when starting with 1$ in the first week (assuming one can take the challenge). A piggy bank that can keep track of the current balance could make the process even easier (Stockinger, Koelle, Lindemann, Witzani, & Kranz, 2013).

6.5.3.2 Anchors

Coming back to the usage of anchors, we did not observe a significant correlation ($p > 0.05$) between the presented split value of €10 and the choice on how much the participants would like to save with each notification. An interesting phenomenon, however, can be seen in Fig. 6.5. Only one participant within the group which saw the anchor set the reminder value to more than €10. Since the effect was not statistically significant ($t(24) = 0.578$, $p > 0.1$), we need to assume that this is due to chance.

We hypothesize that presenting a much higher number as "split value" (in accordance to the Ghandi question in Sect. 6.3.4.1) could nudge the people to unconsciously adjust their reminders towards the higher number. This, however, needs to be shown in another experiment for which our data can serve as control data. One participant perceived the anchor-dialog from Fig. 6.3b as cumbersome. He thought it was a usability issue that there is another dialog keeping the user from achieving her task.

Furthermore, it is possible that the anchors in our experiment failed to provide more visible results because there were too many: the last two digits of one's telephone number, the "split value" in the settings dialog for the experimental group, the amounts which were suggested to save during the experiment—all the numbers might have caused an "anchor overflow", thus mitigating the priming and framing effects.

[21] cf. http://www.savewithkass.com/, last visited Jan 24, 2014.

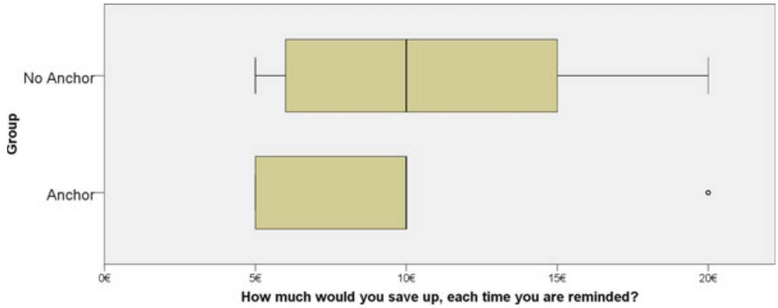


Fig. 6.5 The anchor group in our lab experiment did only once choose to save more than the split value of €10

In a future version, we plan to make use of the asymmetric choice effects mentioned in Sect. 6.3.4.2. The settings menu of the app could be extended by options that are either more comparable to other options or less desirable. We would like the user to save as often as possible, without becoming bothered by notifications. Thus, the app intends to remind them at least every second day to save money. The options could be: getting reminded *every now and then* [A], *every second day through the notification bar* [B] and *every second day through the notification bar with an alarm sound plus vibration* [B-]. We hypothesize that users can compare option [B] and [B-] more easily than the vague "every now and then", which is why we expect them to choose option [B]. Another example could be the options-dialog for the amount of money to save. Presenting an option set containing *fixed amount* [A], *random amount with decimals* [B-] and *random amount (integers only)* [B]. Here, too, we suppose that option [B-] will be the least favorable and votes for option [B] increase.

6.5.3.3 Loss aversion

We investigated how people react once they face losing an already acquired badge. The reported behavior indicates that the prospect of loss is (for some) a sufficient threat to maintain self-control and follow the self-imposed rules to save more money. However, the evidence at hand does not allow to fully confirm H4, yet. Further, long-term behavioral research with our app is necessary to gain deep insights into *loss aversion* in respect to virtual goods.

6.6 Summary and Conclusion

In this chapter, we took a look at behavioral economics in Human-Computer Interaction, especially motivated through mobile computing scenarios. We have shown that the many concepts and theories from behavioral economics offer plenty of opportunities to enrich the understanding of persuasive computing in general, and gamification in particular. Since only a subset of opportunities that reside in behavioral economics could be addressed in this chapter, we will conduct and encourage further research in this area. Extending our financial context, we built a prototype of an electronic piggy-bank that communicates with smartphones (see Stockinger et al., 2013). It allows to control the progress of saving up money and will permit us to investigate self-control and self-deception of users—do they save as much as they claim? Do they follow the reminders and put money into the piggy-bank whenever the smartphone displays a notification? Do they follow through until they have reached their goal? These are just some of the questions that need to be answered in a long-term experiment, that we will carry out in diary studies.

Also, we set out to find new use cases for bounded rationality and cognitive biases in a technology-driven context. Short passwords for highly sensitive data are not apt to defend oneself against the many threats of cyber crime. Yet, people still use them and are inclined to act irrationally that way.

Finally, we aim to explore how people are influenced by user studies, that take place so often in HCI research. Work by Birnbaum (1999) shows that cognitive biases distort people's behavior during user studies to a high degree, resulting in all unwanted type I, II and III errors. Recently, Möller, Kranz, Schmid, Roalter, and Diewald (2013) showed that the design of a user study has a great impact on the behavior of the participants. Besides, the context we work in drives us to investigate how *intuitive* interaction can be explained through neurology and behavioral sciences. We assume that interaction design that prevents the Reflective System (or System 2 (Kahneman, 2011)) from becoming active generates greater usability.

References

Ariely, D. (2009), *Predictably irrational: The hidden forces that shape our decisions*. New York, NY, USA: HarperCollins.

Ariely, D., Huber, J., & Wertenbroch, K. (2005). When do losses loom larger than gains? *Journal of Marketing Research, 42*(2), 134–138.

Ariely, D., Loewenstein, G., & Prelec, D. (2003). Coherent arbitrariness: Stable demand curves without stable preferences. *The Quarterly Journal of Economics, 118*(1), 73–106.

Bao, X., Gowda, M., Mahajan, R., & Choudhury, R. R. (2013). The case for psychological computing. In *Proceedings of the 14th Workshop on Mobile Computing Systems and Applications* (HotMobile '13) (pp. 6:1–6:6). New York, NY, USA: ACM.

Birnbaum, M. H. (1999). How to show that 9 ¿ 221: Collect judgments in a between-subjects design. *Psychological Methods, 4*(3), 243.

Consolvo, S., Everitt, K., Smith, I., & Landay, J. A. (2006). Design requirements for technologies that encourage physical activity. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '06) (pp. 457–466). New York, NY, USA: ACM.

Consolvo, S., McDonald, D. W., & Landay, J. A. (2009). Theory-driven design strategies for technologies that support behavior change in everyday life. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '09) (pp. 405–414). New York, NY, USA: ACM.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM.

Diewald, S., Möller, A., Roalter, L., & Kranz, M. (2012). Gamification-supported exploration of natural user interfaces. In *Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (AutomotiveUI '12) (pp. 47–48).

Field, A. P., & Hole, G. (2003). *How to design and report experiments*. London, England: Sage Publications.

Fitz-Walter, Z., Tjondronegoro, D., & Wyeth, P. (2011). Orientation passport: Using gamification to engage university students. In *Proceedings of the 23rd Australian Computer-Human Interaction Conference* (OzCHI '11) (pp. 122–125). New York, NY, USA: ACM.

Fogg, B. J. (2002). *Persuasive technology: Using computers to change what we think and do*. San Francisco, CA, USA: Science & Technology Books.

Froehlich, J., Dillahunt, T., Klasnja, P., Mankoff, J., Consolvo, S., Harrison, B., et al. (2009). UbiGreen: Investigating a mobile tool for tracking and supporting green transportation habits. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '09) (pp. 1043–1052). New York, NY, USA: ACM.

Froehlich, J., Findlater, L., & Landay, J. (2010). The design of eco-feedback technology. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10) (pp. 1999–2008). New York, NY, USA: ACM.

Gächter, S., Orzen, H., Renner, E., & Starmer, C. (2009). Are experimental economists prone to framing effects? A natural field experiment. *Journal of Economic Behavior & Organization, 70*(3), 443–446.

Hamari, J. (2011). Perspectives from behavioral economics to analyzing game design patterns: Loss aversion in social games. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '11) (pp. 1–6). New York, NY, USA: ACM.

Haselton, M., Nettle, D., & Andrews, P. (2005). The evolution of cognitive bias. In D. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 724–746). Hoboken, NJ, USA: Wiley.

Hurter, C., Girouard, A., Riche, N., & Plaisant, C. (2011). Active progress bars: Facilitating the switch to temporary activities. In *Extended Abstracts on Human Factors in Computing Systems* (CHI EA '11) (pp. 1963–1968). New York, NY, USA: ACM.

Kahneman, D. (2011). *Thinking, fast and slow*. London, England: Allen Lane.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *The Journal of Economic Perspectives, 5*(1), 193–206.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society, 47*(2), 263–291.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. In N. J. Smelser & D. R. Gerstein (eds.), *Behavioral and social science: Fifty years of discovery* (Vol. 39(1), pp. 153–172). Washington, DC: National Academy Press.

Kranz, M., Murmann, L., & Michahelles, F. (2013). Research in the large: Challenges for large-scale mobile application research – A case study about NFC adoption using gamification via an App store. *International Journal of Mobile Human Computer Interaction (IJMHCI), 5*(1), 45–61.

Lee, M. K., Kiesler, S., & Forlizzi, J. (2011). Mining behavioral economics to design persuasive technology for healthy choices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11) (pp. 325–334). New York, NY, USA: ACM.

Marczewski, A. (2012). Gamification: A simple introduction and a bit more. E-Book, ISBN: 978-1-4717-9866-5

Mattes, S., Hallén, A. (2009). Surrogate distraction measurement techniques: The lane change test. In *Driver distraction: Theory, effects, and mitigation* (pp. 107–121). Atlanta, GA, USA: CRC Press.

Maurer, M.-E., De Luca, A., & Stockinger, T. (2011). Shining chrome: Using web browser personas to enhance SSL certificate visualization. In *Human-Computer Interaction* (INTERACT '11). Lecture Notes in Computer Science (Vol. 6949, pp. 44–51). Berlin: Springer.

Meschtscherjakov, A., Wilfinger, D., Scherndl, T., & Tscheligi, M. (2009). Acceptance of future persuasive in-car interfaces towards a more economic driving behaviour. In *Proceedings of the 1st International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (AutomotiveUI '09) (pp. 81–88). New York, NY, USA: ACM.

Möller, A., Kranz, M., Schmid, B., Roalter, L., & Diewald, S. (2013). Investigating self-reporting behavior in long-term studies. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13) (pp. 2931–2940). New York, NY, USA: ACM.

Moraveji, N., Akasaka, R., Pea, R., & Fogg, B. (2011). The role of commitment devices and self-shaping in persuasive technology. In *Extended Abstracts on Human Factors in Computing Systems* (CHI EA '11) (pp. 1591–1596). New York, NY, USA: ACM.

Muran, E. M., & Motta, R. W. (1993). Cognitive distortions and irrational beliefs in post-traumatic stress, anxiety, and depressive disorders. *Journal of Clinical Psychology 49*(2), 166–176.

Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '90) (pp. 249–256). New York: ACM.

Norman, D. A. (2007). *Emotional design: Why we love (or hate) everyday things*. New York, NY, USA: Basic Books.

Norton, M. I., Mochon, D., & Ariely, D. (2012). The IKEA effect: When labor leads to love. *Journal of Consumer Psychology, 22*(3), 453–460.

O'Donoghue, T., & Rabin, M. (1999). Doing it now or later. *The American Economic Review, 89*(1), 103–124.

Pronin, E., & Kugler, M. B. (2007). Valuing thoughts, ignoring behavior: The introspection illusion as a source of the bias blind spot. *Journal of Experimental Social Psychology, 43*(4), 565–578.

Ross, L. (1977). The intuitive psychologist and his shortcomings: distortions in the attribution process. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10, pp. 173–220). Amsterdam: Elsevier Science.

Saini, R., & Monga, A. (2008). How I decide depends on what i spend: Use of heuristics is greater for time than for money. *Journal of Consumer Research, 34*(6), 914–922.

Shafir, E., & Thaler, R. H. (2006). Invest now, drink later, spend never: On the mental accounting of delayed consumption. *Journal of Economic Psychology, 27*(5), 694–712.

Simonson, I. (1990). The effect of purchase quantity and timing on variety-seeking behavior. *Journal of Marketing Research, 27*(2), 150–162.

Stockinger, T., Koelle, M., Lindemann, P., Witzani, L., & Kranz, M. (2013). SmartPiggy: A piggy bank that talks to your smartphone. In *Proceedings of the 12th International Conference on Mobile and Ubiquitous Multimedia* (MUM '13) (pp. 42:1–42:2). New York, NY, USA: ACM.

Thaler, R. (1985). Mental accounting and consumer choice. *Marketing Science, 4*(3), 199–214.

Thaler, R. (1999). Mental accounting matters. *Journal of Behavioral Decision Making, 12*(3), 183–206.

Tractinsky, N. (1997). Aesthetics and apparent usability: Empirically assessing cultural and methodological issues. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '97) (pp. 115–122). New York, NY, USA: ACM.

Wilkinson, N., & Klaes, M. (2008). *An introduction to behavioral economics*. New York, NY, USA: Palgrave Macmillan.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, Canada: O'Reilly Media.

Chapter 7
A Parallel Universe: Psychological Science in the Language of Game Design

Thomas E. Heinzen, Michael S. Gordon, R. Eric Landrum, Regan A.R. Gurung, Dana S. Dunn, and Sam Richman

7.1 Introduction

"*It* felt like an epic win" said Corey, with a suitably modest smile, after his first research conference poster session.

The grandiose term epic win describes hard-won achievements and is part of the native tongue of people coming of age during the digital revolution. Its colorful vocabulary is seeping into mainstream conversations and signals wider acceptance of gamification, applying game design techniques and mechanics to a non-game context (Herger, 2011). We want to wave five cautionary thoughts in front of you before we use this relentlessly evolving language to connect principles of games to psychological science.

First, we cannot yet offer precise definitions because we need to follow the advice for assembling a bicycle: "Keep all connections a little loose until assembly is completed." It is too soon to offer tight definitions. Second, the findings of psychological science are also looser than you might think. Gravity is a relatively consistent

T.E. Heinzen (✉) • M.S. Gordon
William Paterson University, 300 Pompton Road, Wayne, NJ 07470, USA
e-mail: heinzent@wpunj.edu

R.E. Landrum
Department of Pshychology, Boise State University, 1910 University Drive, Boise, ID 83725-1715, USA

R.A.R. Gurung
Human Development and Psychology, University of Wisconsin-Green Bay, Green Bay, WI, USA

D.S. Dunn
Department of Psychology, Moravian College, Room 231, Hurd Academic Complex, 1200 Main Street, Bethlehem, PA 18018-6650, USA

S. Richman
User Experience Strategist

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_7

phenomenon; human behavior, not so much. Third, much of what the general public believes about psychology is a myth (Lilienfeld, Lynn, Ruscio, & Beyerstein, 2010), and some of those myths are dangerous. Although the discipline of psychology is still like a gangly, uncertain teenager, we grow more confident with every passing experiment. Fourth, this chapter connects higher education and the psychology of games in general, not video games in particular. Some recent conference participants expected to see a video game when we merely applied the principles of game design to a simple redesign of a statistics course. Fifth, this chapter is already out of date; gamers are constantly inventing new words to describe some recurring features of gaming.

7.2 A Short History of Games in Psychology

In spite of these cautions, history suggests that higher education would be wise to pay attention to game-based learning. Psychologists have formally explored the psychology of play and games for all of its brief, recorded history. In 1898, Karl Groos used natural selection to explore the adaptive purposes of play in his book, *The Play of Animals*. In 1902, William Roth investigated the games, sports, and amusements of the aborigines of northern Australia and classified them into seven types of play. In 1906, W. H. Winch also classified types of human play, but into only four categories. In the succeeding years, the dominant trend in the psychology literature connected play and games to education. Belle Ragnar Parsons (1909) explored how to infuse content into gym classes and, that same year, C. Ward Crampton argued forcefully for more play in the educational system.

Crampton (1909, p. 489) included what today feels like a prescient comment about the benefits of games by warning against (with the italics added) “a relatively playless, and therefore godless, generation growing up without having *virtually* learned in any real way justice, courage, and the value of decently and fairly ‘fighting hard and square’ in the game of life.” The early literature also contained some warnings about the dangers of “gaming” by which they usually meant warnings against gambling. There have also been warnings about how games can corrupt morals, slow workers, and encourage sinfulness among playful 13th century minstrels (see Ifenthaler, Eseryel, & Ge, 2012). However, no one across 100 years of psychological science appears to have argued philosophically or empirically against the *educational* benefits of fun, play, and games.

Games have also been a productive research model. *Game theory*, for example, creates interpersonal conflicts by putting people in situations that require interdependent decision-making (Wilkinson, 2008), a research approach that has generated insights into problem solving, heuristics, and probability (e.g., Brewer & Kramer, 1986; Poundstone, 1992; Tversky & Kahneman, 1981). The most well known example is the Prisoners’ Dilemma, now a staple plot device for television crime dramas, because the dramatized situation creates conflicts that force internal values to the surface of behavior. Prelec and Simester (2000) also created an auction game in which participants bid for tickets to high profile Boston sporting events. They discovered that, on average, people spent more money using a credit card than cash—and demonstrated how games can approximate reality.

The digital revolution has accelerated the development of games in education. The *New York Times* columnist Chris Suellentrop (2013) compared video games to the printing press or moving pictures in previous eras: an entirely new creative form. Although Suellentrop's view probably reflects the gamer's habit of grandiose speech, the demographic realities suggest we are living through what economist Edward Castronova's (2007) calls a "mass exodus to the virtual world." Older faculty can witness the face validity of this exodus by asking students and younger faculty whether they are familiar with game terms like "epic win," "epic fail," "noobs," "trolls," or "rage quit." A game has the same motivating elements as a well-designed academic experience (Prensky, 2001):

1. Balance, with progressively more difficult challenges;
2. Creativity, rather than a clone of other games (or courses);
3. Focus, so that it delivers an experience with minimal distraction;
4. Character, by delivering a rich and memorable experience;
5. Tension, so that the player cares about achieving an uncertain outcome; and
6. Energy, that keeps players playing.

If you also worry that games are too frivolous for higher education, then you may be comforted by the concepts of *hard fun* (games that stretch abilities) and *serious games* (games with a social purpose). In short, the conclusions across more than a century of research are that a) there are few empirical or philosophical arguments against using games; b) game-based thinking has already penetrated education and research; and c) we would be wise to explore how to apply game-based thinking to more parts of higher education.

7.3 Outside the Black Box: Behaviorism

It is difficult to estimate how much game designers have drawn on their memories of psychology classes. Game design packs an interdisciplinary punch because its target markets are diverse, its designers are constantly probing for new territories to conquer, and it is wide open for anyone willing to call herself a game designer. In short, game design is the current wild west of higher education. Fortunately, psychological science offers a guide through this new territory beginning with *behaviorism*. Strict behaviorists refused to infer what might be going on inside the black box of mental processes or emotions and was eventually absorbed by cognitive science, but many of its scientific principles have endured.

7.3.1 Token Economies

Behaviorists designed *token economies* or, in the language of games, a *virtual economies*. Simple token economies emerge whenever we use points to influence behavior such as effort in college courses, persistence in car washes, or loyalty to airlines.

Table 7.1 Schedules of reinforcement applied to game design

Term	Definition	Examples
Positive Reinforcement	Presenting something that has the effect of increasing the frequency of a desired behavior	Praising a student for a well-written sentence
		Rewarding a gamer with gold coins for leveling up
Negative Reinforcement	Taking something away that has the effect of increasing the frequency of a desired behavior	Letting a student out of detention to reward their cooperation
		Not killing off a player who cooperates with others
Positive Punishment	Presenting something that has the effect of decreasing the frequency of a desired behavior	Criticizing a student for an ungrammatical e-mail
		Killing a troll for disrupting a game
Negative Punishment	Taking something away that has the effect of decreasing the frequency of a desired behavior	Denying recess to a student that is misbehaving
		A parent not allowing a child to play a video game

Game designers and educators motivate by creating *virtual goods* that can be bought with *virtual currency* that function as *reinforcers* that increase the frequency of a behavior or *punishers* that decrease the frequency of a behavior (see Kazdin, 1982; Kazdin & Bootzin, 1972; Matson & Boisjoli, 2009 for reviews). Reinforcers and punishers may be either positive or negative and game designers will want to avoid the common mistake of confusing the word "negative" with something that is bad. Table 7.1 clarifies that "positive" only that something is being presented and "negative" only means that something is being taken away. A negative reinforcer, for example, is removing something that has the effect of increasing a behavior.

Reinforcers are often used in interactive *massive online role player games* (*MMOGs*) such as World of Warcraft (WoW) and Team Fortress 2. For example, players can exchange digital versions of gold sovereign, assorted coins, metals, and hats—currencies that only exist within the imagination and graphics of the game. In WoW, a hat to be "worn" by an *avatar*, a representative player-created character, is valued at close to 10 refined metals (no physical metal required), but it has a "real" value, too. You could fashionably adorn your avatar for about $2.50. Every game that keeps score has elements of a virtual economy.

Within psychology, token economies were first created as a coherent motivational system for therapy and rehabilitation (Ayllon & Azrin, 1968). Lloyd and Garlington (1968), for example, used *shaping*, systematically reinforcing behaviors that progressively lead to desired goals, to influence people with schizophrenia. Game designers refer to continuous shaping as the *flow* that constantly rebalances the difficulty and rewards of a game to progressively lift players to higher levels of achievement. The currency in a token economy has no intrinsic value; its game value depends on the effort required to earn it, its rarity in the system, and social acceptance of the rules of the game.

7.3.2 Rules About Points

The rules for games are similar to the rules for college courses. Like points that may be awarded for simply showing up in class, games sometimes assign *experience points* that are earned for persistently playing the game. However, more points are typically rewarded for *quests*, an especially difficult task such as a 50-page paper, oral presentation, and so on. A point-based token economy does not need to be an elaborate system—the simplest possible approach is usually best. In science, for example, creating theories that are as simple as possible—and no simpler—is called *Occam's Razor* (see Hawking, 2003); also as the *Principle of Least Astonishment* (*POLA*) (see James, 1986); and as being *parsimonious* or cheap (getting a lot of explanation with very little theory). Informally, this principle is often referred to as *K.I.S.S.* for *Keep It Simple*, *Stupid*. For example, the game of Tetris is so simple that its token economy only needs to assign points for successfully manipulating falling geometric blocks.

Earning points in a token economy seems to be irrationally appealing. For example, professors who dislike "giving" extra credit may be surprised that our students designed a course based exclusively on earning extra credit points—which amounts arithmetically to the same thing as a course with no extra credit. But now they were points to be earned rather than points to be lost. Screenwriter and game-designer turned professor Lee Sheldon (2012) announced the same kind of transformation by telling students on the first day that they all had a grade of F (and therefore must start earning points). It is arithmetically irrational to prefer earning points to not losing points, but it is predictably irrational (see Ariely, 2008) and game designers seem to understand this better than curriculum designers. Earning predetermined numbers of points leads to *leveling up* to a new stage of achievement, typically followed by a brief rest period called a *checkpoint*. Games typically reward leveling up with bonus points, new abilities, or *badges* that certify an achievement. In many games, leveling up requires overcoming extreme obstacles called a *boss*—like a "killer midterm" exam. When a gamer puts intense effort into leveling up, it is referred to as *powering up*, comparable to cramming for an exam.

7.3.3 Creating Persistence

Behaviorists are interested in *extinction*, how long a player keeps playing after the rewards stop coming. Extinction is the flip side of what game designers and educators strive to create (persistence). The pattern of persistence is based on a particular *schedule of reinforcement*, specifically whether rewards are based on time (interval) or effort (ratio) and whether the rewards are predictable (fixed) or unpredictable (variable) (see Ferster & Skinner, 1957). For example, the *fixed interval schedule of reinforcement* portrayed in Fig. 7.1 produces a scalloped pattern of rapid, intense responding (the steep part of the line) followed by a brief rest period (the flattened part of the line). This scalloped response pattern shaped the pigeons in Skinner's

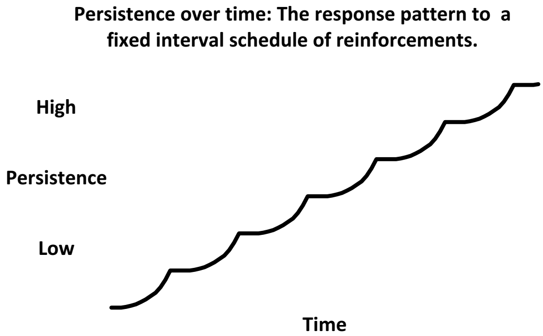


Fig. 7.1 Title. Powering Up: A Fixed Interval Pattern of Persistence. Powering up in a game that rewards players on a fixed interval schedule is similar to cramming for and resting after weekly quizzes. Rewards that arrive on a variable schedule (such as easter eggs) create even greater long-term persistence

(1948) famous "superstition experiments" when the birds developed rituals that persisted long after their food rewards had stopped.

Imagine a very hungry pigeon exploring its cage, doing all the typical "pigeony" things you would expect: bobbing its head, pecking the ground, ruffling its feathers, and so forth. Suddenly, a little hopper with tasty food swings into place. Gamers call such welcome but unexpected surprises *easter eggs* and in this case the happy pigeon immediately starts eating. However, the food hopper swings out of sight after only five seconds only to reappear 15 s later and disappears again five seconds later. This fixed interval schedule of reinforcement keeps repeating but here's how the pigeons responded: Whatever a hungry pigeon happened to be doing the first time the food appeared—bobbing, pecking, ruffling its feathers, well, it started doing even more of that. And that made it even more likely that it was performing that same behavior the next time the food hopper appeared, 15 s later.

Six of the eight pigeons in Skinner's first study quickly developed ritualized behaviors that were unique to each pigeon. One turned counter-clockwise; another kept thrusting its head into a corner; a third tossed its head as if it was lifting some invisible bar. Two birds swung their heads, like clock pendulums, but slowly in one direction and more quickly in the other. A sixth bird was making pecking and brushing motions, but without touching the floor. The rituals became more elaborate when the 15 s interval was lengthened to one minute: One pigeon displayed "a well defined hopping step from the right to the left foot, meanwhile turning its head and body to the left as before." When the food reward stopped (extinction), that pigeon continued its peculiar side-to-side hopping more than 10,000 times!

College courses are already game-like. They use points (a gpa; earned credits), badges (passing a course; earning an A), levels (that eventually lead to graduation), and prizes (scholarships) that are displayed on *leader boards* (honor societies, magna cum laude) that provide meaningful *social comparisons*. But the differences between game designers and curriculum designers are also striking. For example, the *feedback loop* in a game is often detailed and automatic whether the game is hopscotch, Tetris, BINGO, or baseball. In higher education, the feedback loop may wait 3 weeks for a professor or graduate student to read and grade exams. Games are also different from education in how they treat failure (described below). But even these differences are game-like, so it makes sense for educators to get good at a game they are already playing.

7.4 Inside the Black Box: Cognitive Science

Behaviorism was a productive period for scientific psychology but it proved to be unsatisfying in the long run because our lives are experienced within that black box of human experience. And, as Jesse Schell (2008, p. 10) likes to point out, the *game experience*, the overall effect of playing a particular game, is the only thing that game designers have to offer. Fortunately, the cognitive revolution was gathering momentum about the same time that computer games were making their first appearances, arguably starting with Allen Turing's chess program in 1947. Fortunately, some classic experiments gave us glimpses into the black box of human experience. For example, Stroop (1935) demonstrated that our mental processes slowed when confronted with the word RED written in green ink, demonstrating that the black box was now open for investigation. George Miller's, 1956 article about the limitation of short-term memory "The Magic Number Seven, Plus or Minus Two" provided another quick peek at hidden mental structures. It was still pretty dark inside the black box of human experience but now creative experimenters had what would prove to be a powerful flashlight: cognitive science.

Jesse Schell's (2008) *The Art of Game Design* describes psychological science as largely operating within the constraints of behaviorism and in contrast to the experiential, phenomenological approach that cannot be studied. That sharp contrast may be a useful rhetorical device but it misses many discoveries from cognitive science such as the cascade of mental activity that produces a particular emotion (see Cornelius, 1996; Ekman, 2003; Izard, Kagan, & Zajonc, 1984), the operation of intuition (see Myers, 2002), or our dual mental processing system (Kahneman, 2011). These insights can help game designers but the most helpful insight that game designers have borrowed from psychology is the science of motivation.

7.4.1 Maintaining Motivation in the Flow Zone

Werbach and Hunter (2012) describe how game designers balance *intrinsic* and *extrinsic motivation*. Tetris, again, is an easy example. It's both fun and challenging to manipulate those falling blocks (intrinsic motivation) but it also provides competitors' scores and personal best scores that you want to beat (extrinsic motivation). Game designer Jane McGonigal (2011) takes a similar path into the black box of experience through Mihály Csíkszentmihályi's (1975, p. xiii, 1990) description of *flow*, the satisfying, exhilarating feeling of creative accomplishment and heightened functioning that game designers sometimes refer to as *blissful productivity*.

The connections between game design and psychology are so close that McGonigal (2011) finds it difficult to distinguish between game design laboratories and psychological laboratories because both "are actively transforming what once was an intuitive art of optimizing human experience into an applied science" (p. 38). For example, game designers strive to create the *flow zone* or *flow channel* (Schell, 2008, p. 119) described in Fig. 7.2 by balancing between boredom and anxiety. In psychology, the parameters that create a flow zone have been studied for more

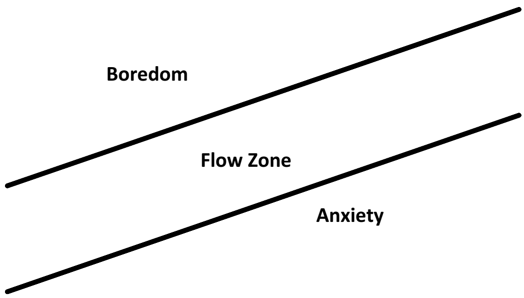


Fig. 7.2 Title. The Flow Zone. The flow zone in game design constantly rebalances boredom (from challenges that are too easy) against anxiety (from challenges that are too difficult) in order to keep players motivated to pursue optimal levels of performance

than a century, with the same goal of maximizing performance. It is sometimes called the Goldilocks effect because it describes the "just right" balance between frustration and challenge. More formally, optimal performance is known as the Yerkes-Dodson Law (1908) represented by the inverted V portrayed in Fig. 7.2 that describes optimal performance as a balance between too little and too much physiological arousal (see Anderson, 1994; Buchwald, 2010; Teigen, 1994).

7.4.2 Personality Types Among Gamers

Game designers also developed player types and their ideas fit imperfectly but well enough with scientific research in personality to be helpful. Like developmental theories of how people change over time, Gabe Zicherman and Christopher Cunningham (2011) described how gamers develop over time. They identified *noobs* or *newbies*, novice players; *problem solvers*, people who have mastered the basic rules; *experts*, players that are now working towards winning the game; *masters*, players that understand the full system from basic rules to small nuances; and *visionaries* or *elders*, players who are thinking of ways to improve the game. The term Noob and its variations provide some insight into game dynamics. Noobs or newbies can be annoying to established players because they often have no idea what they are doing as they learn to play a game. The label is also used in a patronizing manner to ridicule players who neglect to complete an important task. Variations of noob include *choob*, a high level player who behaves like a noob, and *froob*, a player who is free-loading by not paying to be a part of a game.

Richard Bartle (1996) organized gamer personalities based on an online focus group of people playing interactive *Multi-User Domain games* or *MUDs*. Bartle named four personality types that he mnemonically related to the types of playing cards: *Killers* (clubs, because they like to hit other players) impose themselves on other players and the game environment in order to demonstrate their superiority. *Achievers* (diamonds, because they are seeking treasure) regard points gathering and attaining new levels as their main goals. *Explorers* (spades, because they dig for information) want to discover and be surprised by the game world. *Socializers* (hearts, because they empathize with others) mainly wish to interact with the other players Table 7.3.

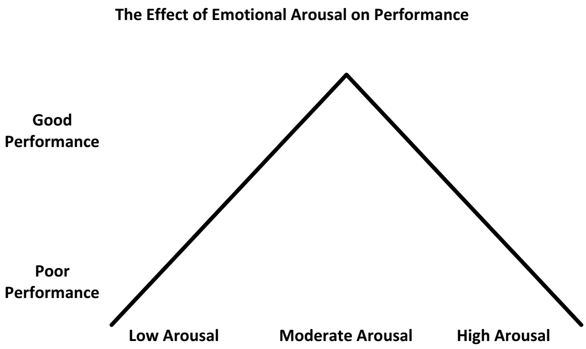


Fig. 7.3 Title. The Yerkes-Dodson Law (1908). Like the flow zone, the Yerkes-Dodson Law predicts optimal performance occurs when arousal is moderately balanced between two competing extremes

Table 7.2 Why gamers play: Yee's (2006) factor analysis of gamers' motivations

Achievement	Social	Immersion
Advancement (Progress, Power, Accumulation, and Status)	*Socializing* (Casual Chat, Helping Others, Making Friends)	*Discovery* (Exploration, Lore, Finding Hidden Things)
Mechanics (Numbers, Optimization, Templating, Analysis)	*Relationship* (Personal, Self-Disclosure, Find and Give Support)	*Role-Playing* (Story Line, Character History, Roles, Fantasy
Competition (Challenging Others, Provocation, Domination)	*Teamwork* (Collaboration, Groups, Group Achievements)	*Customization* (Appearances, Accessories, Style, Color Schemes)
		Escapism (Relax, Escape from Real Life, Avoid Real Life Problems)

Bartle's approach allowed for sub-types. *Trolls* and *Griefers* are players that sow discord in a game by deceiving other players or disrupting the game (Zichermann & Cunningham, 2011). To *Achievers*, the elements of the game (exploring, socializing, and killing) are only motivating when they contribute to winning. An Explorer is less devoted to the actual game but will enjoy *meta games*, difficult games/tasks that are hidden within larger games. *Explorers* are more likely to leave a game once they have explored it sufficiently, even if they have not achieved a very high level (Stuart, 2012). *Socializers* play to make friends and to expand their "friend" base (Zichermann & Cunningham, 2011) and are more likely to belong to online *guilds* and *kinships* who socialize within the game (Stuart, 2012).

The weaknesses of Bartle's approach are that a) we have no idea whether his descriptions are true, b) his conclusions are based on a particular sample, c) he assumes that one particular motive is always dominant, and d) he does not allow people to have mixed motives. Fortunately, Nick Yee (2006) took up the challenge of addressing some of these psychometric shortcomings by using a statistical technique called factor analysis. The study yielded the three major personality types described in Table 7.2, along with their 10 sub-components.

Table 7.3 Fitting Bartle's four personality types and Yee's three motivational types into the Big Five personality dimensions

Bartle: Personality		Achievers	Socializers	Explorers
Yee: Motivation	Killers	Achievement	Social	Immersion
Neuroticism	Bartle	Yee		
Conscientiousness		Bartle, Yee		
Agreeableness			Bartle, Yee	
Extraversion			Bartle, Yee	Yee
Openness to Experience				Bartle, Yee

How have the personality theories of game designers fared compared to 65 years of personality research? Not too bad; Table 7.3 suggests the conceptual overlap between the speculations of game designers and the science of personality researchers. The science of personality research reveals that the same five personality dimensions (called the Big Five) persist over time and across cultures (see DeRaad & Perugini, 2002; Fossati, Borroni, Marchione, & Mafei, 2011). The acronym OCEAN can help you remember Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism and represent what Sampaio et al. (2013) call the *default brain*, the automatic personality dimensions that, when mixed together, described every individual personality. If game designers want to tap human personality, then they should look to the Big Five. Table 7.3 specifies how the Big Five overlap with game designer Bartle's (1996) personality types and Yee's motivational categories.

7.4.3 Games and the Science of the Self

Many video games employ a visual language that represents particular understandings of the self and its capabilities. As a *first-person shooter*, we experience the graphical display as if through our own eyes (e.g., *Call of Duty*, *Doom*, *Halo*, *Turok*), need a mirror to observe ourselves, and experience changes in the environment with simulated head movements or by traveling to new areas within the game. A first-person shooter identifies his *avatar* so closely that the player/avatar will see a flash of red (blood) when struck or when his own hands are represented as picking up and using objects. In contrast, a *third-person shooter* can witness an overview scene that includes a character controlled by the player (e.g., *Grand Theft Auto*, *Max Payne*, *SOCOM*). This third-person perspective usually allows the player to zoom-out for map-like perspective or zoom-in, sometimes all the way to the first-person perspective.

Compared to third-person shooters, first-person shooters usually require greater spatial precision in character movements and allow for rapidly sequenced actions in time (see Claypool & Claypool, 2006). The use of remote sensing/acting drones and avatars that produce a third-person perspective on "self" motion is a very recent perceptual phenomenon. And while our cognitive/perceptual representation of the world may develop to be independent of our bodies—such that we can turn our heads and accurately maintain a stable representation of the environment—our perceptual representation is grounded in an egocentric perspective (see Burgess, 2006; Gibson, 1986/1979 for reviews).

Perhaps more intriguing is the empathy we feel for our characters. First-person characters are designed to represent our body and senses. "I" move, "I" attack or defend myself, and "I" look around to orient myself within the virtual world to facilitate faster reaction times and more precise, coordinated movements of "my" body. In contrast, the third-person perspective is almost voyeuristic, analogous to remotely controlled objects. Cognitively, this requires extrapolation to the character's perspective and thus facilitates a more omniview interaction with the game. Rather than strategizing to protect "myself" and to achieve "my" goals, I help my character achieve these ends. The differences in first person and third person perspectives has been supported by neural studies. A review by Vogeley and Fink (2003) suggests that *empathizing*, experiencing another person's perspective, occurs in third-person but not in first-person game play by recruiting neurons in the inferior-parietal and medial-parietal cortex, brain regions involved in the concept of self-identification (Blanke, 2012; Vogeley & Fink, 2003).

Beyond these neural descriptions, the language of scientific psychology does not seem to offer a corresponding distinction between first and third person perspectives. There are, however, experiments about the self that suggest how game designers can drop people into and pull people out of the flow experience. Most of this may be found in the social psychological literature about the self, starting with a definition in 1890 by William James proposing that the *self* is the sum total of all that a person can call his own (psychological ownership as well as material ownership). Game designers seem to understand the *mere ownership effect* because they often provide psychic rewards by using physical objects to influence our sense of self (Beggan, 1992).

The well-known *cocktail party effect*, for example, describes our ability to hear our own name in the middle of a noisy party generalizes to comparable situations. We also feel as if we somehow "own" our names, including the adjectives that we think describe us (Rogers, Kuiper, & Kirker, 1977). And if we choose a lottery ticket, rather than have one handed to us, then we want more money for it (Langer, 1975). Felt ownership of just about *anything*—even virtual goods—seems to make those things more valuable to us. Perhaps that is why Napoleon Bonaparte may (the attribution is unclear) have said that, "I have made the most wonderful discovery… men will risk their lives, even die, for a bit of ribbon." When properly manipulated, earning and therefore owning those PBLs (points, badges, and leaderboard) that compose the common elements of most games are direct arrows to our sense of self.

7.5 Warnings

So far, we have demonstrated that the language of games often corresponds to established scientific principles of psychology especially within behaviorism, cognitive science, and personality research. However, the scientific literature also contains some cautionary flags that game designers should know about.

7.5.1 Video Game Addiction

Some games certainly appear to be "addictive" so it may help game designers to look more closely at the comparison. Drug addicts desire their particular drug so much that they will betray friendships, disown family members, and devote all of their scarce (and often vanishing) resources to achieve that one cherished thing: Getting high. Do video games have a similar effect? A cross-disciplinary review by Hellman, Schoenmakers, Nordstrom, and van Holst (2013) suggests that comparisons between drug addiction and video game addiction are justified, albeit more in kind than in magnitude. Another review by Sim, Gentile, Bricolo, Serpelloni, and Gulamoyden (2012) provides similarly cautious validation that there is a problem but that it does not fully correspond with the criteria for an addiction—but it's pretty close. They suggest using a more precise yet encompassing phrase, *Pathological Technology Use*, to describe how chronic overuse of a technology can undermine an individual's self interests. Whatever we call it, the people cooking the product, game designers, are among the people who bear some measure of responsibility about its abuse. Educators fighting to keep students persisting toward a degree, however, would love to have a bit more addiction to learning.

7.5.2 Undermining Intrinsic Motivation

Pursuing our intrinsic interests appears, on average, to be good for our health and those positive effects generalize to education and creativity. For example when Niemiec, Ryan, and Deci (2009) followed students 1 year after graduation, they found that those who had placed importance on achieving their goals, whether out of intrinsic or extrinsic motivation, were more likely to have achieved those goals. So, just having a goal was a good thing. However, those students who had attained their intrinsic aspirations displayed more psychological health while those students who had attained their extrinsic aspirations displayed more indicators of ill-being. The *over-justification effect* seems to help explain why extrinsic and intrinsic motivation are so important. If you start paying people for what they once did because they loved doing it (intrinsic motivation), they will now only do if you keep giving them external rewards (extrinsic motivation).

Educators who impose PBLs into their curriculum and think they have gamified their curriculum have not only missed the motivational insights of game design, they may be harming their students. The negative effects on the quality of creative products are predictable. A meta-analysis of 15 papers over 20 years of experimentation indicates that the positive relationship between intrinsic motivation and creative productions is consistent and holds true across samples of both students and employees (see Amabile, 1985; Deci & Ryan, 1987; deJesus, Rus, Lens, & Imaginario, 2013; Niemiec, Ryan, & Deci, 2009). Game designers are already familiar with the challenge of maintaining players in the flow zone; they also need to be careful about slapping PBLs on top of anything just to call it game. We do not want to discourage our best students.

7.5.3 Believing Psychological Myths

When applying psychology to games, game designers should be as cautious as researchers are careful because there are many *psychological myths*, false but commonly believed psychological "pseudo-facts." For example, aggression is a common theme in many games but fighting, shouting, or hitting a pillow doesn't "get it out your system"—in fact, it often has the opposite effect. Here is part of a true–false test of psychological knowledge adapted from a book by Lilienfeld, Lynn, Ruscio, and Beyerstein, (2010) (Table 7.4).

What's so bad, you might wonder, about believing something about psychology that turns out not to be true? And what does that mean for game design? Well, it means that some of your beliefs may be unintentionally harmful to yourself or others. For example, the statement that "Some people are left-brained; others are right-brained" is false. The grain of truth in this statement is buried in the beach sand of money-making, pop psychology. Yes, there were famous experiments that, for valid medical reasons, surgically severed the connection between the two hemispheres of the brain (Gazzinga, 1998). And yes, that led to the discovery that each hemisphere was specialized and could operate independently of the other. But that's exactly the point: these were dysfunctional people; their brains had been surgically severed. You do *not* want anything like that to happen to you. In a normal brain, the two hemispheres are always working together, like the two foot-pedals on either side of a bicycle. (Imagine trying to pedal a bicycle if each pedal operated independently). Convince yourself that you don't want to be either left-brained or right-brained by first drawing with one hand. Then draw a circle with the other hand. Now, draw the triangle and circle at the same time (both hands moving at once). If your triangle suddenly is more circle-like, or if your circle starts to become a bit pointy, thank your corpus callosum for keeping the two hemispheres of your brain pedaling together in harmony.

But again, what's so wrong with a little psychological misunderstanding, especially if it lets you feel smart? Maybe nothing; the right brain-left brain myth may not lead to anything more dangerous than expensive, bogus brain-training interventions. However, it can be more dangerous when game designers communicate the false belief that a) it's best to express anger to others rather than hold it in;

Table 7.4 A test of psychological knowledge

T	F	Most people use only 10 % of their brainpower
T	F	Individuals commonly repress the memories of traumatic experiences
T	F	If you're unsure of your answer when taking a test, go with your initial hunch
T	F	The defining feature of dyslexia is reversing letters
T	F	Students learn best when teaching styles are matched to their learning styles
T	F	It's better to express anger to others than to hold it in
T	F	Low self-esteem is a major cause of psychological problems
T	F	People's responses to inkblots tell us a great deal about their personalities
T	F	There's recently been a massive epidemic of infantile autism
T	F	Criminal profiling is helpful in solving cases

T True or Mostly True, *F* False or Mostly False

b) virtually all people who confess to a crime are guilty of it; or c) most mentally ill people are violent. Popular psychology is an industry that, at enormous profit, dramatically over-simplifies a complex world and encourages stereotypes that end up as counterproductive but expensive interventions that artificially assign people into categories that automatically leads to prejudice (Tajfel, 1970; Tajfel & Billig, 1973).

Unfortunately, game designers already are passing along myths and encouraging negative stereotypes. Bean, Sinatra, and Schrader (2010) have criticized the game *Spore* for inadvertently communicating inaccurate information about evolution. Jesse Fox and Wai Yen Tang (2013) discovered that the substantial sexism in video games was also associated with masculine norms such as a desire for power over women. Paul Stermer and Melissa Burkley (2012) found that playing video games increased attitudes of benevolent sexism for male gamers, but not for female gamers. When Karen Dill and Kathryn Thill (2007) conducted a content analysis of the top-selling gaming magazines, they found that the male characters (83 %) were more likely than the female characters (62 %) to be portrayed in aggressive ways, that female more than male characters were more sexualized (60–1 %), scantily clad (39–8 %), and mixed sex with aggression (39–1 %). Sex and violence? Again? Surely the creative, forward-thinking gaming community can dare to be more original than that.

Oh, yes. How did you score on the Knowledge of Psychology quiz? The answers are all false. The stakes in knowing what's true from what's false are high. If we can gamify higher education in meaningful ways that promote mastery of psychological material, then we can help successive generations of students learn from virtual experiences why some beliefs are false and how to use the science of psychology to discover what is true.

7.6 Summary and Future Directions

The purpose of this chapter was to use the evolving language of game design to establish a scientific foundation for game-based approaches in higher education. We started by summarizing the history of games in the psychological literature. We then described how the sciences of behaviorism, cognitive science, and personality psychology correspond to and inform game design. We also extracted warnings from the scientific literature about video game addiction, the hazards of undermining intrinsic motivation, and the danger of game designers naively endorsing popular myths about scientific psychology. We conclude now with the modest research program described below.

The over arching goal of this research agenda is to test the validity of reframing higher education around game-based principles; we perceive three prominent but manageable difficulties. First, there are so many interacting game elements that discovery requires many experiments to isolate which, if any, combinations are most effective. Second, even with experimental controls at the outset, the eventual application of game-based thinking to higher education will have to mix science and art into a craft. Third, designing effective games for higher education will soon require financial investments for coders, designers, and related specialists. The way through those difficulties is to start small, pick the low-hanging fruit, and test proof of concept. We want to know sooner rather than later if game-based thinking is incompatible with higher education.

A coherent research agenda requires a meta-theory, a clear set of theoretical questions, a trustworthy methodological paradigm, and testable hypotheses—and a handful of enthusiastic gamer-scientist collaborators. We rely on evolutionary psychology as our meta-theory because it explains the persistence of game-playing over centuries and across cultures. We have chosen a constellation of theoretically-driven questions that adapt game-based principles to the creation of more effective student retention interventions. Student persistence to degree a) may be the most urgent financial and ethical question facing higher education, b) lends itself to mixed methods that include experimentation, and c) is the kind of motivational problem that game-based interventions should be able to solve. Consequently, this short-term agenda tests the effects of one element of games: points.

We could have started by researching any number of game elements such as the types of leaderboards, the variety of badges, the effectiveness of checkpoints, the types of social comparisons, the timing of the feedback loop, and even whether participants should be told that they are being guided by game-based thinking. But the manipulation of points is a convenient and modest beginning because we can test the motivational consequences of a) small certifications for leveling up; b) types of visual feedback about progress toward degree; c) whether big numbers typical of games (balloon points) are motivating in education; and d) a framework for points that begins with zero rather than subtracting from 100. In addition, the variable we are most interested in, student retention, requires a non-experimental, time-series approach that will take 4–6 years for the first meaningful data points to emerge. Overall, it will require a great deal of basic, psychometric research to transform a squishy but effective art form into a reliable, practical guide that can help meet the evolving needs of higher education. However, it appears that the initial problem we have chosen—student retention—is worthy of a corresponding investment. It is also a motivational problem that game-based thinking should be able to address.

References

Amabile, T. M. (1985). Motivation and creativity: Effects of motivational orientation on creative writers. *Journal of Personality and Social Psychology, 48*, 393–399.

Anderson, K. J. (1994). Impulsivity, caffeine, and task difficulty: A within-subjects test of the Yerkes-Dodson law. *Personality and Individual Differences, 16*, 813–829.

Ariely, D. (2008). *Predictably irrational*. New York: HarperCollins.

Ayllon, T., & Azrin, N. (1968). *The token economy: A motivational system for therapy and rehabilitation*. New York: Appleton Century Crofts.

Bartle, R. (1996). Heart, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research, 1*. http://www.mud.co.uk/richard/hcds.htm.

Bean, T. E., Sinatra, G. M., & Schrader, P. G. (2010). Spore: Spawning evolutionary misconceptions? *Journal of Science Education and Technology, 19*, 409–414.

Blanke, O. (2012). Multisensory brain mechanisms involved of bodily self- consciousness. *Nature Reviews. Neuroscience, 13*(8), 556–571.
Brewer, M. B., & Kramer, R. M. (1986). Choice behavior in social dilemma: Effects of social identity, group size, and decision framing. *Journal of Personality and Social Psychology, 50*, 543–549.
Buchwald, P. (2010). Test anxiety and performance in the framework of the conservation of resources theory. *Cognition, Brain, Behavior: An Interdisciplinary Journal, 14*, 283–293.
Burgess, N. (2006). Spatial memory: How egocentric and allocentric combine. *Trends in Cognitive Sciences, 10*(12), 551–557.
Castronova, E. (2007). *Mass exodus to the virtual world*. New York: Palgrave Macmillan.
Claypool, M., & Claypool, K. (2006). Latency and player actions in online games. *Communications of the ACM, 49*(11), 40–45.
Cornelius, R. R. (1996). *The science of emotion: Research and tradition in the psychology of emotions*. Englewood Cliffs, NJ: Prentice-Hall.
Crampton, C. W. (1909). Education by play. *Educational Review, 38*, 488–492.
Csíkszentmihályi, M. (1975). *Beyond boredom and anxiety: The experience of play in work and games*. San Francisco: Jossey-Bass.
Csíkszentmihályi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper.
Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*, 1024–1037.
deJesus, S. N., Rus, C. L., Lens, W., & Imaginario, S. (2013). Intrinsic motivation and creativity related to product: A meta-analysis of the studies published between 1990–2010. *Creativity Research Journal, 25*, 80–84.
DeRaad, B., & Perugini, M. (2002). *Big five assessment*. Seattle, WA: Hogrefe and Huber.
Dill, K. E., & Thill, K. P. (2007). Video tame characters and the socialization of gender roles: Young people's perceptions mirror sexist media depictions. *Sex Roles, 57*, 851–864.
Ekman, P. (2003). *Emotions revealed: Recognizing faces and feelings to improve communication and emotional life*. New York: Henry Holt and Co.
Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. East Norwalk, CT: Appleton.
Fossati, A., Borroni, S., Marchione, D., & Mafei, C. (2011). The Big Five inventory (BFI) in three independent nonclinical samples. *European Journal of Psychological Assessment, 27*, 50–58.
Fox, J., & Tang, W. Y. (2013). Sexism in online video games: The role of conformity to masculine norms and social dominance orientation. *Computers in Human Behavior, 33*, 314–320.
Gazzinga, M. S. (1998). The split brain revisited. *Scientific America, 279*, 123–133.
Gibson, J. J. (1986/1979). *The ecological approach to visual perception*. Hillsdale, NJ: Lawrence Erlbaum.
Groos, K. (1898). *The play of animals*. New York: Appleton.
Hawking, S. (2003). *On the shoulders of giants*. Philadelphia: Running Press.
Hellman, M., Schoenmakers, T. M., Nordstrom, B. R., & van Holst, R. J. (2013). Is there such a thing as online video addiction? A cross-disciplinary review. *Addiction Research & Theory, 21*, 102–112.
Herger, M. (2011). *Introduction to gamification: Train for success*. Retrieved from http://www.enterprise-gamification.com/attachments/038_Gamification_Workshop_Train_For_Success.pdf.
Ifenthaler, D., Eseryel, D., & Ge, X. (2012). Assessment for game-based learning. In D. Ifenthaler, D. Eseryel, & X. Ge (Eds.), *Assessment in game-based learning: Foundations, innovations, and perspectives* (pp. 1–8). New York: Springer.
Izard, C. E., Kagan, J., & Zajonc, R. B. (1984). *Cognition & behavior*. New York: Cambridge University Press.
James, G. (1986). The tao of programming. Info Books, retrieved from http://www.canonical.org/~kragen/tao-of-programming.html
Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.
Kazdin, A. E. (1982). The token economy: A decade later. *Journal of Applied Behavioral Analysis, 15*(3), 431–445.
Kazdin, A. E., & Bootzin, R. R. (1972). The token economy: An evaluative review. *Journal of Applied Behavioral Analysis, 5*(3), 343–372.

Langer, E. (1975). " The Illusion of Control ". *Journal of Personality and Social Psychology, 32*, 311–328.

Lilienfeld, S. O., Lynn, S. J., Ruscio, J., & Beyerstein, B. L. (2010). *50 great myths of popular psychology*. West Sussex, England: Wiley-Blackwell.

Lloyd, K. E., & Garlington, W. K. (1968). Weekly variations in performance on a token economy psychiatric ward. *Behaviour Research and Therapy, 6*, 407–410.

Matson, J. L., & Boisjoli, J. A. (2009). The token economy for children with intellectual disability and/or autism: A review. *Research in Developmental Disabilities, 30*(2), 240–248.

McGonigal, J. (2011). *Reality is broken*. New York: Penguin Books.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for information processing. *Psychological Review, 63*, 81–97.

Myers, D. G. (2002). *Intuition: Its powers and perils*. New Haven, CT: Yale University Press.

Niemiec, C. P., Ryan, R. M., & Deci, E. L. (2009). The path taken: Consequences of attaining intrinsic and extrinsic aspirations in post-college life. *Journal of Research in Personality, 43*, 291–306.

Parsons, B. R. (1909). *Plays and games for indoors and out*. New York: A. S. Barnes and Company.

Poundstone, W. (1992). *Prisoner's dilemma*. New York: Doubleday.

Prelec, D., & Simester, D. (2000). Always leave home without it: A further investigation of the credit-card effect on willingness to pay. *Marketing Letters, 12*, 5–12.

Prensky, M. (2001). Fun, play, and games: What makes games engaging. In *Digital game-based learning* (Chapter 5). New York: McGraw-Hill.

Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the ecncoding of personal information. *Journal of Personality and Social Psychology, 35*, 677–688.

Roth, W. E. (1902). Games, sports, and amusements North Queensland Ethnography: Bulletin No. 4. *American Anthropologist, 4*(3), 527–528. Brisbane.

Sampaio, A., Soares, J. M., Coutinho, J., Sousa, J., Gonçalves, O. F. (July 24, 2013). The big five default brain: Functional evidence. Brain Structure & Function.

Schell, J. (2008). *The art of game design*. Boca Raton, FL.: Taylor & Francis.

Sheldon, L. (2012). *The multiplayer classroom*. Boston: Cengage.

Skinner, B. F. 'Superstition' in the pigeon. *Journal of Experimental Psychology, 38*, 168–172.

Sim, T., Gentile, D. A., Bricolo, F., Serpelloni, G., & Gulamoyden, F. (2012). A conceptual review of research on the pathological use of computers, video games, and the Internet. *International Journal of Mental Health and Addiction, 10*, 748–769.

Stermer, S. P., & Burkley, M. (2012). SeX-Box: Exposure to sexist video games predicts benevolent sexism. *Psychology of Popular Media Culture*. doi:10.1037/a0028397.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643–662.

Stuart, B. (2012). *Personality and play styles: A unified model*. Retrieved from http://www.gamasutra.com/view/feature/6474/personality_and_play_styles_a_.php?print=1.

Suellentrop, C. (2013). *It isn't just about fun and games* (p. C4). New York: The New York Times.

Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American, 223*, 96–102.

Tajfel, H. M., & Billig, M. G. (1973). Social categorization and intergroup behavior. *European Journal of Social Psychology, 3*, 27–52.

Teigen, K. H. (1994). Yerkes-Dodson: A law for all seasons. *Theory & Psychology, 4*, 525–547.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*, 453–458.

Vogeley, K., & Fink, G. R. (2003). Neural correlates of the first-person perspective. *Trends in Cognitive Sciences, 7*(1), 38–42.

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Philadelphia: Wharton Digital Press.

Wilkinson, N. (2008). *An Introduction to behavioral economics*. London: Palgrave Macmillian.

Winch, W. H. (1906). The psychology and philosophy of play. *Mind, 15*, 32–52.

Yee, N. (2006). Motivations for play in on-line games. *Cyber-Psychology and Behavior, 9*, 772–775.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*, 459–482.

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design*. Sebastopol, CA: O'Reilly Media.

Chapter 8
Context to Culture for Gamification HCI Requirements: Familiarity and Enculturement

Robert Wellington

8.1 Introduction

Gamification design is, on the face of it, more difficult than traditional game design for entertainment and recreation. You have an imposed 'lesson', whether it be content or a dynamic, that needs to be embedded, and you often have the task of encouraging the majority of the target audience to 'play' the game, whereas, games in general are often played by a select group with a strongly stereotypical personality type. For example, introvert and extrovert gamers have different ways of interacting both individually and in group play in a gaming experience, but are often not explicitly accounted for in the design of the experience (Zainal Abidin & Wellington, 2013).

The *image* of the gamified experience lays on the surface, the Human Computer Interaction (HCI), and more specifically in something that is known in HCI as embodied in the concept of *affordance*. To attract the diversity of the audience to be engaged in the experience requires engineering of the perceived interaction by careful design of *affordance*.

'Building a better mousetrap' has often been used in the literature to explain the issue in marketing of the design of a contextually better device that *should* sell; however, the mousetrap idea is developed to conclude that it will not sell if it is not communicated through marketing to the audience. Communication plays a key part in this, and culture, both explicitly and implicitly is a key part of much of the marketing dialogue about this phenomena. In this chapter we extend the cultural communication impact to the perception of the gamified experience itself, and using affordance show that the design of the game device is paramount to make it marketable, and ultimately a good gaming experience for the users/gamers.

R. Wellington (✉)
School of Computer and Mathematical Sciences, Auckland University of Technology,
Private Bag 92006, Auckland 1142, New Zealand
e-mail: rwelling@aut.ac.nz

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_8

I will be describing the concepts of culture and context in relation to game design in order to explain how games are perceived. Neither of these two concepts are unknown, nor novel; however, rarely are they regarded as properly separate. I distinguish them and show how they lead to two important processes for game design and requirements engineering, familiarity, and enculturement. This is undertaken theoretically in the dialogue below, but does have some grounding in experiences in researching gaming (Wellington & Zainal Abidin, 2011), using gaming environments for research (Wellington, 2011) and in using game environments for teaching usability research process.[1]

Both context and culture are important considerations for the design of any artefact, and I am not suggesting that the principles in this chapter should not be significant in the broader discipline of Information Systems and Computer Science; however, there are aspects of game design that heighten the relevance of these principles. Game designs often have an embedded/hidden interaction method, and are usually highly interactive, system—player, player—system—player. Games often have a high communicative content {language, symbology, and iconology}, and they are usually always attempting to provoke an emotional response from the player. In the business and educational field, they are also usually affective, attempting to change the way the player feels or thinks about some thing. Each of these characteristics elevate the need for awareness of context and culture, as game design goes beyond simple functional interaction.

A common understanding of culture is that it is a 'shared' totality of beliefs, and knowledge. The 'sharing' is communication, and was expertly summarised in 1967 by Berger and Luckman in "The Social Construction of Reality". We have 'social objectifications' that are as real to us as the laws of physics, but that are institutionalised over time through communication, and communicated (overt) behaviour. These social rules are not static but may be slow to change, and individuals finding themselves outside of their own culture, find it difficult to operate socially. A game that pays no regard for these cultural norms can end much like a tourist 'out of their depth' for a player/user. It is only when the social rules are accommodated and in sympathy with use that unobtrusive interaction can occur.

If culture was not important enough to gaming in its own right, the pivotal work of Eduardo Neiva (2007) places communication and culture directly in the domain of game theory. Indeed, the interactions that occur in the process of communication can be defined similarly to gaming interaction; negotiation, conflict, competition, collaboration, deception etc. Sex according to Neiva for instance (ibid), can be considered as a zero-sum game, as when one male is successful in mating, others fail, and success is embedded in communicative ritual. Not just in human procreation, but all animals use vocal, visual, overt behaviour, or other mechanisms to attract a mate, or vie with other of their gender.

[1] The author has been teaching both undergraduate and postgraduate Human Computer Interaction papers for many years and has had many students use console gaming environments to study usability theory and to learn usability research processes.

Context of use could be considered to be the collection of activities, methods, resources, and functions, inherent in a human activity. Where the activity can be considered to have some universality. At the primitive level this may relate to hunting, making fire, or gathering food. In the modern world it might be cutting a piece of wood, or cooking rice. Context relates to human activity, and typically it is useful to understand how people do 'things'.

Software engineering often talks about the importance of context, and the user profile. Personas are developed that represent potential users, or a real user group, but this in itself is an abstraction that creates a barrier between the developer and the real users. However much of that abstraction has been developed from real data, the persona is that which is referred to in understanding the interaction with the system, and a certain amount of the developers 'rationality' creeps in to incorporate much sought after simplicity. Hence, the separation of 'functional' and 'non-functional' requirements that trivialises the cultural aspects of the system/game. Hopefully by the end of this chapter I would have built an argument to be more sensitive to both context and culture dually, and an understanding of how they intermediate the gaming experience.

8.2 A History of Affordance

Affordance has been attributed to 'being' context (Turner, 2005). It has been allied with fundamental social theory, bordering on philosophy (Gibson, 1979), and it has been included in many HCI class texts as significant to the discipline. Affordance, if you understand but a grain of the literature, is absolutely core to any study of HCI and pivotal in any design of a system that humans interact with, and therefore with the success of almost any artefact in the computing field, or indeed in the design of any artefact that might be used for gaming whether it is computer based or material. Affordance is at the centre of the dynamic of human and artefact communication, it is the 'language' by which we interact with our surroundings, and fits closely with the discussion of culture and context.

Simply put, affordance is the property of an artefact that gives meaning to (communicates) its purpose. Affordance could be purposely designed into an artefact, it can be accidental, and it can be *false*. Affordance historically stems from the physical and material properties of artefacts. A few simple examples from around the house are;

- Round knobs that *afford* rotation, especially if there is a textured or flat surface for gripping.
- Textured or shaped handles that *afford* holding.
- Sharp edges that *afford* cutting.

However, in computing there are some obvious examples that stem from the physical properties of artefacts that have evolved into virtual representations. The save icon in many applications is a representation of a 3½ in. floppy disk, something that many computer users of this era have never actually seen, and ‘buttons’ mimic their physical counterparts visually using shadow. As you explore the virtual world of computing you will see more and more connection to historic material affordance, and of course, an emerging *institutionalised* cultural, social reality that is one side of the coin of this chapter.

Affordance has quite a history; with Gibson (1979) given some credit for the original concept, and Norman (1988) the popularity in HCI. Gibson promoted the ecological theory of affordance as part of social theory, later referred to as *real* affordance. Here, there is the concept of affordance being inter-subjective and inherent in material artefacts or natural objects. Water affords drinking, a bowl affords carrying, a sharp rock affords cutting, and a heavy short tree branch affords hitting someone over the head with. In fact, the real affordance of the physical properties of a material object can be seen from the evidence of a modern example of the psychological impact of bayonet charges in the Falklands war and Iraqi confrontations. Despite modern warfare weapons rendering the bayonet obsolete, they have still been used effectively, as they can be *terrifying*, the bare blades and loud shouting ‘affords’ being cut into small pieces in a barbaric fashion and thus renders fear in the enemy despite the greater chance of being injured or killed from projectile or explosive weapons.

Moving from Gibson to Norman we change to the perception based theory of affordance of Norman that is viewer subjective. Here we have *perceived* affordance, that relates better to a more complex human constructed environment. The obvious and most often used example is a ‘D’ pull on a door that ‘affords’ pulling, and a ‘push plate’ that affords pushing, and the most commonly understood situation of when the interior designer puts ‘D’ handles on both sides of the door because they look nicer, but the doors only open one way. Then you have many people pulling on the non-opening side, as the ‘D’ handle affords this behaviour even if the doors don’t allow it. It is a perceived affordance and not an inherent property of artefact. I also remember an example on a car stereo where the tuning/volume/selection knob was a featureless round control that was multi-purpose, depending on which ‘mode’ you were in. Unfortunately I did not realise that you could also press the knob ‘up’ or ‘down’ to make selections in menu mode. Apart from the rotational feature afforded to the roundness of the control, there was no other visual affordance, and the only reason for determining the other functionality was the haptic feedback received on one occasion when accidentally pushing the control. This would be what is now called a hidden affordance, but Gibson would not determine this an affordance at all as there is no visual communication of the functionality.

The moment that I grew more interested in this concept, and that it might be explainable by both context and culture dually was when I was reviewing video of an interview I had undertaken of an air force pilot in the cockpit of a military helicopter. The particular instance that caught my attention was when the pilot was explaining how the indicator needles all lined up when they were operating at nominal conditions. This I remembered from the interview; however, on zooming in on the picture I noticed, in hindsight, that the controls had been rotated within their housings so that their nominal positions would line up. This then was a modification

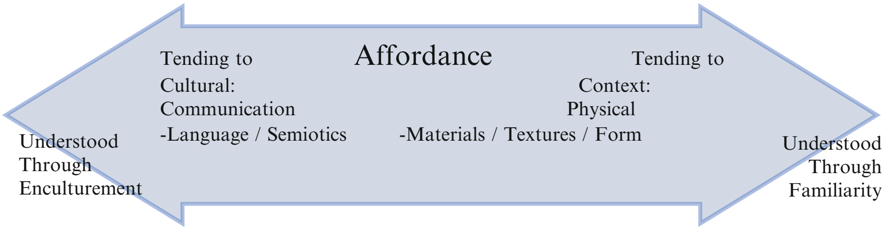


Fig. 8.1 Affordance, the contiuum between context and culture

within the confined cultural group of the squad—the phenomena did not extend to other squads as another interview confirmed the culturally idiosyncratic nature of it—it was a cultural interpretation and modification of what would otherwise be mostly a contextual affordance. This led me on an effort to explore affordance further.

Affordance has been taken further by other authors in the HCI area, such as Gaver (1991), Hartson (2003), and Turner (2005). Hartson's (2003) definitions of '*cognitive*, *physical*, *sensory*, *and functional affordances*' have been widely cited, and constitute some theory development from Norman, and some clarity between '*real*' and '*perceived*' affordances. However, the physical, ecological, and task focus of affordance theorising still dominate and it has been suggested it could be re-grounded using a '*socio-cultural framework*' (Kaptelinin & Nardi, 2012), and that Gibson's theory of affordance still needs to be extended to include such phenomena as '*communication*, *culture*, *and context*' (2012, p. 967).

Affordance as context (Turner, 2005) is a common perspective, with context being paramount and familiarity with the context being necessary for the understanding of affordance cues. The proposal of this chapter is that at one end of a continuum of affordance you do have the context (Figure 8.1), the physical reality that represents human activity and artefacts and that dominates the literature on affordance; however, culture is something else, it is not the physical ecological view that sits well with *task analysis*, or *work flow*, it is the virtual socially constructed set of social objectifications that allow us to navigate in a cultural environment. Indeed, culture at its core is communication, and hence the human interaction with the system, comprising of communication artefacts, is predominantly cultural.

If we put culture at the other end of the continuum then we have culture (language/semiotics etc.) at one end and context (physical reality) at the other. At the very extreme ends of the continuum you have the individual (self) at one end and generalisable (positivistic) universality at the other, although I will not be attempting to argue to these extremities in this chapter. I will; however, be attempting to show that culture and context provide two useful points between which a range of research and development strategies into affordance, and therefore HCI and Gamification, can be designed.

There are references to affordance as communication (Hartson, 2003, p. 319, Bardone, 2010, p. 136), but seldom are there references to communication theory. Considering that artefacts in HCI often have text labels and symbolism it is a wonder that there is not a greater connection to general language and communication theory and semiotics. Communication is synonymous with culture, and indeed we can find reference to culture in the affordances literature. However, perhaps it is believed that the concept of affordance transcends communication, as communication artefacts could conceivably be analysed using affordance theory. I would suggest that whatever the relationship is between affordance theory and communication theory there must be substantial overlap.

Media genre could be considered *context* in communication, it has some cross-cultural propagation, but is still culturally dependent; however, culture becomes more significantly manifest in genre instantiations. Media genre transcend specific communication channels (Wellington, 2005), much as context transcends cultural boundaries and technological platforms in the HCI field. The core of Social Constructionism is communication (Berger & Luckmann, 1967), and similarly many of the tools we use in gaming are socially constructed (Turner, 2005, p. 791,793) and gain legitimacy through communication within a culture {talking about them}, and furthermore, in that the meaning [purpose, utility, what it '*offers*' (Hartson, 2003, p. 316)] of the tools is communicated through affordance, the tools themselves are communication artefacts. The labeling and referencing through language creates social objectifications, and so it is with HCI tangible and intangible interaction elements. As such, semiotics, denotation, connotation, ambiguity, equivocality, are all applicable in the study of HCI, and material artefacts. More often than not culture and context are bundled together or confused in the literature on affordances, and often elsewhere in HCI and Information Systems (IS) Literature; however, it is this indiscriminate use of these two terms that needs attention. Why use the terms interchangeably when there is a difference in meaning? In fact, it is my belief that an important distinction between these terms can aid us in understanding the nature of affordance, and in turn, the epistemological basis for researching it and applying it in the development of artefacts for gamification and computer artefacts more generally.

8.2.1 Confusion Between Culture and Context

The use of context and culture are sometimes treated synonymously, or sometimes context is treated as a derivative of culture. The easiest way to explain the distinction here is to differentiate context. The concepts of affordance in HCI and in the analysis of artefacts in general relate to technologies. Technologies often have a cultural origin; however, the natural development of similar technologies across independent cultures indicates that the context of use is also a strong initiator of design, and now the internationality of technologies suggests that the context of use is strongly formative in the interpretation of controls. A car, a bike, an electric drill, a spreadsheet application, all have strong contexts within which we can interpret the meanings of the intended controls. Hartson (2003), p. 322 says "*To put Gibson's ecological view in HCI terms, affordances have a relational ontology: their* *existence as an affordance is relative to the environment of users and usage. In HCI, the user's environment is the work context plus the interaction design.*"

The references to context in the affordance literature are many, Turner (2005) discusses the 'Soviet' school in relation to Ilyenkov's '*significances*' that, interestingly, he says "*These signifcances are ideal that is, they are subjective and independent of an individual mind existing instead in the collective—affordances/significances are the visible manifestations of our culture.*" However, he then continues, "*So, it would appear that on affordances, Ilyankov and Heidegger, despite differences in language, are of one mind. A thing is identified by its use- that is, we identify it through its affordances or significances—so as equipment is context, affordance and context must be synonyms.*" This clearly demonstrates a confused set of overlapping arguments that cannot explain a differentiation of culture and context.

For example Turner states "*researchers in the field of CSCW have noted that artefacts mediating cooperation are frequently socially constructed and their affordances can be seen to differ from one workplace to another. … To be useful by these different communities they must be sufficiently flexible to be used in different ways, by different people for different purpose in a range of contexts.*", and if social constructionism is taken to mean within cultures as is normal then some confusion arises from this use of the terms as well.

If we revert culture to the traditional definition then we find this may be different from context, indeed we can intentionally make it different and use that difference to aid our understanding of affordance. Culture is about language, communication, and a shared understanding amongst a group of people, although that sharing and understanding is by no means static. A cultural group may be large, small, dispersed, co-located, overt, covert, evolving, institutionalised, or even ephemeral.

The cultural independence of affordance has predominated the early views in the literature, but has slowly evolved. Gaver (1991), p. 81 states, "*The actual perception of affordances will of course be determined in part by the observer's culture, social setting, experience and intentions. Like Gibson I do not consider these factors integral to the notion, but instead consider culture, experience, and so forth as highlighting certain affordances.*" In this way, culture is seen as a mediator of *familiarity*, as it is with Ilyenkov's perspective of "*…the process of becoming **encultured** into this objectified, historically developed world.*" [emphasis added] (Turner, 2005, p. 795). However, Turner (2005), p. 797, discussing Heidegger, suggests that familiarity is in relation to assumed or acquired identities "*Thus by worlds we mean cultural worlds.*" Which is supported by Kaptelinin and Nardi (2012, p. 973) in their socio-cultural framework where they suggest that affordances are "*possibilities for human actions in cultural environments.*", and also by Vyas, Chisalita, van der Veer, and G.C (2006, p. 94) "*Users*' '*active interpretation*' *is central to the emergence of affordance that is socially and culturally determined.*"

Needless to say, there is some ambiguity in relation to these terms in the affordances literature, and differentiating them in the continuum in Fig. 8.1 so that both context and culture are ways in which affordance is communicated—dually—is an advancement.

8.2.2 The Culture to Context Continuum

As suggested above, context and culture are replete in the literature about affordance. There have been some attempts to formulate the relationship between them, such as a layered model (Turner and Turner, 2002 cited in Turner, 2005), but generally they are considered as being separate influences, and some times part of a classification scheme of mutually exclusive characteristics, such as Fragoso, Rebs, and Barth's (2012) *representational*, *technical*, and *social affordances*. More often culture is considered as a mediator to the way that *real* affordance is perceived. Even though affordance is often considered from a social constructionist perspective, there is not generally an incorporation of both ecology and culture in the design and communication of what affordances *offer*. Creating a continuum from culturally dependent communication cues of affordance to context dependent communication cues could provide a framework to understand affordance better and aid in design choices.

The spectrum from more culturally dependent to more context dependent would not be a spectrum of absolutes as there must still be physical aspects of culturally dependent afforded controls and vice versa. One could even go so far as to suggest that Gibson's theory of affordance is at the right extreme of this continuum, whilst Norman's theory of 'perceived' affordance is toward the left, whilst both extreme positions are ideals and no practicable example would never be unaccompanied by some influence from the other. With the two ends of this spectrum being Semiotics/Language at one end, and Physical/Physiological at the other, this is potentially the range of ways that a control or tool communicates or *offers* the ability to perform a function. At the language end, the way that affordance is offered is purely symbolic in relation to a context, typically, this might be a text label, or an icon. For example, the universal symbol for on/off, i.e. '⏻', has no meaning outside of it's *familiar* associative reference, I asked my wife and she thought it might be a finger hovering above a button; however, she knows exactly what the symbol means in relation to the button it is on, but can only guess at any meaning intrinsic to the symbol itself. It is an entirely socially constructed artefact associated with the affordance of switches, albeit it is one that is widely shared. Since the on/off label is often on a physical button, we also have the ecological influence of human physical manipulation/exploration.

At the other end of the spectrum, there is intrinsic contextual affordance in physical objects that can then have less cultural influence than contextual. A knife is sharp, and we see it is sharp, and we don't run our finger along the edge—unless we are crazy, or extremely naïve, despite the different forms that knives take across cultures and through time. The affordance literature is replete with examples of this end of the spectrum, and it is this end that get's the most attention, and has had the most theoretical discussion; however, the translation from the physical objects to the virtual or complex environments that we often deal with in gamification is problematic. Even the knife example becomes more complicated as we start to get into different 'forms' of knives within and across cultures. I believe it is the addition of influences of context and culture together that will allow us to understand affordance better. Figure 8.2 gives a tentative 'sketchy' idea of steps or stages along the

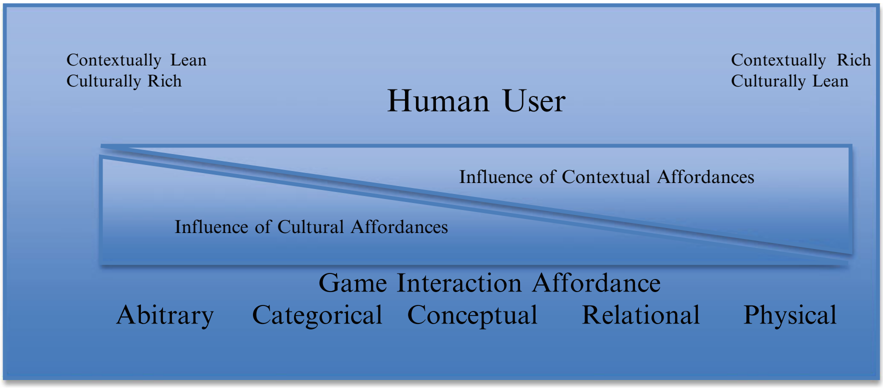


Fig. 8.2 Affordance as the membrane between the user and game interaction

continuum from context to culture, and whilst this is quite open to discussion, the core idea about stretching the difference between context and culture for pragmatic HCI theorising and design reasons for gamification is centrally there. Here I use ‘arbitrary’ not in a derogatory fashion, but in the extreme position where perhaps an individual develops an affordance for an object that is not shared amongst a collective group, and hence is entirely individualistic. Consider numbered pre-selects on a car stereo, in themselves the ‘buttons’ have no real meaning, they are just numbering (usually from 1 to 6). If the driver puts their most preferred radio station on the far left and works toward the right, then to them it might be tending toward Categorical or Conceptual Affordance. To others, it is arbitrary, there is still no meaning in the button labeling. Working along the continuum from the left hand side, we could consider Berger and Luckmans (1967, p. 111) concepts of ‘incipient’, and ‘referential’ legitimacy as a move toward the conceptually derived affordance.

8.3 Crush the Castle and Angry Birds

As an example of context and culture we have the example of Angry Birds, which is ubiquitous in contemporary culture, moving from the game to merchandise, to television. However, Angry Birds has been called a ‘blatant rip-off’ (Davis, 2012) of Crush the Castle, a game that cites inspiration and permission from the creators of Castle Clout, an earlier free on-line ‘physics’ game that was essentially a gamified physics lesson. The release time line, the game physics, and the game interaction all give credence to the claim that Angry Birds is just another plagiarized piece of modern culture. However, in this case the copy was so much more popular than the original that suggests something else was going on.

Some aspects of this phenomenon defy reason. Crush the Castle was a free online game, Angry Birds you had to buy through iTunes. Incredibly, there was even one on-line blog that directed Angry Birds players to Crush the Castle, if they wanted to play on-line, and said "*Try out Crush the Castle*, *free internet game which is somehow your closest Angry Birds Internet game*." (Narang, 2010) Although the author of the blog does mention that Crush the Castle isn't as much fun!

So what is the difference? An analysis of the game play is interesting, but not particularly rewarding. The interaction is as similar as it can be considering that the games were originally designed for different platforms. However, with the release of the mobile version of Crush the Castle, and the Android version of Angry Birds, there has been convergence rather than divergence in similarity of interaction. It would seem, from our discussion of context and culture above, that the context is essentially the same. The game play, workflow, or human activity is almost identical.

Is the only difference culture? iPhone sales accelerated in the last quarter of 2008, and by the end of 2009 sales were hitting seven million a quarter, and importantly, this is when the iPhone 3GS was released, offering an overall better specification at the same price as the 3G. This coincided with the Angry Birds release, some six months after Crush the Castle was launched. It was at this point you could assume that some critical mass occurred. Subsequent sales may very well include prior users of earlier model iPhones; however, when Angry Birds was released on iTunes, you essentially had a burgeoning market full of users who were only just becoming used to owning a 'smart phone' and downloading 'apps', one of Apples slogans at this stage was '*there*'*s an app for that*'. It was a culturally formative era, where users of the new devices were reaching out for meaning and explanation that was available in; advertising, blogs, magazine articles, and social media. It could be that Angry Birds, being a time wasting game, fitted with a lot of people wanting to achieve just that with their new phones. Or, it could just have been that Angry Birds was just a little bit more 'fun'. Why? … because they happen to be birds that are angry, and that is just so much more fun that little 2D pictures of knights, damsels, Kings, and Queens. It is perhaps the commercial cuteness factor, and it is why Mickey Mouse became so popular, whilst Steam Boat Willie himself was relegated to relative obscurity. Angry Birds happened to hit a socially/culturally responsive audience- one that was receptive to cultural change. I consider that either blind luck or expert marketing by the creators. It also points toward the cultural influences of the match between the audience and the game being far more influential than the functional context and playability characteristics of the game. The context would appear to be the same, thus the only conclusion that can be made is that the cultural differences alone have contributed to such a dramatic difference in use and propagation. Whether the cultural factors are more influential in the marketing aspects, or in the *image* of the game, these communicative processes cannot be considered to be separate. Fundamentally the communication about the game, includes the game artefact as part of the dialogue. Therefore, what people think of the game relates to what the game 'affords'.

We also need to consider the evolution of Angry Birds into a mainstream game, from its traceable origin as a *gamified* physics tutorial. Even though the physics is still there in the contextual interaction, as that has not substantively changed, it has become subsumed by the gaming experience. Here the boundaries between gamification and gaming blur, and where the field at the moment is attempting to go in a positive direction—toward a productive goal for games—this case is an illustration of the reverse occuring, attributable solely to culture changes.

8.4 Discussion and Conclusion

This paper has attempted to argue that affordance can been described by both context and culture, and there is potentially a continuum of influence of these two factors. HCI research, being more virtual than physical may tend toward stronger cultural influences rather than contextual ones effecting gamification design.

Context is important and is often understood by asking gamers (or users more generally) how they want the game (or system) to operate, and then going away and designing the gamified experience based on these explicit requirements. Unfortunately this often creates distance between the developers and the audience. It would be better to more closely connect the potential audience with the development process and have them involved throughout. Requirements elicitation can occur by observing what the gamers do in mock-ups, or with existing gamified systems, by gaining *familiarity* with the contexts that exist and may exist in the new design. Familiarity of context relates to the human activities, not to explicated preferences, so the only way to understand the contextual factors is to gather requirements in active user participation.

On the other hand, culture needs to also be understood, and there are three ways that culture needs to be understood when designing a gamified experience;

- Reference cultures that users may adopt,
- Specific existing cultures of users,
- Potentially new cultures that may emerge from the new experience itself, technology platforms, or new social interaction that might be enabled.

In each of the first two cases above the requirement gatherers need to develop enculturement of the user group/organisation themselves. What would be called ‘immersion’ in an ethnographic study. In this way they can then appropriately interpret the way in which the users will want to interact with the system. In the case of socially affective change, as in the third point, then there probably is no way that you could rigorously develop an understanding of the new social phenomena, this then becomes social engineering rather than requirements gathering and requires a completely different approach, extremely well developed intuition, or expertise in social psychology and marketing.

A problem exists where you are not undertaking requirements engineering for the creation of an artefact for a given user group, rather, you are creating it for the market. In the creation of packaged games, for example in the case of educational games, there will always be an abstraction, and the fit between the users and the game will depend a great deal on the distance between the imagined and the real users, this of course, is unavoidable. However, there is no reason to 'guess' the requirements. It can still be appropriate to gain familiarity and enculturement through real user proxies and to use more global measures of cultural analysis such as a national; identity, educational systems, and learning styles.

Further theorising and research using the continuum of context and culture could provide fruitful if we extend the framework to include such concepts as mapping and learning. Affordance and learning have often been intertwined, with the addition of the concepts of familiarity in the ecology literature, and enculturation (or socialisation) in the social constructionist literature. Mapping would extend the framework to further elaborate on how the affordance relates to the functions of the artefact, and would be a valuable extension of this model. At present mapping is typically considered a separate concept from affordance; however, it logically sits within the theory presented in this chapter as a characteristic of affordance, and will hopefully resolve into a more unified theory of interaction in the future.

Gamification is about developing motivation for engagement and prolonged use (Luminea, 2013) (Deterding, 2012). It often uses motivational devices that have been used in traditional gaming, and these often relate to intrinsic motivation and social rewards. The cultural environment of the game is as important to how the user engages with the gamified experience as the 'technical/instrumental' device and control methods of interaction. This chapter has highlighted one of the core HCI theories and shown how it can be used to gain insight into the cultural needs of interaction in this field, and how these relate to the traditional perspective of context in HCI design and software development.

References

Bardone, E. (2010). Affordances as abductive anchors. In L. Magnani (Ed.), *Model-based reasoning in science and technology, SCI 314* (pp. 135–157). Berlin: Springer.

Berger, P. L., & Luckmann, T. (1967). *The social construction of reality: A treatise in the sociology of knowledge*. New York: Anchor Books.

Davis, R. (2012). *5 Insanely successful video games that were total ripoffs*, Cracked.com. Retrieved January 31, 2014, from http://www.cracked.com/article_20057_5-insanely-successful-video-games-that-were-total-ripoffs.html

Deterding, S. (2012). Gamification: Designing for motivation, interactions, July + August, 14–17.

Fragoso, S., Rebs, R. R., & Barth, D. L. (2012) Interface affordances and social practices in online communication systems. *International Working Conference on Advanced Visual Interfaces* (pp. 50–57), Italy.

Gaver, W.W. (1991) Technology affordances, *CHI'91 Conference Proceedings*, ACM, 79–84.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghten Mifflin.

Hartson, H. R. (2003). Cognitive, physical, sensory, and functional affordances in interaction design. *Behaviour & Information Technology, 22*(5), 315–338.

Kaptelinin, V., Nardi, B. (2012) Affordances in HCI: Toward a mediated action perspective, CHI'12 Conference Proceedings, ACM.

Luminea, Cristina (2013) Gamification, *Financial Management*, Mar, 13

Narang, R. (2010) *Like angry birds iPhone game, wanna play Online? Check this out!*, GizJets a blog about gadgets, technology and video games, Retrieved January 31, 2014, http://www.gizjets.com/gaming/angry-birds-iphone-game-online.html.

Neiva, E. (2007). *Communication games: The semiotic foundation of culture*. Berlin, Germany: Mouton de Gruyter.

Norman, D. A. (1988). *The design of everyday things*. New York: Basic Books.

Turner, P. (2005). Affordance as context. *Interacting with Computers, 17*, 787–800.

Vyas, D. Chisalita, C.M. van der Veer, G.C. (2006) Affordances in interaction, *Proceedings of the 13th Eurpoean conference on cognitive ergonomics, ECCE'06*, 92–99.

Wellington, R. J. (2005) Making Sense of Electronic Communication: Media Richness, Media Genre, and Marshall McLuhan, *16th Australasian Conference on Information Systems*, Sydney.

Wellington, R. J. (2011). The design of artifacts: Contextualisation, and the moment of abstraction in imagined ethnography. *GSTF Journal of Computing, 1*(3), 57–60.

Wellington, R. J., & Zainal Abidin, N. F. (2011). The usefulness of a simulated environment in ethnographic research for gaming and HCI. *GSTF Journal on Computing, 1*(4).

Zainal Abidin, N. F., & Wellington, R. J. (2012). Motivation of Extrovert and Introvert Gamer's using Different Screen Sizes, *The Asian Conference on Society, Education and Technology 2013*, Osaka, Japan.

Chapter 9
Psychological Theory and the Gamification of Learning

Richard N. Landers, Kristina N. Bauer, Rachel C. Callan, and Michael B. Armstrong

9.1 Introduction

Gamification is defined as "the use of video game elements…in non-gaming systems to improve user experience and user engagement in non-game services and applications" (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011, p. 1). This is in contrast to serious games, which are "game[s] in which education (in its various forms) is the primary goal, rather than entertainment" (Michael & Chen, 2005, p.17). Gamification has emerged as a common instructional intervention to improve learner motivation and learning outcomes. For example, one course at Indiana University was gamified by presenting standard course elements in game-like terms; students gained "experience points" by completing assignments, and grades became "levels" to achieve, among other changes (Tay, 2010). Another instructor at Syracuse University gamified his course by adding narrative elements and a record of "achievements" to the course based upon current published recommendations, with mixed success (Nicholson, 2013). In this way, most efforts to gamify learning involve the identification of target game elements, such as the use of narrative and score tracking, from video games and the use of those elements in learning contexts.

Unfortunately, the practice of gamification has far outpaced researcher understanding of its processes and methods. Even researcher understanding of serious games, which have a much longer history, lags behind industry use (Bedwell, Pavlas, Heyne, Lazzara, & Salas, 2012). If gamification of learning can be considered the refinement and application of lessons learned from serious games,

R.N. Landers, Ph.D. (✉) • R.C. Callan, M.S. • M.B. Armstrong
Old Dominion University, Norfolk, VA, USA
e-mail: rnlanders@odu.edu; rjohn104@odu.edu

K.N. Bauer
University of West Florida, Pensacola, FL, USA

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_9

researchers therefore must strive to understand the effects of both much more clearly before reasonable recommendations for practice can be made.

This lack of foundational knowledge is most evident in the widely varying recommendations for implementing gamification. Points, badges, leaderboards and achievements are commonly adopted with only some vague intention of "increased engagement." Sometimes game narratives are used to transform a course, but other times leaderboards are simply added to a pre-existing project. Some argue that improved learner engagement is the primary purpose of gamification (e.g., Kapp, 2012), but others argue that psychological engagement is only a tool to trigger behavioral change (e.g., Zichermann & Cunningham, 2011). Quite simply, we do not have a complete understanding of when gamification is an appropriate instructional tool and when it is not. We do not know what aspects of human cognition and behavior it is capable of changing and what might be changed unintentionally when used.

We contend that an entirely new research literature is unnecessary to build such an understanding. Psychological research has already developed a great deal of theory to describe learning and motivational processes, and these theories can serve as a strong foundation for our understanding of gamification. In this chapter, we present a review of the motivational and learning theories in psychology most likely to describe the effects of gamification when it is implemented as an instructional intervention. In doing so, we highlight the most promising investigatory directions for researchers as well as potential roadblocks for practitioners in the implementation of gamified learning.

9.2 Theoretical Review

In our review of the literature, we identified two major types of psychological theory relevant to gamification: learning theories and motivational theories. Among learning theories, we identified two major frameworks to describe the learning outcomes of gamification: the theory of gamified instructional design and classic conditioning theories of learning. We also identified three major types of motivational theories: expectancy-based theories, goal-setting theory, and self-determination theory. For each, we will first describe the theory, second describe its importance to the study of gamification, and third explore unresolved but provocative research questions related to the intersection of that theory and gamification.

9.2.1 Theory of Gamified Instructional Design

The psychological theory most closely related to gamification is the theory of gamified instructional design (Landers & Landers, in press; Landers, in press). This theory describes two major psychological processes by which game elements can be used to affect learning in the context of gamification. Both portray the effect of gamification on learning through an intermediary behavior or attitude that is itself caused by the use of game elements in instruction; specifically, gamification must be designed to affect a particular attitude or behavior. For example, game narrative might be used to improve affective attitudes toward training, or game goals might be used to increase learner meta-cognitive activity.

The theory proposes that the effect of this target attitude or behavior differs depending upon the precise nature of the attitude or behavior. Some behaviors are part of a mediating process, whereas others are part of a moderating process. In the mediating process, the target behavior or attitude directly affects learning outcomes. For example, if game goals were used to increase learner meta-cognitive activity, increased meta-cognition should, in turn, increase learning directly. In the moderating process, the target behavior or attitude alters the effectiveness of instructional design. For example, more positive affective attitudes toward anticipated training should not itself lead to increased learning. A student does not learn *because* they have a positive attitude. Instead, a more positive attitude will encourage the learner to take better advantage of high quality instructional material provided by the instructional designer. If the learner cannot ever reach desired learning outcome levels from the instructional material, increased learner engagement will not fix this problem.

The specific process anticipated is critical when evaluating the success of gamification. If gamification is intended to operate through the mediating process and increased learning does not occur, one can conclude that gamification was unsuccessful. If gamification is intended to operate through the moderating process and increased learning does not occur, it may be due to poor gamification, or it may be due to poor quality instructional content.

Relating the Theory of Gamified Instructional Design to Gamification Of all psychological theories we identified, this is the only theory that speaks to gamification specifically. It describes two specific processes by which gamification can affect learning, highlighting intermediary psychological attitudes and behaviors through which this effect should occur.

Critically, the theory of gamified instructional design also indicates the specific aspects of games which should be adapted for use in gamification. Based upon work by Bedwell et al. (2012), which empirically derived a taxonomy of game elements in serious games relevant to learning, the theory of gamified instructional design applies this taxonomy to gamification. Thus, this theory suggests action language, assessment, conflict/challenge, control, environment, game fiction, human interaction, immersion, and rules/goals are the most critical game elements to be applied in gamification.

Future Directions for the Study of the Theory of Gamified Instruction Although Landers and Landers (in press) tested the mediational process of the theory of gamified instructional design, the moderation process remains untested and should be a high priority for researchers. Additionally, the effectiveness of this mediation likely varies by the particular target attitudes and behaviors chosen by the instructional designer; as concluded by the researchers, the use of leaderboards in a course project directly improved time spent on that project but much more indirectly affected learning outcomes. As game elements and target behaviors vary, so likely will the effectiveness of gamification. Future research is needed to explore such variations.

The theory also leaves the specific target attitudes and behaviors of interest to future researchers. Although Landers and Landers (in press) successfully increased time on task, this is only one example of a potential target behavior. Many more likely exist and should be explored explicitly. Similarly, the theory does not suggest which game elements should be more effective than others or in what contexts, leaving this too to future researchers. This theory thus provides several promising directions for future empirical research.

9.2.2 Theories of Learning via Conditioning

Two of the earliest and most pervasive theories of learning are classical and operant conditioning. Classical conditioning can be defined as the association of one stimulus normally not yielding a certain behavioral response to a response normally associated with another stimulus. There are three essential elements of classical conditioning: an unconditioned stimulus, causing an unconditioned response; a conditioned stimulus, not initially causing the unconditioned response; and repeated exposure to both the unconditioned and conditioned stimuli in a specific, controlled manner (Hilgard & Marquis, 1940). If a new or altered response to the conditioned stimulus resulted from this joint exposure, the response is a conditioned response (Hilgard & Marquis, 1940). Watson and Rayner (1920) used classical conditioning to create emotional responses in a child to animals not normally evoking emotional reactions. In this experiment, the child was exposed to a harsh sound (unconditioned stimulus) that caused fear (unconditioned response). The child was then presented with several animals (conditioned stimuli). When exposing the child to the animals and the harsh sound at the same time, the child reacted with fear and crying. Eventually, the child would cry at the mere sight of the animals (conditioned response). As an example in the modern learning context, consider a learner who experiences anxiety (unconditioned response) as a result of test-taking (unconditioned stimulus). After a great deal of test-taking, the student begins to associate the sound of pencil scratching in a quiet room (conditioned stimulus) with test-taking. Later, the student hears pencil scratching in a quiet room and experiences anxiety (conditioned response).

In contrast, operant conditioning is a form of learning based on behavioral consequences (Irons & Buskist, 2007). The process is best described as the three-phase process, often abbreviated ABC: an antecedent event or stimulus, a behavioral response to that stimulus, and a consequence dependent upon that response. Skinner (1948) observed operant conditioning in hungry pigeons. The pigeons observed a food hopper enter their cage while moving (antecedent). The pigeons would repeat that movement continuously (behavior) until they received more food (consequence). As an example in the modern learning context, consider a learner who knows a difficult test is looming (antecedent). As a result of the impending test, the learner studies harder than usual (behavior). As a result of extra studying, the learner scores a higher grade than usual (consequence). The learner has thus been reinforced to study harder in the future.

Consequences are the focus of learning in operant conditioning. Behavioral consequences can either be reinforcement, which increase certain responses, or punishment, which decrease certain responses (Irons & Buskist, 2007). An effective application of operant conditioning for obtaining a desired behavior is shaping (Irons & Buskist, 2007). By reinforcing approximate desired responses, the likelihood of the target response will increase. When the target response occurs and is reinforced, the behavior will increase. Shaping is a way to acquire certain target responses without explicitly explaining what response is desirable. Skinner (1958) utilized shaping in developing teaching machines to optimize efficiency in education. In order to "shape" students' behavior, Skinner's machines allowed learners to compose their own answers and gradually moved the learner closer to fully competent behavior. A simple application of this machine was to teach spelling. A student would see the definition of the word he or she was learning, see it used in a sentence, and copy the word down on paper, as well as learn to recognize root words, fill in missing letters, and finally spell the entire word in a sentence. By presenting the student with a sequence of small steps, and using correct answers to move the student toward subsequent steps, Skinner was able to shape student behavior such that the student learned how to spell a word, while comprehending both its meaning and use.

Relating Conditioning to Gamification Operant conditioning has often manifested in gamification via conditioned reinforcers (Antin & Churchill, 2011; Evans, Jennings, & Andreen, 2011; Malala et al., 2007). Irons and Buskist (2007) described conditioned reinforcers as stimuli gaining reinforcing properties by their association with primary reinforcers (food, water, or other necessities to life). Conditioned reinforcers in gamification can range from points on a scoreboard to badges to money (Antin & Churchill, 2011; Evans et al., 2011). These rewards reinforce desirable behavior within the gamified system, despite badges' inability to buy food, water, or shelter. Attaining more conditioned reinforcers indicates a strong record of desirable behavior, which hopefully pleases educators and employers, possibly leading to more self-satisfaction or money, paying for the necessities to live.

Evans et al. (2011) explained the use of badges in assessing learning outcomes. For instance, a skill-based learning outcome could be accomplished via a mechanical skill-based badge—mastery of a game mechanic (e.g., speed, strategy) earns the badge. A skill-based learning outcome could also be accomplished via a behavior repetition-based badge—repeating an action a certain number of times. This badge may require mastery of some game element, thus accomplishing the skill-based learning outcome. Completing a goal outlined by a particular badge earns the user the badge, which is the reward increasing the behavior of completing more behavior-based goals (Antin & Churchill, 2011). This reward mechanism could strengthen many different types of learning outcomes, including outcomes based on learning facts, procedures, and strategies (Evans et al., 2011).

Positive reinforcement varies in effectiveness based on reward schedules (Davis, 2012, Irons & Buskist, 2007), which should apply to gamified systems. Reward schedules can either be fixed or variable and either ratio-based or interval-based

(Davis, 2012; Irons & Buskist, 2007). Consider a fixed-ratio schedule, which reinforces behavior after a certain number of responses (Irons & Buskist, 2007). In a gamified system, a repetition-based badge could correspond with a fixed-ratio reward schedule—after a certain number of responses, the badge is earned, reinforcing the repetition of behavior.

Another reward schedule is variable-ratio, where the reward is granted after a certain number of responses, but varies in response amount from one reward delivery to the next (Irons & Buskist, 2007). In a variable-ratio 20 schedule, a reward may be presented after the 10th, 20th, or 30th response, but on average after the 20th response (Irons & Buskist, 2007). In a gamified system, a variable-ratio reward schedule may exist as viewing variable amounts of content. For instance, when browsing an educational website, the learner may receive points after viewing a variable number of web pages. Because the learner does not know when he will be rewarded, research on rewards schedules suggests that he would be more motivated to browse different web pages in the hopes of obtaining more points. Even though this approach may increase the behavior of browsing educational web pages, this reinforcement does not guarantee that the user will process the content or learn. Care should be taken when designing gamified systems on reward schedules to ensure that the intended behavioral outcome is achieved (i.e., learning as opposed to web browsing).

Gamifying a learning environment could change its atmosphere, but may come at a cost. Gamifying a learning environment via operant conditioning might mean purchasing rewards for users. Lee and Hammer (2011) worried that constantly providing classroom students with rewards (e.g., candy, stickers, gift certificates) might absorb teacher resources that could be used on educational material or supplies. If students have insufficient rewards in an operant conditioning gamified system, the system collapses. Desirable behavior needs reinforcement, and if students become accustomed to expensive rewards, encouraging words may not suffice in the future.

When a gamification system is based on competition among users, the focus of the environment is on the accumulation of virtual wealth (Rao, 2013). The top scoring users might be motivated by their large accumulation of points on the public scoreboard, but some users may become discouraged or humiliated by the gamified system if they lack points. Users might also be discouraged by the use of gamified punishment. Consider a learner in a gamified classroom where learning behavior (e.g., answering questions) corresponds to points on a scoreboard. If a student answers correctly, he will gain points and his name will travel up the scoreboard. However, if incorrect answers are punished, he might possibly lose points, discouraging users from answering due to fear of failure, one of the detrimental effects of punishment (Irons & Buskist, 2007).

Davison and Baum (2006) found that conditioned reinforcers are not as effective as primary reinforcers. In a gamified system, where most of the reinforcing rewards are conditioned reinforcers (e.g., points, badges), learners might not be as motivated as they would by primary reinforcers (e.g., food, sleep). Consider a student in high school or college who stayed up all night to finish an important paper. In a gamified classroom, a reward for this behavior might be a badge for completing the term paper. However, a badge may not motivate this student to complete the next assignment. Rewarding his hard work with sleep (primary reinforcer) might be more effective in increasing the behavior of completing assignments.

Future Directions for the Study of Conditioning in Gamification Research should be conducted on the varying levels of gamification integration within systems. Some learners may be effectively conditioned by badges as rewards, but other learners may be better conditioned by other learning-related game elements like conflict/challenge, environment, game fiction, human interaction, immersion, rules/goals, or others (Landers, in press). Combinations of elements, like the use of leaderboards, may condition behavior more effectively than any element in isolation.

If the system that people encounter daily within education and the workplace must be based on external rewards in order to motivate users, genuine interest in those activities may not be present. Deterding, Khaled, Nacke, and Dixon (2011) suggest that gamification is a valuable approach for non-game products, services, and systems to be rendered more enjoyable, motivating, and/or engaging to use. Research will need to be conducted to determine if extrinsic rewards such as reinforcers of gamified systems can ultimately lead to intrinsic motivation. If gamified systems are not found to be more motivating, then they are complicating systems in current learning environments. For example, in the classroom, if gamification is found to be ineffective, adding game elements (e.g., game fiction, additional rules/goals) might be more complicated than a system of completing assignments and receiving letter grades.

Recall that Davison and Baum (2006) found that conditioned reinforcers are not as effective as primary reinforcers. Research should be conducted to identify any differences in effect between primary and conditioned reinforcers in gamified systems in order to determine the value of conditioned reinforcers. Without such examination, learning environment administrators may better focus on how to allocate primary reinforcers to users in order to properly motivate them.

Davison and Baum (2006) also found that conditioned reinforcers only signal the availability of primary reinforcers. Research is necessary to determine whether conditioned reinforcers in gamified experiences serve as signals for primary reinforcers or strengthen the responses that produce them. Conditioned reinforcers such as points or badges may strengthen the behaviors that produced them in some settings, while in others may only indicate a job well done. A learner may see rewards as a signal preceding verbal praise, a possible primary reinforcer. If conditioned reinforcers only act as signals of primary reinforcers, administrators could avoid gamification, and instead devise a systematic way of extending primary reinforcers to learners for desirable behavior.

In conclusion, Rapp (2013) stated that gamification efforts should identify elements of deeper engagement than simple aesthetic gamification. The true potential of gamification may be discovered by engaging learners beyond aesthetic changes (e.g., adding a progress bar indicating completion of a profile, awarding badges for behavior already present). These aesthetic changes are positive reinforcement by type, but may not have the motivating power of other types of gamification. Research should test operant conditioning against other motivation theories in order to determine the most efficient methodology for motivating modern day learners.

9.2.3 Expectancy Theories

Vroom's (1964) expectancy theory includes three components: valence (V), instrumentality (I), and expectancy (E). Valence refers to the affective orientation toward a specific outcome to a particular individual, and is termed the rewards-personal goals relationship. Individuals have valence perceptions toward all possible outcomes. Valence can be positive (i.e., the person prefers obtaining an outcome to not obtaining it), zero (i.e., the person is indifferent to obtaining an outcome), or negative (i.e., the person prefers not obtaining the outcome to obtaining it) with a wide range of positive and negative possible values (Vroom, 1995). It is important to note that Vroom (1995) distinguishes between the valence (i.e., the anticipated satisfaction) and value (i.e., the actual satisfaction) of an outcome. Furthermore, these outcomes or rewards can be extrinsic like pay and promotion or intrinsic like feelings of accomplishment or enhanced self-esteem (Pinder, 2008).

The second component of VIE theory is instrumentality. Instrumentality is a probability belief linking one outcome (performance level or learning) to other outcomes that have associated valence (Pinder, 2008; Vroom, 1964) and is termed the performance-outcome relationship. Instrumentality can take on values ranging from 1, meaning that performance will certainly lead to the outcome, to −1, meaning that the outcome is certain without performance and performance would prevent outcome attainment. An instrumentality value of 0 indicates that there is no perceived relationship between performance and an outcome.

The third component of VIE theory is expectancy. Expectancy is the strength of the belief that action (i.e., effort) will lead to an outcome (i.e., performance level or learning) and is referred to as the effort-performance relationship (Pinder, 2008). Expectancy ranges from zero, indicating no probability that effort will lead to performance, to 1, indicating certainty that effort will lead to performance. It is important to distinguish between expectancy and instrumentality. Expectancy refers to an action-outcome relationship, whereas instrumentality refers to an outcome-outcome relationship (Vroom, 1995).

Vroom (1964) asserted that an individual's level of motivation to engage in a given behavior—the force to perform an act—is a function of these three components: motivation = $V \times I \times E$. In other words, an individual is motivated to perform a behavior if he or she perceives that effort will lead to successful performance, that performance will lead to an outcome, and that the outcome has high value.

Similar to yet distinct from Vroom's expectancy theory, the expectancy-value model proposes that there are three components to motivation, which are specifically linked to self-regulated learning (Pintrich, 1988, 1989; Pintrich & de Groot, 1990). They are expectancy, value, and affect. A major distinction between the general expectancy-value model and Vroom's (1964) expectancy theory is that the expectancy-value model was developed to predict student behavior in a learning environment, whereas expectancy theory was developed as a broad motivational framework for explaining a variety of behaviors. Similar to Vroom's (1964) expectancy theory, the expectancy component refers to individuals' beliefs about their ability to perform a task and about whether they are responsible for their own performance. Expectancy involves learners asking themselves, "Can I do this task?"

The second component is value, which is defined quite differently from Vroom's (1964) conception of valence. Value, in the expectancy-value model, refers to individuals' goals and beliefs about the importance and interest of the task (Pintrich & de Groot, 1990). At its core, value is the individual's reasons for doing a specific task (Pintrich & de Groot, 1990; Pintrich, Smith, Garcia, & McKeachie, 1993), and the key question learners ask themselves is, "Why am I doing this task?" In a sense, value subsumes valence as one reason an individual might be doing a task is because of the anticipated satisfaction of completing the task.

The final component of the expectancy-value model is the affective component, which includes individuals' emotional reactions to the task (Pintrich et al., 1993; Pintrich & de Groot, 1990). A variety of emotional reactions are possible, such as anger, pride, guilt, anxiety, and so on. The essential question learners ask themselves is, "How do I feel about this task?"

Relating Expectancy Theories to Gamification There are three key links between gamification and the expectancy-based theories of motivation. First, expectancy theory can be used to understand why rewards (e.g., collecting points, earning badges, etc.) in gamified learning lead to motivation (Vassileva, 2012). These game elements can be considered outcomes; that is, game elements may have valence, in a VIE sense, and value, in an expectancy-value model sense. Hsu, Chang, and Lee (2013) developed a framework of gamification design and identified achievement as a design component. Hsu and colleagues defined achievement as including rewards, goal setting, reputation, and status. These design factors are all outcomes that, in the framework of expectancy theory, a person may value. If an individual values earning points or badges and sees a clear path from effort to performance and performance to outcome, then the individual is motivated to engage in the action, suggesting that such design factors can be used to enhance student learning.

The second key link is between gamification and the instrumentality component of expectancy theory. In addition to developing the taxonomy mentioned above, Hsu, Chang, and Lee (2013) surveyed users of a gamified collaborative storytelling website to determine the most important gamification features. They found that the most attractive game feature was that the relationship between actions and rewards is clear. In expectancy theory terms, this is consistent with instrumentality or the perception that performance will lead to outcomes.

The final link is between gamification and the affective component of the expectancy value model of motivation. Status and reputation are two gamification design factors that both refer to achieving some level or rank (Hsu et al., 2013). However, Vassileva (2012) distinguishes between the two of them by noting that status is gained in isolation, whereas reputation depends on the opinions of others. Status and reputation can serve as a source of pride to an individual, which is an emotional reaction to the task. Increased pride can lead to continued participation and better learning.

Future Directions for the Study of Expectancy in Gamification Very little work has examined expectancy-based theories of motivation and gamification.

Thus, future research needs to begin by manipulating individual components of the three-part motivational theories to determine how levels of motivation and engagement with the environment are impacted. Specifically, manipulating valence from expectancy theory and value from the expectancy-value model is an important first step because it would allow for a better understanding of which activities a student would choose to engage in, and hence, better designed reward systems. However, before manipulating value/valence it might prove fruitful to take a qualitative approach. Students could be provided with all of the possible reward-based gamification design elements and asked to rate the value assigned to each one. The design elements identified as having the highest valence could be used to inform an experimental design. For example, a study that holds instrumentality (e.g., the link between performance and the reward is clear for all learners) constant might randomly assign participants to a learning environment with badges or one with a leaderboard. This type of study would shed light on whether students place greater value on earning badges or on being at the top of a leaderboard.

Another avenue for future research is to manipulate instrumentality. This line of research would answer the question, "How clear does the link between performance and reward need to be in a gamified learning environment?" For example, researchers might gamify a learning environment by adding badges and manipulate instrumentality by assigning participants to (a) a no instructions condition where there are no rules for badge attainment, (b) a vague instructions condition where there are unclear rules for badge attainment, and (c) a clear instructions condition where there are clear rules for badge attainment. It could be that in a gamified learning environment, exploring the paths to badge attainment is considered part of the fun and rules can be less clear.

Finally, in accordance with the broader motivation literature, it will be important for future gamification research to begin to examine the interactive effects of value and expectancy in a gamified learning environment. Vroom (1964) originally proposed that value and expectancy exhibit interactive effects on learning. Yet this assertion has not been well supported (Van Eerde & Thierry, 1996). Recent research in the work motivation literature has proposed that value and expectancy have additive effects and that expectancy may be differentially related to outcomes (Vancouver, 2008; Vancouver, More, & Yoder, 2008). Future gamification research should attempt to manipulate expectancies in an effort to parse out the effects of expectancies and value on learning.

9.2.4 Goal-Setting Theory

Like expectancy theory, goal-setting theory has a long history in the literature dating back to the 1960s (e.g., Locke, 1968). Goal-setting theory proposes that goals directly motivate action by directing attention and effort toward goal-relevant activity and away from goal-irrelevant activity, by energizing effort, and by increasing persistence; goals indirectly affect action through the use of task strategies (Latham & Locke, 1991; Locke & Latham, 1990, 2002). In other words, goals lead to performance through self-regulatory processes (Kanfer & Ackerman, 1989; Locke & Latham, 1990). Difficult, specific goals are the optimal goal type for eliciting motivated behavior (Locke & Latham, 2002). Furthermore, the underlying assumption is that individuals perform differently because they have different goals.

Goal-setting theory proposes four key moderators of the goal-performance relationship (Locke & Latham, 2006). The first moderator is goal commitment; individuals must be committed to their goals in order for goals to lead to performance (Locke & Latham, 2002). Klein, Wesson, Hollenbeck, and Alge (1999) conducted a meta-analysis of the goal-commitment literature and found that commitment is most important when goals are difficult. Although there are a number of factors that lead to goal commitment (Hollenbeck & Klein, 1987), two key constructs are the importance of the goal to the individual and self-efficacy or confidence in the ability to attain the goal (see Locke & Latham, 2002 for a review of this research). Individuals who view a goal as important and are confident they can achieve it are more committed to their goals (Locke & Latham, 2002). Additionally, individuals with higher self-efficacy use better strategies to attain their goals (Locke & Latham, 1990; Seijts & Latham, 2001).

The second moderator of the goal-performance relationship is feedback. Feedback has been shown to be an important determinant of performance (Kluger & DeNisi, 1996). Yet, it is the combination of goals *and* feedback that positively impact performance (Becker, 1978; Latham, Mitchell, & Dossett, 1978; Locke & Bryan, 1969; Strang, Lawrence, & Fowler, 1978). As Locke and Latham (2002) note, “for goals to be effective, people need summary feedback” (p. 708). Goal-setting theory asserts that feedback allows individuals to track their progress toward goal completion (Locke & Latham, 2002, 2006). Research also suggests that negative feedback leads to downward goal revision or an easier goal and positive feedback sometimes leads to upward goal revision or a more challenging goal (Donovan & Williams, 2003; Ilies & Judge, 2005).

The third moderator of the goal-performance relationship is task complexity. As a task becomes more complex the effect of goals becomes dependent on the individual’s ability to automate performance and develop appropriate task strategies (Locke & Latham, 2002). A meta-analysis conducted by Wood, Mento, and Locke (1987) found that the effect of goal setting was strongest when tasks were easy (e.g., reaction time; $d=0.76$) and weakest when tasks were more complex (e.g., business game simulations; $d=0.42$).

The final moderator of the goal-performance relationship is situational constraints. One such situational constraint is time until goal completion. Individuals often operate in a multiple goal environment and time has been shown to impact the way individuals allocate resources to goal progress (Kernan & Lord, 1990; Schmidt & DeShon, 2007; Schmidt & Dolis, 2009; Schmidt, Dolis, & Tolli, 2009). Another example of a situational constraint is role overload, which is an individual’s perception that there are insufficient resources to deal with the demands of his or her current role, resulting in stress (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964). Brown, Jones, and Lee (2005) found that role overload moderated the relationship between goal level and performance such that the relationship was only significant when role overload was low.

Relating Goal-Setting Theory to Gamification. Hsu et al. (2013, p. 2) note that gamification design to date with respect to goal setting has mainly utilized "explicit signs" (e.g., badges) and "progress toward goals" (e.g., progress bars). Thus, three mechanisms for applying goal-setting theory to gamification are badges, progress bars, and levels. Badges and levels can be seen as explicit signs whereas progress bars are progress alerts. To start, in gamification, badges are a virtual good awarded to an individual for completing a specific task, which can be viewed as a goal, although not always an explicit one (Antin & Churchill, 2011; Hsu et al., 2013). Furthermore, progress bars serve as feedback to users (Antin & Churchill, 2011; Hsu et al., 2013).

From a goal-setting perspective, badges should be accompanied by a source of feedback like progress bars in order to maximize the likelihood of successful performance, that is, badge attainment. Singer and Schneider (2012) gamified a computer science course. They implemented "milestones," which were used as implicit goals, and a weekly digest, which can be thought of as a form of feedback. Interviews with students indicated that being able to see progress in the weekly digest was motivating. Consistent with goal-setting theory, it was the combination of goals and feedback that students found motivating. Furthermore, Hamari (2013) conducted a field experiment to determine whether gamification (i.e., the implementation of badges) of a peer-to-peer trading service results in increased activity. The study found that merely implementing badges did not lead to increased activity. It was only when individuals monitored their own badges (i.e., sought a form of feedback) that they engaged in more and better quality activity in the trading service.

Some gamified environments contain a variety of badges that individuals can earn. In fact, Hsu et al. (2013) found that having diverse and interesting badge types was the fifth most attractive feature of gamification to users of gamified, collaborative storytelling websites. This finding could suggest that having a variety of learning goals in a gamified environment would enhance student motivation and learning.

With respect to the other explicit signs, imposing "levels" or "leveling up" can be viewed as setting small sub-goals within the larger goal of the gamified system. The goal-setting theory literature suggests that setting smaller, proximal goals can help individuals reach larger, more complex goals (Donovan & Williams, 2003; Latham & Brown, 2006; Latham & Seijts, 1999). Latham and Seijts found that participants who had been assigned proximal and distal goals were the only group to significantly increase in self-efficacy compared to participants who were assigned only distal goals or "do your best." Thus, beating easier levels may serve to boost self-efficacy in a gamified system, which has been shown to be an important moderator of the goal-performance link by impacting goal level, goal commitment, and task strategies (Locke & Latham, 2002).

Future Directions for the Study of Goal Setting in Gamification Decades of research have examined the optimal goal type (Locke & Latham, 2002). Yet, no research has empirically examined whether the optimal goal type—a specific, difficult goal—remains the same in a gamified environment. Thus, an important first step for research with respect to gamification and goal setting theory is to manipulate goal type and examine the effect it has on performance. It could be that a gamified environment is so intrinsically motivating that an easy or do-your-best goal would function similarly to a difficult goal.

Likewise, to the authors' knowledge, no research has specifically examined goal regulation (either single or multiple goals) in the context of a gamified environment. This represents a serious gap in the literature. As aforementioned, Hsu et al. (2013) found that a variety of badge types (i.e., goals) was an attractive feature of gamification to users of a collaborative storytelling website. One interesting question for future research is how the provision of a variety of badge types in a gamified learning environment impacts learning. Designing a badge for each learning objective may positively impact learning through increased engagement with all learning material. Alternatively, learners may have trouble regulating multiple goals, which would negatively impact learning. With respect to the latter possibility, research suggests that time pressure may be an important moderator of the relationship (Schmidt et al., 2009; Schmidt & Dolis, 2009).

Interestingly, the amount of time spent playing a game has a curvilinear relationship with time, represented as an inverted U shape. In other words, individuals start out playing a little, increase their play over time, and then eventually decrease and stop playing. In a learning context, the downward trend in game play in a gamified learning environment would likely negatively impact learning as a learner could stop engaging in the learning environment before all learning has been accomplished. The web-based training literature suggests that time spent in training is related to learning (Brown, 2005). It will be important for research to examine mechanisms that prevent a learner from disengaging in a gamified learning environment.

One such mechanism is self-regulation, which goal-setting theory proposes as a key mediating mechanism of the goal-performance relationship (Kanfer & Ackerman, 1989; Locke & Latham, 2002). Self-regulation involves the modulation of thought, affect, and behavior (Karoly, 1993), and includes constructs like metacognition, planning, effort, self-efficacy, and affective reactions to the task (Pintrich, 2000). Thus, an important avenue for future gamification research is to determine whether self-regulation functions similarly in a gamified learning environment as it does in more traditional learning environments. If it does, the more important question becomes whether self-regulatory interventions can overcome the potential decrease in engagement in the learning environment associated with the expected decrease in game play. Research in online instruction has found that prompting self-regulation can increase learning and reduce attrition (Sitzmann, Bell, Kraiger, & Kanar, 2009; Sitzmann & Ely, 2010). These studies utilized simple prompts asking trainees questions like, "Am I concentrating on learning the material?" It may be that re-engaging students in the learning environment is as simple as reminding them to do so. For example, if a learner disengages from game play, an automated self-regulatory prompt could be utilized to keep the student on track.

9.2.5 Self-Determination Theory

Self-determination theory (SDT) has been extremely influential in the field of psychology with its conceptualization of intrinsic and extrinsic motivators. Self-determination theory is derived from cognitive evaluation theory (CET) (Deci & Ryan, 1985), which states that rewards have two important features: they provide performance feedback and they tell a person why he or she is performing a given task. This awareness of why one is performing the task is also known as "control perceptions". According to CET, if the control perceptions have more weight for the actor, the locus of causality shifts from within the individual to the external environment. For example, we can imagine a student who finds the process of painting rewarding so she decides to major in fine arts in college. The student earns a scholarship for her studies that requires a minimum GPA of 3.5. Once the student begins taking classes, she must now paint well in order to get good grades because of the scholarship. If this change causes the student to begin working solely based on the reward (the scholarship), the external rewards would have become more important to the student than that drive for personal enjoyment (an intrinsic reward), according to Deci and Ryan (1985).

Indeed, what is illustrated in this example is seen as the main implication for CET: pay for performance should reduce internal rewards by shifting individuals' focus to an external reward (e.g., pay). However, CET theory could not explain motivation outside of contexts where the task is intrinsically appealing (Deci & Ryan, 1985). This is a major limitation as many tasks are not intrinsically motivating—many employees complete hours of training activities that they have little interest in but are required to finish as part of their job duties. As a result, Ryan and Deci (2000) further developed the concept of extrinsic motivation in what became known as SDT.

SDT further defines intrinsic and extrinsic motivation and posits that these different kinds of motivation exist on a continuum from more extrinsic to more intrinsic, with the mixture thereof lying in between (Ryan & Deci, 2000). Tasks that catalyze intrinsic motivation are defined as inherently enjoyable or interesting to the learner. Intrinsic motivation is also theorized to produce higher-quality learning outcomes and increase creativity in the learners (Ryan & Deci, 2000). Referring again to the student painter, before enrolling in school, he or she was painting for enjoyment and learning more about Impressionists and novel painting techniques purely for his or her own benefit. This would likely be a period of serious exploration and expression. However, once the student is focused on maintaining a high GPA, he or she may no longer push the boundaries as much in terms of content or style of artwork. Similarly, the student may not spend as much time visiting museums and identifying new sources of inspiration for its own sake. Instead, the student needs to spend time making art that will earn good grades and doing well in all of the other courses required in the program.

Ryan and Deci (2000) further posited that intrinsic motivation satisfies three basic psychological needs: competence, autonomy, and relatedness. For our student, this means that painting allows the student to perform a task proficiently, independently, and while connecting with others. Extrinsic motivation is defined as a person being driven to complete the task to achieve some other outcome, such as earning a promotion only after completing mandatory coursework. It is important to note that extrinsic motivation should not be viewed as weaker than intrinsic motivation. The only implication of SDT is that extrinsic rewards are driven by the environment, and intrinsic rewards are driven by need satisfaction. Extrinsic rewards may be more effective at altering behavior in some contexts, whereas intrinsic rewards may be more effective in other contexts.

SDT takes this idea of different forms of motivation one step further by creating a taxonomy that lies on a continuum. On one end is amotivation, or a lack of motivation, and on the other lies intrinsic motivation. In between these extremes are different kinds of extrinsic motivation (i.e., external regulation, introjection, identification, and integration). These external motivations vary from an entirely external locus of causality to an internal locus of causality as well as from less to more autonomous. Amotivation is unique in that it is characterized by an impersonal locus of control and a lack of autonomy. In this state, an employee would be completely unmotivated to complete a training course, perhaps due to feelings of incompetence or a belief that effort will not result in the desired outcomes, and thus the task will not get finished. External regulation has a completely external locus of causality, while introjection and identification are both a combination of internal and external locus of causality, with the former being largely external and the latter largely internal. In the state of external regulation, the employee will want to complete the training to receive an external reward, such as a bonus for having participated. Introjected regulation works through not only external rewards but also self-esteem. For our employee, he or she will complete the training to receive the bonus and to not feel guilty for not having participated with the rest of the work group. In identification, the employee utilizes more self-determination to make his or her decision to complete the training and participates because he or she believes the knowledge gained will help him or her on the job. Integration and intrinsic motivation are both considered to have an entirely internal locus of causality. Integration is similar to identification, but now the reasons for completing the training are further internalized, although the employee is still motivated by some external outcome. In this case, the employee completes the training because he or she feels it is vital for his or her development on the job, but sees it as a means to a promotion. If the employee were motivated intrinsically, he or she would complete the training with or without any expected outcomes solely for its merits.

Relating Self-Determination Theory to Gamification: Gamification can utilize both intrinsic and extrinsic motivators to change behavior in employees or students. To help frame the application of SDT to gamification, this section will begin by investigating support for SDT in the literatures related to gamification before describing how one study in particular applied both types of motivations to a student sample.

Much of Ryan and Deci's (2000) work has been explored and supported in the gaming literature. Further, one group of researchers sought to develop a gaming motivation scale based on the SDT motivation taxonomy and found support for the factor structure proposed by Ryan and Deci (2000) in this context

(Lafrenière, Verner-Filion, & Vallerand, 2012). This suggests that the same taxonomy of motivation may apply in the context of gamification, which provides some implications for design, such as adding more autonomy to a task in order to promote different kinds of motivation in students and employees.

Researchers have also investigated the supposition that intrinsic motivation changes behavior by satisfying basic psychological needs. Ryan, Rigby, and Przybylski (2006) found satisfaction of the autonomy, competence, and relatedness needs predicted both enjoyment and future game play. This was further supported experimentally by Sheldon and Flak (2008), who manipulated learners' abilities to satisfy these basic psychological needs within a game-learning context. Ability to satisfy needs was controlled by including statements at the beginning of the training task, such as encouraging participants to explore the task however they wish to support their need for autonomy. The results suggested that satisfaction of these needs predicted outcomes including affect and performance. Of particular interest, competence satisfaction was found to be related to improved task performance. This suggests that including a social component such as those seen in social networking may be especially important when attempting to utilize gamification to improve task performance.

Another group of researchers expanded the SDT model in the gamification context to include antecedents to the basic needs when investigating enjoyment as an outcome (Tamborini, Bowman, Eden, Grizzard, & Organ, 2010). The antecedents included perceived game skill, natural mapping of the game controller, and co-playing. The proposed model was able to explain 51 % of the variance in enjoyment of the gaming task. This is strong support for Ryan and Deci's (2000) model but also demonstrates that characteristics of gamification can be linked to the psychological needs.

It is important to note that implementations of gamification may target both intrinsic and extrinsic motivators. For example, in a social networking site developed for psychology students that included gamification elements, both types of motivation were influenced (Landers & Callan, 2011). Students could earn badges by completing optional knowledge tests, which were then displayed with their profile whenever they posted on the site. These badges would be an extrinsic motivator because the students may be completing knowledge tests simply to gain those badges, rather than the enjoyment of taking the test. However, the social aspect of the site also played upon the psychological need for relatedness, and completing the tests may have met the students' needs for competence. In this way, we can see that gamification applications related to both school and work tasks may change behavior through either intrinsic or extrinsic motivators as well as some combination thereof.

Future Directions for the Study of Self-Determination in Gamification: Although some researchers are certainly working to answer questions about how SDT applies in the context of gamification, many questions are still left unanswered. Two of the biggest issues that should be investigated in the future are what aspects of gamification are intrinsically motivating and what moderators need to be considered when looking at these relationships. Answering these questions will not only assist in theory development by suggesting more complete models of motivation in gamification but also provide practical recommendations for practitioners and teachers seeking to include gamification elements in school and work contexts.

Bedwell et al. (2012) developed a taxonomy of game elements in educational settings that could be used as a guide for establishing which of these elements relates to intrinsic motivation and basic psychological needs specified in SDT. The elements include game characteristics like challenge/conflict, rules/goals, human interaction, and game fiction, which researchers could manipulate experimentally to isolate the effects on motivation. Participants could then rate satisfaction of the basic needs during the task and criteria such as performance and enjoyment could be assessed to further develop theory on these relationships.

Another approach to this task would be manipulating each element to identify different levels at which the element becomes more or less motivating to a learner or a trainee. For example, a training task could include a simple game fiction or a more elaborate game fiction to investigate if the level of game fiction affects motivation. This could further be investigated by comparing the work and educational contexts to see if students are more motivated by the inclusion of game elements than employees. For these questions, the gamification motivation scale developed by Lafrenière et al. (2012) may be useful.

Investigating employee and student samples taps into the issue of moderators in the relationship between game elements and motivation. These two populations differ on important characteristics that could influence the relationship between gamification characteristics and motivation such as computer experience, age, and attitudes toward gamification. Computer experience may also prove to be an important moderator of this relationship. Computer experience has been found to be related not only to pre- and post-training scores in computer-based training (Brown, 2001) but also attitudes toward the training task (Czaja & Sharit, 1998). Understanding this relationship will provide some guidance regarding which employees or students are most likely to benefit from gamification because those with more experience may be more open to utilizing these features in a training context. This will allow practitioners to develop more targeted interventions, perhaps adding more game elements for populations with more experience or providing more training on the elements themselves for less experienced trainees.

Finally, the task itself may influence the relationship between gamification and motivation. In particular, task complexity may be important as a more complex task will require more cognitive resources (Morris & Leung, 2006; Van Gog, Kester, & Paas, 2011) and also likely more time in training. It may be that manipulating intrinsic motivation through gamification has a stronger effect on learning for complex tasks because of the investment required from the learner. On the other hand, these elements could prove distracting if the cognitive load becomes too great. By investigating moderators, we will better understand not only how to tailor training to the individual but also to the task. Practitioners and teachers can then capitalize on this knowledge to improve outcomes such as learning, making training more effective.

9.3 Summary and Recommendations for Researchers and Practitioners

We have described here the five major theoretical traditions that we have found to be most relevant to gamification: the theory of gamified instruction, conditioning theories of learning, expectancy-based theories, goal-setting theory, and self-determination theory. These theories speak not only to gamification as it is intended but also to gamification as it is practiced. One of the most critical unanswered questions in gamification is: What is really changing when instruction is gamified? How is the learner changing, and is this change positive?

For researchers, we recommend careful consideration of these theories as exploration of gamification continues. It is not a useful contribution to consider gamification to be a unique and altogether new technique for influencing learning. Instead, gamification represents a new combination of and perspective on many prior techniques, all wrapped into new packaging. This new combination may provide unique value beyond any of those prior techniques alone, but this is an unresolved empirical question. We must better understand what can be extracted from the serious games literature so that it can be effectively applied in this new context. Only in that way can we demonstrate any incremental value provided by gamification over the sizable arsenal of instructional techniques already available.

For practitioners hoping to implement gamification in their own courses, we recommend careful consideration of unintended immediate and longitudinal consequences. Although a leaderboard may improve learner motivation to participate in a course project, it may also decrease later intrinsic motivation for course objectives. Although some learners may be highly motivated to meet relatedness needs through the social context of games, others might be motivated by competence needs through the achievement context of games.

Until future empirical research can examine the application of these theories to gamified instructional environments, best practices from the broader research literatures can be used to inform the design of gamified learning environments. From conditioning research, we conclude that one must be cautious to reward only the particular behavior that is being targeted. Conditioning proxy behaviors (e.g., rewarding test scores instead of learning, or website browsing history instead of motivation) may be unwise. From expectancy theories, we note that individuals differ widely in their perceptions of expectancies and valence. What one learner values, another may not; what one learner believes is achievable, another may not. Instructional designers should be cautious to ensure that the rewards from gamification are perceived as valuable and realistic to their learners. From goal-setting theory, we reiterate a central tenet of that theory: goals must be accompanied by feedback (Locke & Latham, 2002). For instructional designers wishing to implement gamification, this means that game design elements must trigger both goal-setting and allow for feedback about goal progress. Further, best-practices from the goal-setting literature suggest that gamification interventions should be developed to encourage difficult, specific goals, rather than do-your-best or easy goals (Locke

& Latham, 2002). This will help to ensure that the gamification intervention properly motivates leaners without boring or frustrating them. Finally, from SDT theory, we highlight findings by Tamborini et al. (2010), which provide a direct link between game characteristics and psychological need fulfillment (Ryan & Deci, 2000). This linkage provides guidance for practitioners. For example, if an organization wants to utilize gamification to improve learning outcomes in a training task, it is important to ensure that the game characteristics help support psychological needs. This could be done by providing a social component like a chat room to support relatedness needs, practice activities to support competency needs, and a good deal of control for the learners to support autonomy. By supporting all of the basic psychological needs, a gamification intervention should be more motivating to learners and thus more likely to yield the desired outcomes.

References

Antin, J., & Churchill, E. F. (2011). *Badges in social media: A social psychological perspective*. CHI EA.

Becker, L. J. (1978). Joint effect of feedback and goal setting on performance: A field study of residential energy conservation. *Journal of Applied Psychology, 63*(4), 428–433. doi:10.1037/0021-9010.63.4.428.

Bedwell, W. L., Pavlas, D., Heyne, K., Lazzara, E. H., & Salas, E. (2012). Toward a taxonomy linking game attributes to learning: An empirical study. *Simulation & Gaming, 43*(6), 729–760. doi:10.1177/1046878112439444.

Brown, K. G. (2001). Using computers to deliver training: Which employees learn and why? *Personnel Psychology, 54*, 271–296. doi:10.1111/j.1744-6570.2001.tb00093.x.

Brown, K. G. (2005). A field study of employee e-learning activity and outcomes. *Human Resource Development Quarterly, 16*(4), 465–480. doi:10.1002/hrdq.1151.

Brown, S. P., Jones, E., & Leigh, T. W. (2005). The attenuating effect of role overload on relationships linking self-efficacy and goal level to work performance. *Journal of Applied Psychology, 90*(5), 972–979. doi:10.1037/0021-9010.90.5.972.

Czaja, S. J., & Sharit, J. (1998). Age differences in attitudes toward computers. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 53B*, 329–340.

Davis, M. (2012). *Get in the game: How credit unions can engage members, solve problems, and improve skills with game thinking.* Retrieved from http://filene.org/research/report/Game_Thinking

Davison, M., & Baum, W. M. (2006). Do conditional reinforcers count? *Journal of the Experimental Analysis of Behavior, 86*, 269–283. doi:10.1901/jeab.2006.56-05.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Springer.

Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011). *Gamification: Toward a definition.* Proceedings from CHI 2011.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). *Gamification: Using game-design elements in non-gaming contexts.* Proceedings from CHI 2011.

Donovan, J. J., & Williams, K. J. (2003). Missing the mark: Effects of time and causal attributions on goal revision in response to goal-performance discrepancies. *Journal of Applied Psychology, 88*(3), 379–390. doi:10.1037/0021-9010.88.3.379.

Evans, M., Jennings, E., & Andreen, M. (2011). Assessment through achievement systems: A framework for educational game design. *International Journal of Game-Based Learning, 1*, 16–29.

Hamari, J. (2013). Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service. *Electronic Commerce Research and Applications, 12*, 2236–2245. http://dx.doi.org/10.1016/j.elerap.2013.01.004.
Hilgard, E. R., & Marquis, D. G. (1940). *Conditioning and learning*. New York: D. Appleton-Century, Company.
Hollenbeck, J. R., & Klein, H. J. (1987). Goal commitment and the goal-setting process: Problems, prospects, and proposals for future research. *Journal of Applied Psychology, 72*(2), 212–220. doi:10.1037/0021-9010.72.2.212.
Hsu, S. H., Chang, J.-W., & Lee, C.-C. (2013). Designing attractive gamification features for collaborative storytelling websites. *Cyberpsychology, Behavior and Social Networking, 16*, 428–435.
Ilies, R., & Judge, T. A. (2005). Goal regulation across time: The effects of feedback and affect. *Journal of Applied Psychology, 90*(3), 453–467. doi:10.1037/0021-9010.90.3.453.
Irons, J. G., & Buskist, W. (2007). Operant conditioning. In S. F. Davis & W. Buskist (Eds.), *21st century psychology: A reference handbook* (pp. 329–339). Thousand Oak, CA: SAGE Publications, Inc.
Kahn, R. L., Wolfe, D. M., Quinn, R. P., Snoek, J. D., & Rosenthal, R. A. (1964). *Organizational stress: Studies in role conflict and ambiguity*. Oxford, England: John Wiley.
Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology, 74*(4), 657–690. doi:10.1037/0021-9010.74.4.657.
Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. San Francisco: Pfeiffer.
Karoly, P. (1993). Mechanisms of self-regulation: A systems view. *Annual Review of Psychology, 44*, 23–52. doi:10.1146/annurev.ps.44.020193.000323.
Kernan, M. C., & Lord, R. G. (1990). Effects of valence, expectancies, and goal-performance discrepancies in single and multiple goal environments. *Journal of Applied Psychology, 75*(2), 194–203. doi:10.1037/0021-9010.75.2.194.
Klein, H. J., Wesson, M. J., Hollenbeck, J. R., & Alge, B. J. (1999). Goal commitment and the goal-setting process: Conceptual clarification and empirical synthesis. *Journal of Applied Psychology, 84*(6), 885–896. doi:10.1037/0021-9010.84.6.885.
Kluger, A. N., & DeNisi, A. (1996). Effects of feedback intervention on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2), 254–284. doi:10.1037/0033-2909.119.2.254.
Lafrenière, M.-A. K., Verner-Filion, J., & Vallerand, R. J. (2012). Development and validation of the Gaming Motivation Scale (GAMS). *Personality and Individual Differences, 53*(7), 827–831. doi:10.1016/j.paid.2012.06.013.
Landers, R. N., & Callan, R. C. (2011). Casual social games as serious games: The psychology of gamification in undergraduate education and employee training. In M. Ma, A. Oikonomou, & L. C. Jain (Eds.), *Serious games and edutainment applications* (pp. 399–423). New York: Springer.
Landers, R. N. & Landers, A. K. (in press). An empirical test of the theory of gamified instructional design: The effect of leaderboards on academic performance. *Simulation & Gaming*.
Landers, R. N. (in press). Developing a theory of gamified instructional design: Linking serious games and gamification of learning. *Simulation & Gaming*.
Latham, G. P., & Brown, T. C. (2006). The effect of learning vs. outcome goals on self-efficacy, satisfaction and performance in an MBA program. *Applied Psychology: An International Review, 55*(4), 606–623. doi:10.1111/j.1464-0597.2006.00246.x.
Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes, 50*(2), 212–247. doi:10.1016/0749-5978(91)90021-k.
Latham, G. P., Mitchell, T. R., & Dossett, D. L. (1978). Importance of participative goal setting and anticipated rewards on goal difficulty and job performance. *Journal of Applied Psychology, 63*(2), 163–171. doi:10.1037/0021-9010.63.2.163.

Latham, G. P., & Seijts, G. H. (1999). The effects of proximal and distal goals on performance on a moderately complex task. *Journal of Organizational Behavior, 20*(4), 421–429. 10.1002/(SICI)1099-1379(199907)20:4<421::AID-JOB896>3.0.CO;2-#.

Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*, 1–5.

Locke, E. A. (1968). Toward a theory of task motivation and incentives. *Organizational Behavior & Human Performance, 3*(2), 157–189. doi:10.1016/0030-5073(68)90004-4.

Locke, E. A., & Bryan, J. F. (1969). Knowledge of score and goal level as determinants of work rate. *Journal of Applied Psychology, 53*(1), 59–65. doi:10.1037/h0026736.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*(9), 705–717. doi:10.1037/0003-066x.57.9.705.

Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. *Current Directions in Psychological Science, 15*(5), 265–268. doi:10.1111/j.1467-8721.2006.00449.x.

Malala, J., Major, A. Maunez-Cuadra, J., & McCauley-Bell, P. (March, 2007). *The use of rewards in instructional digital games: An application of positive reinforcement.* Presented at Annual Conference of the International Academy of Business Disciplines 2007.

Michael, D., & Chen, S. (2005). *Serious games: Games that educate, train, and inform*. Boston: Thomson Course Technology.

Morris, C. H., & Leung, Y. K. (2006). Pilot mental workload: How well do pilots really perform? *Ergonomics, 49*(15), 1581–1596. doi:10.1080/00140130600857987.

Nicholson, S. (2013). *Exploring gamification techniques for classroom management.* Paper presented at Games+Learning+Society 9.0, Madison, WI.

Pinder, C. C. (2008). *Work motivation in organizational behavior* (2nd ed.). New York: Psychology Press.

Pintrich, P. R. (1988). A process oriented view of student motivation and cognition. *New Directions for Institutional Research, 57*, 65–79. doi:10.1002/ir.37019885707.

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In M. L. Maehr & C. Ames (Eds.), *Advances in motivation and achievement: Motivation enhancing environments* (pp. 117–160). Greenwich, CT: JAI Press.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). San Diego, CA: Academic.

Pintrich, P. R., & de Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40. doi:10.1037/0022-0663.82.1.33.

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (mslq). *Educational and Psychological Measurement, 53*(3), 801–813. doi:10.1177/0013164493053003024.

Rao, V. (2013). Challenges of implementing gamification for behavior change: Lessons learned from the design of Blues Buddies. Proceedings of CHI 2013, Paris, France.

Rapp, A. (2013). *Beyond gamification: Enhancing user engagement through meaningful game elements*. Presented at the Foundations of Digital Games Conference 2013.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54–67. doi:10.1006/ceps.1999.1020.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion, 30*(4), 347–363. doi:10.1007/s11031-006-9051-8.

Schmidt, A. M., & DeShon, R. P. (2007). What to do? The effects of discrepancies, incentives, and time on dynamic goal prioritization. *Journal of Applied Psychology, 92*(4), 928–941. doi:10.1037/0021-9010.92.4.928.

Schmidt, A. M., & Dolis, C. M. (2009). Something's got to give: The effects of dual-goal difficulty, goal progress, and expectancies on resource allocation. *Journal of Applied Psychology, 94*(3), 678–691. doi:10.1037/a0014945.

Schmidt, A. M., Dolis, C. M., & Tolli, A. P. (2009). A matter of time: Individual differences, contextual dynamics, and goal progress effects on multiple-goal self-regulation. *Journal of Applied Psychology, 94*(3), 692–709. doi:10.1037/a0015012.

Seijts, G. H., & Latham, G. P. (2001). The effect of distal learning, outcome, and proximal goals on a moderately complex task. *Journal of Organizational Behavior, 22*(3), 291–307. doi:10.1002/job.70.

Sheldon, K. M., & Filak, V. (2008). Manipulating autonomy, competence, and relatedness support in a game-learning context: New evidence that all three needs matter. *British Journal of Social Psychology, 47*(2), 267–283. doi:10.1348/014466607x238797.

Singer, L., & Schneider, K. (2012). *It was a bit of a race: Gamification of version control.* Paper presented at the Games and Software Engineering (GAS), 2012 2nd International Workshop.

Sitzmann, T., Bell, B. S., Kraiger, K., & Kanar, A. M. (2009). A multilevel analysis of the effect of prompting self-regulation in technology-delivered instruction. *Personnel Psychology, 62*(4), 697–734. doi:10.1111/j.1744-6570.2009.01155.x.

Sitzmann, T., & Ely, K. (2010). Sometimes you need a reminder: The effects of prompting self-regulation on regulatory processes, learning, and attrition. *Journal of Applied Psychology, 95*(1), 132–144. doi:10.1037/a0018080.

Skinner, B. F. (1948). 'Superstition' in the pigeon. *Journal of Experimental Psychology, 38*, 168–172.

Skinner, B. F. (1958). Teaching machines. *Science, 128*, 969–977.

Strang, H. R., Lawrence, E. C., & Fowler, P. C. (1978). Effects of assigned goal level and knowledge of results on arithmetic computation: A laboratory study. *Journal of Applied Psychology, 63*(4), 446–450. doi:10.1037/0021-9010.63.4.446.

Tamborini, R., Bowman, N. D., Eden, A., Grizzard, M., & Organ, A. (2010). Defining media enjoyment as the satisfaction of intrinsic needs. *Journal of Communication, 60*(4), 758–777. doi:10.1111/j.1460-2466.2010.01513.x.

Tay, L. (2010). *Employers: Look to gaming to motivate staff. itnews for Australian Business.* Retrieved from http://www.itnews.com.au/News/169862,employers-look-to-gaming-to-motivate-staff.aspx

Van Eerde, W., & Thierry, H. (1996). Vroom's expectancy models and work-related criteria: A meta-analysis. *Journal of Applied Psychology, 81*(5), 575–586. doi:10.1037/0021-9010.81.5.575.

Van Gog, T., Kester, L., & Paas, F. (2011). Effects of concurrent monitoring on cognitive load and performance as a function of task complexity. *Applied Cognitive Psychology, 25*(4), 584–587. doi:10.1002/acp.1726.

Vancouver, J. B. (2008). Integrating self-regulation theories of work motivation into a dynamic process theory. *Human Resource Management Review, 18*(1), 1–18. doi:10.1016/j.hrmr.2008.02.001.

Vancouver, J. B., More, K. M., & Yoder, R. J. (2008). Self-efficacy and resource allocation: Support for a nonmonotonic, discontinuous model. *Journal of Applied Psychology, 93*(1), 35–47. doi:10.1037/0021-9010.93.1.35.

Vassileva, J. (2012). Motivating participation in social computing applications: A user modeling perspective. *User Modeling and User-Adapted Interaction, 22*(1–2), 177–201. doi:10.1007/s11257-011-9109-5.

Vroom, V. H. (1964). *Work and motivation*. New York: Wiley.

Vroom, V. H. (1995). *Work and motivation*. San Francisco: Jossey-Bass Inc., Publishers.

Watson, J. B., & Rayner, R. (1920). Conditioned emotional reactions. *Journal of Experimental Psychology, 3*, 1–14.

Wood, R. E., Mento, A. J., & Locke, E. A. (1987). Task complexity as a moderator of goal effects: A meta-analysis. *Journal of Applied Psychology, 72*(3), 416–425. doi:10.1037/0021-9010.72.3.416.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Chapter 10
A History and Frameworks of Digital Badges in Education

Nathaniel Ostashewski and Doug Reid

10.1 Introduction

As more and more informal educational opportunities are becoming available on the Internet, learners and the organizations to which they belong are challenged with finding ways of representing their educational experiences. Until recently, it was difficult for learners to collect, display, and connect learning experiences online to online artifacts, without using HTML code. As digital badging has acquired more functionality, through the efforts of organizations such as the Mozilla Open Badges initiative or Purdue University's Passport project, the usefulness of digital badging for representing learning experiences online has become more apparent. Digital badges are intended to allow users to selectively display badges on websites, social media pages, online profiles and resumes as claims of achievement. As such they are quickly becoming a new method of validating and representing learning.

Emerging from the intersection of games culture, visuals on the Internet, and the traditional and historical uses of badges and medals, the digital badge is an online visual representation of an accomplishment, skill, or award. Gibson and colleagues (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2013) identify a digital badge as "a representation of an accomplishment, interest or affiliation that is visual, available online, and contains metadata including links that help explain the context, meaning, process and result of an activity." Context metadata, for example, might be artifacts linked to the tool or environment that a person utilized to develop the artifacts, providing evidence or validation of the person's skills. Badges can be linked

N. Ostashewski (✉)
Athabasca University, Box 7505, Bonnyville, AB, Canada, T9N 2H8
e-mail: nostashewski@athabascau.ca

D. Reid
MacEwan University, 8909-80 Avenue, Edmonton,
Alberta Canada T6C0T6
e-mail: reidd48@macewan.ca

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_10

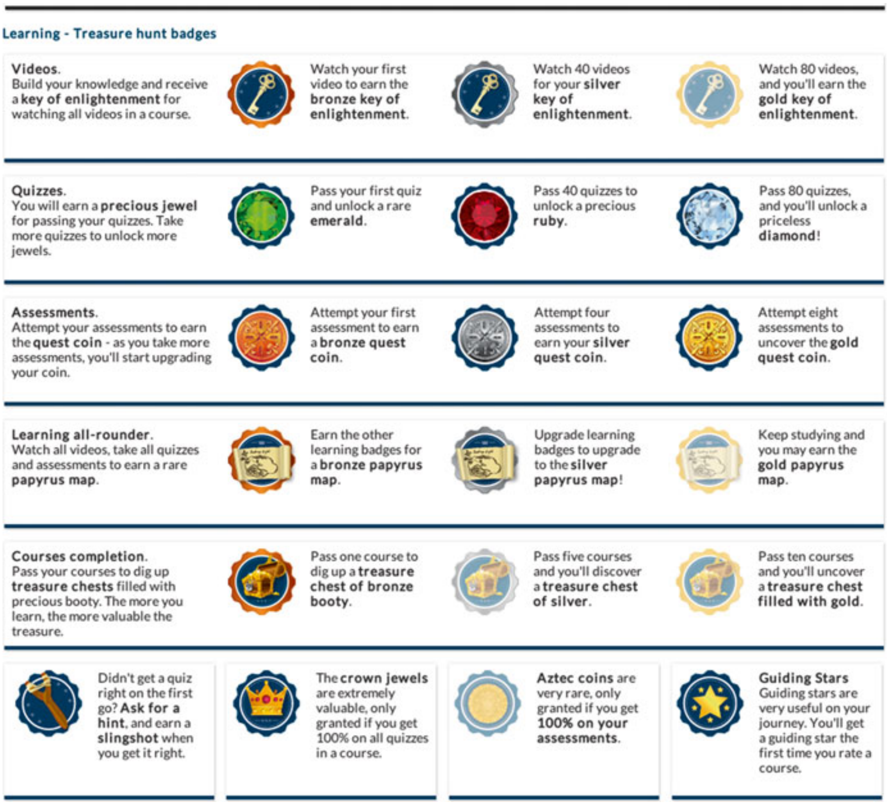


Fig. 10.1 Open2Study badges

to assessment, but are not the assessment in and of themselves, rather badges recognize learning and assessment that has happened. They do open up possibilities to be innovative about assessment in areas such as competency-based learning. Figures 10.1 and 10.2 provide some examples of digital badges that were earned by the authors in Open2Study and Tumblr.

The concept of digital badges can be understood across a variety of implementations. Some of these are, in no particular order:

1. The digital representation of a skill, achievement, interest or affiliation.
2. Information and evidence-based credentials complete with a set of data that explains and vets that badge.
3. Connectors between learning experiences and contexts. In the connected learning framework, badges are the connectors that communicate and translate learning across the peer, interest, and school learning contexts of a youth's life.
4. Tools for getting jobs, credit, additional learning, reputation and other opportunities.
5. Digital identity and reputation currency

Fig. 10.2 Tumblr badge

6. Alternative credentialing and accreditation system
7. Distributed portfolios in that they are skill first, with the evidence linked behind them, instead of the traditional evidence/artifact first without an indication of aligned or assessed skills (Knight, 2013).

In summary, digital badging has emerging practices, processes, and implementation contexts as the Internet continues to represent and connect users globally.

10.2 History and Context

Historically badges have been varied in terms of their form and purpose. The practice of creating, awarding, and displaying digital badges appears to have evolved from age-long customs of awarding ribbons and medals, such as to military personnel, that represent accomplishments or status.

The origins of the physical badge stem from the Middle Ages where they were worn as jewelry, or to denote the completion of a pilgrimage, or as a mark of political allegiance. In modern times the physical badge has become known as a manner in which to denote military rank and achievements or for advertising, branding or means of visual identification.

As military badges of rank or merit, badges have been physical items composed of cloth or metal intended to be affixed to the wearer. Earliest Boy Scout badges were also embroidered patches of cloth representing an accomplishment or to recognize proficiency in a scouting skill. The scout badges were developed to encourage scouts to pursue areas of interest and develop skills that might lead to careers or lifelong hobbies. The digital badge is a virtual representation of a credential or accomplishments, visible to others through graphical display on an Internet page. Today, organizations like the 4-H Movement have adopted the concept of digital badges and are piloting the implementation in the area of robotics competencies (4-H, 2014).

Just as physical awards and badges represent achievements, digital or virtual badges are also markers of achievement with an added component of being linked to online evidence of the accomplishment, quality or skill. Digital badges contain metadata that can provide significantly more information about the badge to a viewer than traditional badges. While a Policeman's badge, for example, provides visual evidence of being a person employed in a specific job, the digital badge can go beyond the visual evidence and provide direct online URL links to additional information or evidence about the badge. This has specific value in that the viewer can validate confidence in the digital badge at any time. While the policeman carrying the badge can be verified as well, it would require a viewer to call a police station and inquire further to confirm the badge holder to be credible. Digital badges, and the metadata they contain in the form of URL links, are particularly valuable for education, as the information they can provide as validation material can be accessed by any viewer at any time. Digital badges also have the added advantage of being able to be connected virtually or shared when users wish to communicate success or accomplishments

One of the earliest and most notable implementations of digital badges representing real learning and skills was the automated badge system on Stack Overflow. They used badges for recognizing and rewarding behaviors within the site—good mentor, editor, popular question/answer—as well as hard skills demonstrated through the answers—html, javascript, java, and so on (WaybackMachine, 2008). Stack Overflow (2014) currently lists their badging system as an automated system where badges are "earned by achieving a measurable numeric goal queried out of the site database." They further describe badges as:

> Badges are little bits of digital flair that you earn for almost every kind of activity on Stack Overflow. The number and type of badges you've earned are displayed together with your username and reputation score around the site, as part of your usercard.

Stack Overflow implements the badge system to accomplish two specific goals: to teach new users how Stack Exchange works, and to encourage activities that are positive to the community. While their badges are only available through their website and cannot be shared outside of their site, they launched Careers2.0, a companion website, that allows employers to pay in order to access employment candidates based on the badge data. This early example is one way in which informal learning is being represented through the use of digital badging.

Digital badges also appear to have begun as a metaphorical extension of the merit badges used by the Boy Scouts association around the globe. The merit badges highlight the achievement of the Scout in terms of a clearly defined skill or knowledge set and at an established standard or level of practice. Scouting badges were recognized with the following attributes:

- used to recognize skills and achievements
- often unlocked access to various roles or additional learning opportunities
- displayed and contributed significantly to reputation within communities

- physical badges that could not be transferred across contexts very easily.
- defined top down and left little flexibility for customized pathways or learning.

The scouting badge system suited educational contexts especially well, and according to Erin Knight (2013), one of the innovators of the Open Badge project, was a starting point for Mozilla:

> The current Open Badges work looks to capitalize on the learning recognition and reputational aspects of the scouting badges, but moving to a digital badge gives us the opportunity to make them information-based and transferrable. Also, the 'open' part is aimed at ensuring that there are many different pathways for learners and they can get recognized for learning of all kinds.

Mozilla launched the beta of the Open Badge Initiative in April 2012 and had 100 unique issuers and 5,000 badges by June 2012. These numbers increased to 450 issuers and 40,000 badges by December 2012. On March 14th, 2013 Mozilla launched the production version of Open Badges, including both the standard and software, and by mid-2013 there were already over 700 unique issuers and 75,000 badges (Knight, 2013).

There are more and more systems being developing that allow organizations to create, award, and display digital badges on members' websites, profiles, social media pages, and resumes. One of the leading organizations in the development of types and standard is the Mozilla initiative, however others are emerging as standalone (such as Accredible) or networked APIs (such as Purdue Passport, BB Building block, Wordpress) as well as the growing gaming platforms (World of Warcraft, etc.). With the advent of the Internet, badging came into its digital form initially as a way to represent website traffic (Website counters), denote awards (Blogger Awards), and to demonstrate secure electronic payment services (Secure Site).

10.3 Value for Education

Digital badging has been used in recent years in marketing and engagement strategies by a variety of online services. Examples can be found on social media sites where the collection of badges is used as a form of incentive to promote particular online behaviors. Badging systems, such as the one found on the social media site Foursquare (www.Foursquare.com), encourage certain interaction behaviors from users by awarding digital badges for these behaviors. These behaviors are ones such as: to check in frequently, to utilize the social network often, to contribute opinions, and to accumulate credit, recognition and prestige on the Foursquare community. While these kinds of badges are intended to provide some recognition in an online community, they are also increasingly being used as a way to foster brand loyalty and customer retention.

In education, badging systems serve a similar purpose. For education, digital badges are intended to:

- Allow learners to set goals,
- Incentivize learners to engage in positive learning behaviors,

- To represent learner accomplishments, and
- Communicate success in many contexts supported by connections to learning artifacts.

In order for badges to be recognized as meaningful indicators they must eventually be linked with evidence of what activity and learning the claimant has actually completed. To this end developers of badging systems are looking to embed quality metadata within the badging system, thereby allowing the badge to be identified by

- issuer,
- standards achieved, and
- activities undertaken.

This association with the digital evidence of learning or engagement might be as simple as a hyperlink to a description or artifact, or as is occurring in more sophisticated developments, the image file that displays the digital badge itself is encoded with metadata.

To date the most comprehensive development of a badging environment is arguably found in the Mozilla Open Badges initiative, however there are several systems and organizations with similar goals and approaches (eg. Digitalme, Credly.com, Badgestack). The Mozilla system built upon open software strategies is intended to provide a structured and standardized environment to utilize the strengths of digital badges. The Open Badges project provides a platform that allows verification, portability, creation and collection of badges and the associated metadata that allows badges to be accepted as useful credentials. Other systems may be more proprietary in their business model and accommodate varying degrees of interoperability but most developers are aware of the need for portability of credentials and the expectations that users will want to accumulate and display badges as they decide. Custom badging solutions are also emerging as stand-alone products, (such as Accredible) or leverage APIs (such as Purdue University's Passport, Blackboard's Open Badges building block, various Wordpress plugins).

Degree credentials granted by higher education institutions are one formal way in which accomplishments based on standards are communicated about learners. However, while degrees represent information about about learner's skills and successes, they are often abstracted from the real learning that took place. Two people with the same degree may in fact have very different skillsets yet a degree is not able to communicate these to potential employers. Similarly many higher education institutions recognize the development of "soft skills" that have value for potential employers, and the degree systems do not provide for much flexibility in this area. In this regard, badges may be very helpful by providing a more complete picture, presenting a more complete set of skills. Examples of what digital badges can be valuable for in education include:

1. Capturing the learning pathway—granular representations of skills or achievements along the way.
2. Recognizing mastery and certification.
3. Signaling skills and achievements to relevant stakeholders like employers, institutions and social networks.

4. Carrying the information needed to understand, authenticate and validate the badge and the learning that it claims to represent.
5. Discovering additional learning opportunities or ways to level up.
6. Motivating continued or additional learning.
7. Supporting innovation and flexibility around what skills we recognize and legitimize—for example, twenty-first century skills or often-ignored "soft" social skills.
8. Building and formalizing identity or identities.
9. Building and formalizing reputation within and across communities
10. Fostering community and kinship through discovery of shared interests and skills (Knight, 2013).

Two opposing views are being expressed in the *digital badges in education* debate. The debate centers on the internal versus the external source of motivation for completion of learning tasks.

Advocates of digital badges point out that students are constantly being evaluated and rewarded for their grades (Rughinis, 2013). These rewards are for task completions, projects, behavior, skill competency and more. Classroom rewards include grades, praise, stickers, certificates, ribbons, medals and even badges or pins. These rewards already drive learning in significant ways and the badges initiative creates new opportunities to assign real-world value to students' interests and learning accomplishments, and to demonstrate that these skills are as important regardless of where they are accessed. On the other hand, skeptics of digital badges worry that by creating too many incentives or "treats" in exchange for learning, students will lose interest in learning for learning's sake:

> [S]keptics of the badge system have pointed to research that shows extrinsic motivation, or giving out rewards, for activities students would already be completing for their personal benefit reduces their overall motivation to take part in these activities. The risk is badge getting as the goal, rather than the learning it represents. (Herron, 2012)

Regardless of the outcome of this debate, the use of digital badges has begun to capture the interest of educators and corporations around the world (Mozilla Foundation and Peer 2 Peer University, 2011).

The next section presents the literature which includes a number of pieces that provide futuristic views of what might take place with digital badges in education (Duncan, 2011; Finkelstein, Knight, & Manning, 2013; Frederiksen, 2013; McDaniel, Lindgren, & Friskics, 2012; Moore, 2013; Santos et al., 2013). This literature gives a useful starting place to examine the current state of the literature surrounding digital badges and their use in education.

10.4 Frameworks for Educational Use

There are numerous frameworks and contexts for the implementation of digital badges found in the literature. These frameworks vary a great deal in terms of goals and outcomes but have key commonalities around either *motivation*, *representation of learning*, or *communication of success*. Several frameworks will be reviewed that focus on actual use with students rather than the more theoretical understandings of badges and their potentials in the education context.

One framework found in the literature is digital badges as being their own *credential* and *evidence-based documentation*. These kinds of digital badges are presented as motivators, conversation topics, and boundary objects (Rughinis, 2013) in learning implementations. Rughinis argues that digital badges can be designed as status symbols and demonstrations of expertise in a learning context. There are also "role badges" which act as antennae to demonstrate entitlements for further participation such as "unlocking" other educational possibilities.

A second framework for digital badges focuses on *student behaviours* and *gamification*. Having badge types for learning, time management, and carefulness (Haaranen, Ihantola, Hakulinen, & Korhonen, 2014) puts this type of framework in the gamification design field. Haaranen provides examples using frameworks found in video games, computer science, and behavior of students. This research bases much of theoretical underpinnings on earlier work which breaks down digital badge use into three components; signifiers, completion logic and rewards (Hamari & Eranti, 2011). This computer science based technically focused article is highly technical and represents a whole stream of literature exploring digital badges that is of limited use when dealing with digital badge use in educational designs.

The literature based in *gamification* may have more relevance with the future use of digital badges in education. Giannetto, Chao, and Fontana (2013) present a more basic framework with badges being used as achievements to accomplish three outcomes. First, badges act as *a source of positive feedback* and reward for when students accomplish particular tasks. Second, there is the social component of badges that allow students to *share their accomplishments* with others. Third, badges are designed to *foster a sense of accomplishment* as students progress through pathways leading to more advanced learning material. Similar research presented by Phelan (2012) describes a pragmatic three point model for badge use. In this instance digital badges are seen as: certification of informal learning, social recognition and digital portfolio elements. Even with similar models in the literature, there are often vastly different viewpoints of the purpose and use of digital badges. This is likely due to the new and emerging nature of digital badges and the overlap of education and computer science perspectives of implementation.

There are also more complex frameworks of digital badge use found in the literature. Some of these base their framework on the fact that *badges are an abstraction of tracked data* (Charleer, Klerkx, Santos, & Duval, 2013). While this is based on the one foundational concept, the framework further expands into four key characteristics. Digital badges are *feedback*, *motivation*, *catalysts for discussion*, and *socially sharable*. Other complex frameworks are based on informal learning environments rather than classroom or traditional online learning settings (Barker, 2013). Barker's research presents a five-part digital badge environment that has badges awarded for recognition of behaviors including *cooperation*, *peer competition*, *progress toward personal goals*, *achievement*, and *educational experiences*.

Another example of a more complex framework examines the use of Mozilla's open badges program (Goligoski, 2012). This model explores a wider milieu as it includes badge issuers, learners, and users viewing badges externally from the educational environment in which they were awarded. The indepth exploration into the planning and motivation of offering badges makes this unique in the current literature with details such as badge earning criteria and design implications. There is also consideration given to the range of hard and soft accomplishments and skills, sharing preferences, privacy preferences, and electronic portfolio options. Mozilla's model is very detailed as it also explores the social impact of how participants may use their badges in other aspects of their life.

10.5 Models of Educational Use

There are simple models of digital badge use in education represented throughout the literature.

In one article, Grant (2014) presents a simple model of badge use as proof of skill and achievements at a very granular level by leveraging the transparent and information rich metadata provided by digital badges. In another piece of literature Waller (2012) describes a model where badges are awarded for almost any system achievement, behaviour or action. These awards act as a reward and reinforcement of behaviour. Badges are also presented to demonstrate achievement, recognize skills or actions. A third simple model structures badge use as recognition of participation and recognition of demonstrated skills (Abramovich, Schunn, & Higashi, 2013). These models are quite general and do not provide an indepth explanation for educators, as expected in a field of research that is still very young. Further research in the implementation of simple badging models with specific outcomes is one area identified by the authors as much needed.

Badging systems have been emerging in education in a variety of ways. One research project explores these system models in some detail (Gibson et al., 2013). They describe digital badge use in three distinct areas. They include:

1. To incentivize learners to engage in positive learning behaviors
2. To identify progress in learning and content trajectories
3. To signify and credential engagement, learning and achievement

This research initially begins with a basic model and then explores in much greater depth the components that are separate stages in other less evolved models.

There are articles in the literature that base their research upon a more educational design framework. Using the visual aspects of badges to illustrate the curricular flow for the learner was highlighted in Higashi, Abramovich, Shoop, and Schunn's 2012 study. They envision digital badge use for several key purposes such as: curriculum mapping, evidence trails, assessment, feedback, and global design documents. From this starting point, they present a more detailed framework of how digital badges can be used in educational settings. They present an educational progression or scaffolding of badges that vary in visual size, purpose and detail. For example:

- Small size badge for motivational purpose
- Medium size badges to represent progress milestones
- Large size badges for recognition purpose

The recognition badges in this system are further broken down into categories including:

- Teaching badges for pedagogy demonstration,
- Knowledge badges for content proficiency,
- High Performance badges for empirical excellence and
- Industry badges for external certification.

This matrix of badge useage in educational settings is very detailed compared to the majority of the current literature.

10.6 Current Use of Digital Badges in Education

Throughout the literature, there are examples of the implementation of digital badges across the educational milieu. There are four main contexts that are presented in the literature including K-12 schooling, Post-secondary environments, Professional/Corporate, and Lifelong learning endeavours. These four contexts will be presented in the following section.

K-12 Schooling: The evidence of the use of digital badges in K-12 school environments is limited in the current literature. There is literature regarding the use of merit badges which eventually evolved into an electronic form (Bruckman, 2004) but this did not contain a theoretical underpinning similar to more recent digital badge implementations. The presentation of digital badge use for grade 7 and 8 students explored student motivation and engagement (Abramovich et al., 2013). Abramovich present findings that demonstrate badges can have a positive impact on critical learner motivations. Their research also described how different types of digital badges affected different learners motivation. They argue that the extrinsic motivational factors badge use introduces to educational settings can have negative implications for some learners. The key implication of the research points to the need for badging implementation designers to know the ability and the motivations of the students for whom they are developing the curriculum.

Post Secondary environments: The largest subset of digital badges use in the literature presented examples from postsecondary environments. Examples included universities from Australia, Finland, Belgium, the United States and the United Kingdom. There were several examples in the literature from American postsecondary institutions including MIT, Harvard, UCDavis, Carnegie Mellon, Kent State (Pytash & Ferdig, 2014) and the University of Pittsburgh (Abramovich et al., 2013). Other countries had fewer pockets of digital badge use in their institutions.

From Finland, Aalto University presented research of what to do and what not to do when implementing digital badges (Haaranen et al., 2014). Haaranen et al. presented findings that demonstrated that the introduction of digital badges can improve scores on practical competence. At the same time digital badges had a negative effect on students' understanding of theoretical concepts. Also noted was the social aspect of learning that was impacted with the introduction of badges and how this affected behaviors involving earning badges. There were some very practical suggestions about the planning and the implementation of badges that grew out of their experience at Aalto University.

A pilot use of digital badges involving engineering students was conducted at KU Leuven in Belgium. Charleer et al. (2013) explored student awareness and reflection through collaborative activities and the personal dashboard approach. This research also included the use of automated awarding of badges rather than instructor awarded badges. They discovered with careful planning and hardware, students found badges to be a social conduit to further discussion and reflection. This type of implementation may have significant value for online learning environments, such as those used in Massive Open Online Courses or MOOCs.

The focus of much of the postsecondary literature highlighted the fact that digital badge use is an emerging field of study. For example, in one study students were used to incentivize postgraduate students (McDaniel et al., 2012). In another, badges were awarded to students for being: social, intelligent, inquisitive, helpful, and hard working (Giannetto, Chao, & Fontana, 2013). Again, the literature examined found that digital badges were mainly being used for motivation and social purposes with many recommendations for how implementations should proceed the next time digital badges are used in similar settings.

An interesting side note of the social and sharing aspects of digital badges is how some institutions are offering and recognizing badges across organizations. Global MOOC provider organizations such as edX, and other well-known universities, have begun to work toward this goal (How-it-works, 2014). Open2study, a MOOC provider in Australia (a similar collaboration across institutions such as edX) offers digital badges which all member institutions recognize as part of the course delivery. Open2Study (Kevat, 2014) uses badges to motivate learners to share and help each other during courses, signal profile completeness, and to represent learning milestones such as assessment and resource access milestones.

Professional & corporate: A different tact from the digital badge in education literature is the material being presented from corporate business organizations. Both Yahoo (Antin & Churchill, 2011) and Mozilla (Hickey, Itow, Rehak, Schenke, & Tran, 2013; Mozilla Foundation and Peer 2 Peer University, 2011) have published articles on the use of digital badges. Intel has also entered into an agreement with *Society for Science and the Public* to explore whether open badges can be utilized to increase youth science research (Society for Science and the Public & Intel Corporation, 2013). Mozilla has been very active regarding their Digital Badges and backpack system. The presentation of Mozilla's Open Badge system is referenced in a number of articles but there is very little research-based evidence to demonstrate actual outcomes or results of implementation. Given how many articles are demonstrating implementation interest in the topic of digital badges, there needs to be more evidence of the educational impact this system is making on students for the field to move forward.

Lifelong learning endeavours: While Digital Badge systems are being used in corporate and traditional educational settings, it is having an impact in lifelong learning endeavours. A number of authors (Barker, 2013; Duncan, 2011; Phelan, 2012) refer to the structures that are emerging to change how people view education and society. People outside of formal education and corporate structures are also being allowed access to digital badges through lifelong learning endeavours. American military service veterans are being given opportunities to use badges after their active service is up (Duncan, 2011). Other lifelong learning initiatives include using digital badges with the 4-H program in its youth development system. These are a few of the many examples of how badges are being used for lifelong learning and does not include edX and Open2Study users who appear to be engaging in learning for interest as opposed to their potential future career and certifications.

10.7 Summary

The introduction of digital badges as a method of representing online activities, credentials, or linking to metadata presents a way for twenty-first century representations to be shared and valued by all types of organizations and institutions. As with traditional credentialing processes, such as university degrees or professional designations, digital badging provides a method of presenting the required elements of issuer, standards, and activities but additionally extends beyond to include fine granularity details as well as links to artifacts as evidence. Specifically for education, and perhaps implementations of competency-based or mastery type learning activities, digital badges show real promise for providing motivation, signposting, and sharing of accomplishments in the virtual spaces of the Internet. As more and more formal as well as informal educational activities take hold of online technologies for delivery, digital badging provides opportunities for learning designers to mimic some of the face-to-face classroom rewards and processes that good teachers employ to encourage students. Research is sorely needed to extend the value of digital badges, digital badging systems, gamification using badges, as well as the transferability of digital badges between online presentation environments. Tools such as Accredible are already showing promise in the world of MOOC learning, where learners can select digital badges and pathways that represent their informal learning in ways that employers may soon expect. In closing, digital badges as virtual representations of merit or credibility are providing ways for twenty-first century learners to present their skillsets online, linked to evidence of those skills.

References

4-H. (2014). 4-H Digital Badging System. Available at http://www.fyflnet.org/4hbadges/

Abramovich, S., Schunn, C., & Higashi, R. M. (2013). Are badges useful in education?: It depends upon the type of badge and expertise of learner. *Educational Technology Research and Development, 61*, 217–232.

Antin, J., & Churchill, E. F. (2011). Badges in social media: A social psychological perspective. *Proceedings of the 2011 SIGCHI conference on Human Factors in computing systems. Presented at the CHI 2011*, Vancouver, BC, Canada.

Barker, B. (2013). Digital badges in informal learning environments. InICIW 2013, *The Eighth International Conference on Internet and Web Applications and Services* (pp. 252–255).

Bruckman, A. (2004). Co-evolution of technological design and pedagogy in an online learning community. *Designing for Virtual Communities in the Service of Learning*, 239–255.

Charleer, S., Klerkx, J., Santos, J., & Duval, E. (2013). Improving awareness and reflection through collaborative, interactive visualizations of badges. In Kravcik, M., Krogstie, B., Moore, A., Pammer, V., Pan-nese, L., Prilla, M., Reinhardt, W. & Ullmann, T.(Eds.). Awareness and reflection in technology-enhanced learning (ARTEL13), Paphos, Cyprus.

Duncan, A. (2011). Digital badges for learning. MacArthur Foundation. Chicago. 15 Sept. 2011. Retrieved May 8, 2014, from http://www.ed.gov/news/speeches/digital-badges-learning.

Finkelstein, J., Knight, E., & Manning, S. (2013). The potential and value of using digital badges for adult learners. Retrieved May 7, 2014, from lincs.ed.gov/publications/pdf/AIR_Digital_Badge_Report_508.pdf.

Frederiksen, L. (2013). Digital badges. *Public Services Quarterly, 9*(4), 321–325.

Giannetto, D., Chao, J., & Fontana, A. (2013). Gamification in a social learning environment. *Issues in Informing Science & Information Technology, 10*, 195–207.

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S., & Knight, E. (2013). Digital badges in education. *Education and Information Technologies, 16*, 1–8.

Goligoski, E. (2012). Motivating the learner: Mozilla's open badges program. *Access to Knowledge: A Course Journal, 4*(1).

Grant, S. (2014). Badges: Show what You know. *Young Adult Library Services, 12*(2), 28–32.

Haaranen, L., Ihantola, P., Hakulinen, L., & Korhonen, A. (2014). How (not) to introduce badges to online exercises. In *Proceedings of the 45th ACM technical symposium on Computer science education (pp. 33–38)*. ACM.

Hamari, J., & Eranti, V. (2011). Framework for designing and evaluating game achievements. *Proc DiGRA 2011: Think Design Play, 115*, 122–134.

Herron, K. (2012). The Great Digital Badges Debate. Common Sense media blog post available at: http://www.commonsensemedia.org/educators/blog/the-great-digital-badges-debate

Hickey, D. T., Itow, R. C., Rehak, A., Schenke, K., & Tran, C. (2013). Speaking personally: With Erin knight. *American Journal of Distance Education, 27*(2), 134–138.

Higashi, R., Abramovich, S., Shoop, R. & Schunn, C. (2012). The roles of badges in the computer science student network. *Paper published at the Games + Learning + Society conference*, (pp. 423–429). Madison, WA.

How-it-works. (2014). In edX—online courses and classes from the world's best. Retrieved May 8, 2014, from https://www.edx.org/

Kevat, P. (2014) Open2Study Research Report February 2014 (Cohorts 1–7). Available at: https://www.open2study.com/research/download/819

Knight, E. (2013). Personal email communication. *March, 21*, 2013.

McDaniel, R., Lindgren, R. & Friskics, J. (2012). Using badges for shaping interactions in online learning environments. *In Professional Communication Conference (IPCC), 2012 IEEE International,* (pp 1–4). IEEE, 2012.

Moore, M. G. (2013). Independent learning, MOOCs, and the open badges infrastructure. *American Journal of Distance Education, 27*(2), 75–76.

Mozilla Foundation and Peer 2 Peer University. (2011). Open Badges for Lifelong Learning. Retrieved May 7, 2014, from https://wiki.mozilla.org/images/b/b1/OpenBadges-Working-Paper_092011.pdf.

Phelan, L. (2012). Politics, practices, and possibilities of open educational resources. *Distance Education, 33*(2), 279–282.

Pytash, K., & Ferdig, R. (2014). Implementing Digital Badges in a Teacher Education Program. *In Society for Information Technology & Teacher Education International Conference*, 2014(1), 1779–1780.

Rughinis, R. (2013). Talkative objects in need of interpretation. re-thinking digital badges in education. *In CHI'13 Extended Abstracts on Human Factors in Computing Systems (pp. 2099–2108)*. ACM.

Santos, J. L., Charleer, S., Parra, G., Klerkx, J., Duval, E., & Verbert, K. (2013). Evaluating the use of open badges in an open learning environment. In Scaling up Learning for Sustained Impact (pp. 314-327). Berlin: Springer.

Society for Science and the Public & Intel Corporation. (2013). SSP and Intel digital badge program. *In Digital Media & Learning Conference (2013)*.

Stack Overflow (2014) What are badges? Webpage available at: http://stackoverflow.com/help/what-are-badges

Waller, D. (2012). Open badges: Portable rewards for learner achievements. Retrieved May 7, 2014, from http://ob-awareness.myknowledgemap.com/MKM_open-badges_portable-rewards-for-learner-achievements.pdf.

WaybackMachine. (2008). Stack Overflow Website archived from: http://web.archive.org/web/20081014180904/http://blog.stackoverflow.com/category/beta/

Chapter 11
Game-Based Assessment: The Mash-Up We've Been Waiting For

Thomas E. Heinzen, R. Eric Landrum, Regan A.R. Gurung, and Dana S. Dunn

11.1 Introduction

Assessment is a "global term used to refer to the authentic evaluation of teaching and learning outcomes" (Dunn, McCarthy, Baker, Halonen, & Boyer, 2011, p. 145). There are many stakeholders in assessment: students, parents, the workforce, educators, and taxpayers. They all have compelling interests in the authentic evaluation of higher education (Association of American Colleges and Universities, 2010; Institute for a Competitive Workforce, 2012; Keeling & Hersh, 2012). The success of game-based assessment (GBA) hinges on its distinctive approach to failure and the vision to invest in the psychometric work needed to discover whether GBA deserves to be transformed from a few pilot tests into a widely distributed reality. The early work has begun. Ifenthaler, Eseryel, and Ge's (2012) edited volume is clarifying principles and technological methods as well as the justifications for game-based assessment. Shute and Ventura (2013) have described why some effective game-based assessments deserve to be called "stealth assessments." And the community of game designers at conferences such as G4C (Games 4 Change) is demonstrating the many ways that games can be applied to novel situations.

T.E. Heinzen (✉)
William Paterson University, 300 Pompton Road, Wayne, NJ 07470, USA
e-mail: heinzent@wpunj.edu

R.E. Landrum
Department of Psychology, Boise State University, 1910 University Drive, Boise, ID 83725-1715, USA

R.A.R. Gurung
Human Development and Psychology, University of Wisconsin-Green Bay, Green Bay, WI, USA

D.S. Dunn
Department of Psychology, Moravian College, 1200 Main Street, Bethlehem, PA 18018-6650, USA

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*, DOI 10.1007/978-3-319-10208-5_11

Keep three things in mind as you are introduced to GBA. First, we are only describing game-based *assessment* of teaching and learning, not new ways to teach and learn. Game-based learning and teaching is merely a happy byproduct of GBA. Second, we are exploring game-*based* assessment, not video games. Computer games are scalable and can be standardized but they are only one kind of game. Third, the pivot point that promises to make *game*-based assessment succeed where other approaches have failed is its playful, motivating approach to failure.

11.2 Section 1. Why Higher Education Needs Game-Based Assessment

Humans enjoy mysteries (Wilson, Centerbar, Kermer, & Gilbert, 2005). Unresolved endings motivate gamers to play, scholars to research, and readers to turn the page. GBAs can bring clarity to the decades old mystery of how to conduct authentic evaluations in higher education, but let's begin by telling you enough of assessment's back story to get you grinding your teeth with worry. The stakes are high, the investment is enormous, and the outcome is uncertain—a tipping point for creative solutions. To be blunt, the business of higher education is big business and, as an industry, we are going downhill.

11.2.1 Completion Rates

We'll begin reviewing the crisis in higher education by considering costs versus outcomes in terms of completion rates. In 2012, the National Center for Education Statistics (Snyder & Dillow, 2012) used their most recent data to report that 1.4 million faculty were teaching 21.0 million students that produced approximately 1.7 million bachelor's degrees (roughly 15 students per faculty) member. The current cost (meaning it will be more by the time you read this) of undergraduate tuition, room, and board at public universities is $13,564 per year; at private not-for-profit universities, $36,252 per year; at private for-profit universities, $23,495 per year. Sixty-three percent of students receive federal financial aid. If you combine the investment spent directly via student and parent contributions with the indirect investments through taxes and federal student loans, then the estimated cumulative expenditures for degree-granting postsecondary institutions in 2011 was estimated at $460 billion. This enormous investment yields about a 57 % completion rate after 6 years—a failing grade by conventional academic standards. The remaining 43 % of those 21 million students represent some 9 million debt-accumulating students who do not earn a degree.

11.2.2 Workplace Skills

Americans remain deeply vested in higher education because there are core cultural assumptions about what higher education can do for individuals and society. Completion rates, however, do not tell us what students can actually do. So, let's shift from completion rates to workplace skills. In 1991 the U.S. Department of Labor (1991) issued a report categorizing necessary workplace skills into three areas: (1) foundation skills; or (2) competency skills, that can become (3) applied workplace skills. To establish the Area 1 foundational skills, workers need to possess (a) basic skills (b) thinking skills (creative thinking, decision-making, problem solving, and metacognitive skills); and (c) personal qualities (individual responsibility, self-esteem, sociability, and integrity). Effective employees then work to establish Area 2 competencies by applying their foundational skills to productively use (a) resources, (b) interpersonal skills, (c) information, (d), systems, and (e) technology. The Association for Career and Technical Education (2010) emphasized that these skills are *essential but incomplete*. Employees should also be able to apply their Area 3 academic knowledge and skills to (a) practical situations; and (b) as technical skills that may be necessary for licensure or certification in certain fields.

The U.S. Department of Labor is not the only player articulating what graduating college students should be able to do. The Lumina Foundation for Education (2010) recommended a similar degree profile that assessed applied learning, knowledge (specialized, broad, and integrative knowledge), skills (communication and thinking skills), and civic learning. *The Chronicle of Higher Education* (2010) reported that since 2005, five major quality-of-learning projects have emerged, including the Association of American Colleges and Universities (AAC&U, 2005) Liberal Education and America's Promise (LEAP) program in 2005. These projects reflect efforts to conduct national studies of employers and other stakeholders ranging from the general workforce readiness of college graduates to specific topics such as the importance of writing for future success. The LEAP project sponsored by AAC&U promotes a liberal education with assessments that can judge institutional success because there were *no national data* about information literacy, teamwork, integration of learning, civic responsibility and engagement, ethical reasoning, intercultural knowledge and actions, and propensity for lifelong learning.

In short, we know what we want in higher education—more or less—but we haven't created ways to find out if we are getting it. We know more about relatively meaningless completion rates than what students can actually do. The AAC&U report noted some beginning efforts, but at present *no national data exist* on learning outcomes that are deemed critical for success. Kuh, Kinzie, Schuh, Whitt, and Associates (2010, p. 18) pointed out that we do not even assess our successes. "There are disadvantages to being successful and not knowing why. Not knowing what contributes to exceptional performance makes an institution vulnerable to losing over time what made it successful in the first place." In our opinion, the research-based landscape has not improved much since 2005.

11.2.3 The Need for Authentic Data

Despite the absence of data, many Americans perceive far-reaching benefits of higher education: lower unemployment and poverty rates; increased earnings, civic engagement, consideration of others' opinion, and healthier lifestyles (Baum & Ma, 2007). However, that faith in higher education may be slipping. When asked to rate how much value higher education returns to students and families, only 5 % responded with an *excellent* rating, 35 % *good*, 42 % *only fair*, and 15 % *poor* (Chronicle of Higher Education, 2011). Shouldn't a $460 billion investment be doing better than a combined 40 % excellent or good rating? It looks like another failing grade but those numbers reflect public perceptions rather than authentic assessments. Perhaps higher education is doing better than its public perception. We don't know but other indicators are alarming. Newly minted college graduates often struggle in the workplace (Gardner, 2007) so the graduation "rate" may not even be an indirect measure of learning outcomes. Keeling and Hersh (2012) collated data that suggest a deeper "crisis in higher learning" (p. 18):

- most undergraduates are studying 10–13 h per week currently, down from 24 h per week in 1961
- 75 % of 2-year college students and 50 % of 4-year college students cannot perform at a proficient level on tasks such as summarizing the pro and con arguments of newspaper editorials or comparing credit card offers with different interest rates
- only 31 % of college graduates could read a complex book and extract meaningful lessons from the reading
- only 7 % of college students make a significant gain in problem solving, critical thinking, and communication skills (writing) in the first 2 years of college; 35 % of students make almost no gain at all after a 4-year college career
- because many believe a bachelor's degree is a ticket to a job, teaching and learning are devalued, de-prioritized, and educational performance standards are reduced.

Now add to these red flags Arum and Roksa's (2011a, 2011b) reflections on the outcomes of their national study of critically thinking skills published in the book *Academically Adrift*:

At least 45 % of students in our sample did not demonstrate any statistically significant improvement in Collegiate Learning Assessment (CLA) performance during the first 2 years of college. Further study has indicated that 36 % of students did not show any significant improvement over 4 years. They might graduate, but they are failing to develop the higher-order cognitive skills that are widely assumed college students should master (p. A30).

We need the practical results from authentic assessment if we are to find our way forward in a global, competitive environment.

11.2.4 Competency Assessments

Games are only one general approach; there are many other approaches to assessing competencies (Klein-Collins, 2012; Porter, 2012). The *Council for Adult and Experiential Learning* has identified two different competency frameworks: (1) the redesign of existing courses around competency assessments; and (2) a series of projects that allows credits for prior learning, such as the Western Governors University approach (Klein-Collins, 2012). In addition, assessment centers and the examination of work samples through portfolios also push assessment beyond mere knowledge retention. Performance assessments outside of higher education typically focus on domain-specific tasks (Mumford, Baughman, Supinski, & Anderson, 1998). A game-based lens is promising here, too, because game mechanics routinely offer skills-based badges (Carey, 2012). Some believe that performance assessment is a preferred approach because it attempts to capture complex skills evidenced through actual behavior rather than relying on a singular right or wrong "answer." Why infer "intelligence," for example, when we can rely on observable skills across multiple settings. Each of Mumford et al.'s (1998) four keys to performance assessment is inherent in game design:

1. observations are made of actual performance in the specific domain of interest;
2. participants create their responses (rather than selecting response choices from a list);
3. inferences drawn are limited to domain-specific skills rather than used for broad generalizations (such as one's intelligence); and
4. assessments of performance skills are made against a standard or rubric that reflects the quality of the observed behavior.

Compare competency-based assessments in any form to what it means to do well on multiple-choice exams. Although deciding between alternatives is a valuable life skill, Funk and Dickson (2011) point out that, "performance on multiple-choice exams may provide inaccurate information… and overestimate students' learning" (p. 273). The resulting grades can miss what matters most. By contrast, Berrett (2012) encouraged deep approaches to learning such as making students analyze and apply information in different contexts, reflect on their own knowledge, identify gaps in knowledge, and resolve contradictory arguments. That deeper approach appeals to the story-telling ways we view the world and correspond to Jesse Schell's (2008) understanding that stories are embedded in even the simplest games.

11.2.5 Stealth Assessment

The playfulness of game-based assessments can provide rich data without participants realizing how much they are revealing. For example, Shute and Ventura's book (2013) *Stealth Assessment* described an assessment problem in physics that occurs in other disciplines: students can pass a course in physics yet "fail to develop an appreciation of physical principles and more important, do not remove erroneous notions of how the world works" (p. 53). However, a stealth assessment required students to demonstrate competencies in their understanding of physics by playing a game (called *Newton's Physics*) that required them to manipulate a ramp, lever, pendulum, and springboard in accordance with principles of physics.

In *Newton's Physics*, players inadvertently revealed their level of understanding of physics by simply playing the game. But stealth assessment does not necessarily imply that GBA is sneaky. GBA is stealth-like because it can yield latent information by providing competency-based, evaluative feedback. We are already trying to use weakly related multiple-choice data to make such inferences; GBA provides more data and more realistic data and it does so in a continuous feedback loop the same way that turning the wheel of a car provides drivers with a stream of actionable information. Kuh et al. (2010) stated, "a key lever for continuous improvement is having and using good-quality, actionable data that demonstrate whether policies, programs, and practices are having the desired effects on student success" (p. 336). With the kind of creativity seldom seen in psychometrics, GBA provides fertile ground for skills-based stealth assessments because it is a multi-modal, multi-method approach that (a) uses embedded assessment, (b) can lead to nationally standardized tests, (c) provides cross-sectional and longitudinal data, (d) creates more meaningful results for program review, (e) can identify best practices, and (f) assesses critical thinking skills across diverse areas (Kaya, 2010).

However, GBA is a sneaky form of stealth assessment in one way. Like any game, GBA can only succeed if it is engaging (i.e. fun). And that counterintuitive feature of GBA makes it possible to influence change with minimal opposition (Banta, Griffin, Flateby, & Kahn, 2009; Liu, Bridgeman, & Adler, 2012). And opposition is likely, as Kevin Carey recognized in the *Chronicle of Higher Education*: "Without information about learning, there is less learning. Faculty cultures and incentive regimes that systematically devalue teaching in favor of research are allowed to persist because there is no basis for fixing them and no irrefutable evidence of how much students are being shortchanged" (Carey, 2010, p. A72). The lack of authentic assessment in higher education is a big problem; GBA is an incremental, stealth approach that represents a big solution.

11.3 Section 2. Eight Failures of Current Assessment Approaches

Why is authentic assessment in higher education such a challenge—and how might GBA overcome those challenges? The most obvious answer is the overreliance on convenient, traditional outcome measures: grades on quizzes, exams, and in courses. The implication of these traditional measures is that assessment is a not so subtle summary judgment of a person. For example, even very young students are threatened with "it will go on your permanent record" in ways that sound more like religion than science. Games are much kinder and treat failure as information rather than a summary judgment. In these next paragraphs, we will treat the failures of assessment in the same way—as information that can guide us to authentic assessment. The current failures of assessment can be summarized in the following ways:

1. *Uncertainty about the target audience and the stakeholders*. Uncertainty about who is being assessed is understandable, especially in departments that focus exclusively on teaching their majors. Most students only take one introductory course, so faculty have but one opportunity to teach a field's methods, content, meaning, and place in the wider world. A classical education in the liberal arts urges us to focus our assessment efforts on those survey courses, where we have the widest impact.

   There is also uncertainty about who the assessment stakeholders are. Economic uncertainty has enlarged that pool to include would-be and current students, their parents, alumni, individual faculty, academic program leaders, department chairs, deans, provosts, presidents, boards of trustees, regents, accrediting agencies, and the surrounding business community. The data driving assessment is a local process but its consequences reach much further, for example, as an institutional bragging tool. Assessment in such a politicized environment undermines authentic assessment.
2. *Lack of agreement about what is being assessed*. Faculty and departments often see assessment as just one more annoying responsibility. It is not that difficult, however, to translate the typical hyperbole of an institution's mission statement into a thoughtful departmental mission statement that can specify learning outcomes. Thus, before any agreement about what will be assessed is determined, colleagues need to first revisit or create a mission statement.
3. *Lack of authentic assessment*. An institution's big, overall assessment is composed of many small assessments; if they are not authentic, then every subsequent assessment is tainted and most likely a self-serving fiction. Traditional tests seldom assess how well students can apply what they have learned in a new context but authentic assessment relies on real-world tasks that require higher-level skills rather than discrete bits of recognition or recall memory (Halonen, Bosack, Clay, & McCarthy, 2003; Wiggins, 1990). Well-conceived essay questions can allow students to apply what they have learned but essays from test banks seldom encourage such thoughtful applications.
4. *Reinventing the wheel*. Faculty members often create unnecessary work by assuming that assessments must be created from scratch; but many assessment tools can be adapted to local conditions. In psychology, for example, there are assessment activities related to teaching and classroom pedagogy (Dunn, Baker, Landrum, Mehrotra, & McCarthy, 2012; Dunn, Mehrotra, & Halonen, 2004), academic program assessment (Dunn, McCarthy, Baker, Halonen, & Hill, 2007; see also, Dunn, McCarthy, Baker, & Halonen, 2011), and curricula development and design (APA, 2008). The American Psychological Association (APA, 2013) also developed specific guidelines for assessing learning for each course within the undergraduate psychology major (APA, 2007, 2009). The 2013 APA guidelines can direct the development of game-based assessments.

5. *Assessment is done only sporadically*. Too often, assessment is done quickly, usually to satisfy some external demand, such as an accreditation process, or to provide some bit of information for a departmental report. Once the need or demand is satisfied, further assessment wait for the next "crisis." Authentic assessment, however, requires collegial agreement around a plan. One of GBA's potential contributions is to automate that plan in a continuous feedback loop that allows faculty to use that data to make adjustments that are consonant with the department's mission. More data, better data, and less work sounds like a pretty good plan; games do it all the time.
6. *Assessment is used for summative rather than formative purposes*. Faculty are justifiably worried about how the data will be used. Like games, *formative assessment* provides timely information that guides meaningful adjustments. By contrast, *summative assessment* relies on assessment data to reward or penalize instructor performance. An instructor's professional life is often at stake in summative assessment and that leads to reliance on low risk pedagogies. Knowing the hazards associated with summative assessment (e.g., a critical administrative evaluation) can discourage teachers from being creative. Formative assessment must be a clear and stated policy within a department or program.
7. *Absence of developmental rubrics linked to assessment*. Learning outcomes are not all-or-nothing; it is a developmental process that moves from knowledge to understanding to application and generalizability (e.g., Dunn, McCarthy, Baker, & Halonen, 2011; Halonen et al., 2003). A developmental rubric can guide the assessment through this developmental process the same way that game designers are guided by a game design document (GDD). In psychology, for example, one would expect a student who has only taken one or two courses in the discipline to have a less sophisticated understanding of research design and experimentation than a student who completed, say, six or eight courses. Developmental rubrics can assess this academic progress in the same way that games articulate and reward levels of achievement that allow students to map their educational progress.
8. *Lack of attention to benchmarks that can inform and define program development and assessment*. Programs often rely on reputation and intuition rather than their own benchmarks (if they exist). Benchmarks, however, represent performance criteria that track progress to educational goals and document teaching effectiveness (Dunn, McCarthy, Baker, & Halonen, 2011). That information allows faculty and administrators to develop strategic plans, allocate resources, expand programs, and monitor progress with descriptive outcomes such as underdeveloped, developing, effective, or distinguished (see Dunn et al., 2007; Dunn, McCarthy, Baker, & Halonen, 2011).

These eight major problems with current assessment approaches in higher education challenge both individuals and their organizations with a fundamental assessment question: Do you really want to know how you are doing? Over time, GBA could provide a non-threatening, enjoyable way to find out.

11.4 Section 3. Game-Based Solutions to the Failures of Current Assessment Approaches

Games transform failure into meaningful information so we will do the same thing by using the eight failures of assessment described above as our guide to gamifying academic assessment. Each of those problems is addressed by following two psychometric principles: specificity (operationalize your variables) and multiple methods (measure the same construct in multiple ways). Specificity guides game design by recognizing that the target of our assessment is both what our students know and the skills/competencies they have acquired. We define those specific learning outcomes from the work of all those committees and sub-committees of our professional organizations, universities, colleges, departments, and programs (your authors have served on several such committees for the American Psychological Association as well as at our own universities and colleges). In short, GBA doesn't have to reinvent the content wheel.

We can illustrate GBA by examining one item from an inauthentic assessment of graduating seniors: "Please indicate the degree to which you think that your college education helped you become a better critical thinker." That is bogus for so many reasons that it is difficult to know where to begin—but let's start: (a) Perception is not reality; (b) graduating seniors are emotionally biased to supply an answer that justifies their years of effort and expense; (c) cognitive dissonance coerces them to supply a positive response; (d) the question is full of demand cues about how they are supposed to respond; and (e) even if the item had been written fairly, there is no comparison group. These data are likely to be smugly interpreted along the lines of, "92.4 % of our students have become critical thinkers." However, no about of statistical fuzz will ever make that assessment item anything other than an invalid, self-serving self-deception that confuses stakeholders while demonstrating an alarming lack of critical thinking.

GBAs can bypass all those perceptual biases with challenging, enjoyable games that require students to demonstrate specific critical thinking skills across multiple situations. For example, Ifenthaler, Eseryel, and Ge (2012) classify game-based measurements into three categories: game scores (accuracy, percentage correct), external criteria (time to complete a game task, debriefing, comparisons with traditional tests), and embedded assessments (click streams, log files, and information trails). That automatically collected data provides much richer information than any response to a biased multiple choice question.

For example, *Stinkin' Thinkin'* (in development) is a series of brief game situations that all require critical thinking. One situation, for example, requires players to identify independent, dependent, and confounding variables while interpreting classic experiments, such as the elements of Milgram's phony shock experiments. A second situation asks the players to identify the same variables and reasoning about why their stalled car suddenly starts after pounding on the wheel, staring at the engine, jiggling the key, etc. We keep players within their flow zone by gradually ratcheting up the complexity of the situations and rewarding them with difficulty points.

In this way, the game uses multiple methods to test students' specific abilities to apply their methodological knowledge across a range of situations in game-like ways that make failure informative, the material applicable, and the context meaningful. Students are allowed to persist playing each situation until they achieve mastery, earn a badge, and graduate to the next level of difficulty. Meanwhile, in the background, we are measuring percentage correct, number of attempts to get the right answer, time on task, and tracking the order in which they formulate answers to each assessment problem. All that data is available for group and/or personal leaderboards whose effectiveness can be determined through game-testing.

The goal is assessment, not learning. However, an automatic byproduct of authentic GBA is generalizable learning. Students get better with each game as they master the material and improve their scores. We can assess critical thinking skills in a fun, failure-friendly way that reaches across disciplines and real life situations in order to apply scientific principles to their everyday lives. Compare that to the bogus assessment item, "Indicate the degree to which you think that your college education helped you become a better critical thinker."

GBA partially addresses problem 1, uncertainty about assessment targets and the stakeholders, by targeting what students know and can do while playing a game. GBA addresses problems 2 and 8, lack of agreement about what is being assessed and the lack of benchmarks, by relying on the developmental rubrics that represent academic standards and specific learning outcomes established by our professional societies, modified by the mission of each department. GBA resolves problem 3, a lack of authenticity, by designing games with many stories that are generalizable and relevant to students' lives. For example, GBAs might create intermittent opportunities to cheat in order to assess the goal of ethical behavior articulated by the APA.

A different set of problems is represented by problems 4 through 8, beginning with the constant reinvention of the assessment process and the unsystematic nature of assessment, in two ways. But those are not our problems because GBA is only a method with only one tool in its toolbox: motivation. We have to rely on the guidance of professional societies for their gradually changing content. Fortunately, game mechanics have a wide range of motivational tricks that overlap with established psychological principles (described in another chapter of this book). Creating a comprehensive system of games addresses problem 6, that traditional assessments are summative rather than formative, global rather than instructive, and judgmental rather than helpful. The GIGO principle asserts that test questions that are Garbage In ("How good do you think you are at critical thinking?") can only yield answers that are Garbage Out (invalid, biased, organizationally narcissistic) information. By designing a comprehensive set of games around the learning outcomes articulated by our professional societies, we can also address problem 7, the lack of developmental rubrics. Because the feedback loop is automatic and prompt, GBA provides specific, comparative, high quality information about what our students know and can do at different stages of their academic careers.

That brings us to a hole we left open in Section 1, uncertainty about who our stakeholders are and how assessment can help them. There's no way around this last concern: At some level, assessment is about making judgments; otherwise we would just call it feedback. GBA is merely an information tool; people have to make the assessments, but GBA lets them make data-driven evaluations. Some students should fail; some professors should not be tenured; some departments should be dissolved; and some universities should be discredited. There is a time and place for creative destruction. Many of our current assessment approaches should be and will be destroyed because they just don't work well enough; in a few years, GBA may soon have us wondering why we put up with such a terrible system for so many decades when such an obvious improvement was hiding in plain sight.

11.5 Section 4. Social Comparisons: Why People Love to be Assessed

GBA provides partial answers to these assessment challenges by recognizing another social truth that has been hiding in plain sight: *People love to be assessed*. Think about how we informally assess the self. We use social comparisons—in fact, we can't stop ourselves from making social comparisons (see Dunning, Heath, & Suls, 2004; Festinger, 1954). Upward comparisons occur when the target of comparison is someone who is superior in some way (e.g., intelligence, athleticism, test scores); downward comparisons occur when the target of comparison is inferior. Both upward and downward comparisons are potentially motivating *and* demotivating. For example, in some massive multi-player online games (MMOs), you can see others' avatars and be inspired by their skills; but those upward comparisons also might disturb or threaten your sense of self (Muller & Fayant, 2010). Downward comparisons produce a similar set of nuanced reactions.

Social comparisons suggest two take-home messages for GBA. First, social comparisons explain why points, leaderboards, and badges (PBLs) are motivating. Second, the motivational consequences of social comparisons are tricky; don't slap PBLs on top of some existing activity and expect it to motivate participants. Like any psychometric effort, GBA will require a great deal of pre-testing, false starts, and learning curves. The payoff for an effective leaderboard is motivation. Sheldon (2011) begins the semester by telling his class that they all have a grade of F, in the same way that a player starts a game at zero. He then uses students' avatars to create an anonymous leaderboard that provides ongoing social comparisons. However, Fig. 11.1 demonstrates how leaderboards can provide more meaningful social comparisons than a one-dimensional rank-ordered list.

A fully automated GBA can produce a (confidentially-protected) two-dimensional scatterplot-leaderboard that changes each week by monitoring the relation between hours spent studying in the game environment and earned test points. The constantly changing leaderboard lets students see for themselves whether hours spent within the game environment really pay off. Such visual feedback is more informative and probably more motivating than a professor hectoring students to study harder—especially when students are empowered to make their own data points move from one week to the next.

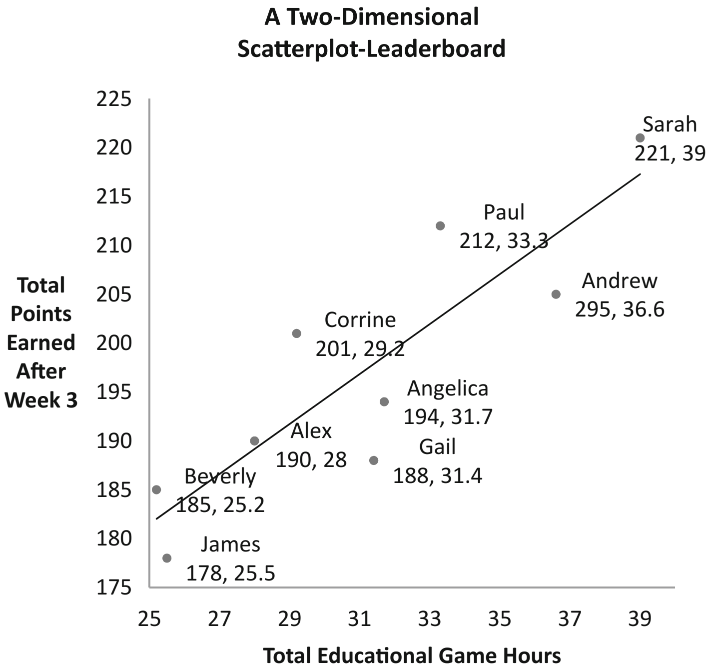


Fig. 11.1 A two-dimensional leaderboard: points earned and educational game hours. This two-dimensional leaderboard provides more meaningful social comparisons by using an automatic feedback loop that can change with each week's new data

Social comparisons also promote social facilitation that can improve performance merely by making people aware of the presence of others. In a classic 1898 social psychological study, Norman Triplett noticed that bicyclists pedaled faster when they were riding with companions. When he took that observation into a lab, his results matched his field observations: children winding fishing reels with other children present wound faster than when winding alone (see also Strube, 2005). Social facilitation appears to the same thing that Jane McGonigal (2011) calls "social presence" in *World of Warcraft* or *Spore*, where players share a virtual environment. Our impulse to make social comparisons is evidence that we love to be assessed. Game designers know how to use leaderboards to tap into motivating social impulses that improve performance.

The craft of designing social comparisons is how we can use the epoxy-like mash-up between games and assessment to transform the world of assessment into something that sticks, hardens, and holds its value—if we mix these two ingredients thoroughly and get the timing right. It may prove to be more craft than either art or science but either way it means working with new materials, so creating GBAs will not be easy. It will also require a significant amount of creativity and financial investment in terms of design, coding, and game-testing. But as we demonstrated in Section 1, we're already conducting traditional assessments and getting a very low return on our investment.

11.6 Section 5. Overcoming Fear of Failing: We're Already Playing an Assessment Game

GBA recognizes another social truth hiding in plain sight: *College is already a game*. The structure of most college courses uses game elements such as points, levels, awards, leaderboards, and rules that guide voluntary participants to overcome arbitrary obstacles—in other words, a game. However, there is at least one critical difference and it has to do with failure. In academic culture a failing student is threatened with a lower grade and dismissal if it continues; a failing department is threatened with a hiring freeze or dissolution; a failing university is threatened with loss of its accreditation. Those harsh consequences all inspire the kind of fear of failing that promotes risk-averse decision-making and a fear-informed quality of achievement (Birney, Burdick, & Teevan, 1969).

Table 11.1 compares the consequences of failing academically and failing in a traditional game. In the college game, the drop out rate hovers around 50 % (Schneider & Yin, 2011), often the result of many small failures in many domains. The rate of small failures in games is even higher—about 80 % (see Lazarro, in McGonigal, 2011), but sometimes it is even worse. In poker, six out of seven poker players will lose the hand; in the classic video game of Tetris every participant is guaranteed to fail. Almost all sports clubs fail to achieve their goal of winning a championship. Yet even after retirement, professional athletes seem to look back on a failure-filled career with fondness and a wish that they could have gotten just one more chance.

A surprising finding about student procrastination suggests a key difference between failure in academics and failure in a game: student procrastination is positively correlated with self-compassion, that is, with being kind to yourself (Deniz, Tras, & Aydogan, 2009; Iskender, 2011; Rice, Richardson, & Clark, 2012; Solomon & Rothblum, 1984). What do think many students actually do when procrastinating? Klassen and Kuzuci (2009) found that academically procrastinating adolescent boys in Turkey turn to computer games. These games provide feelings of being challenged in ways that they do not experience when studying (Hainey, Connolly, Stansfield, & Boyle, 2011). In short, many procrastinating students are not running from a challenge; they are running to a challenge. They don't seem to be afraid of failing; they just dislike the way academic failure makes them feel.

What would happen if we treated academics like the game it really is by reducing students' fear of failure? In a study of 1,492 adolescents (50.8 % female), over the four high school years, Adachi and Willoughby (2013) showed that more strategic

Table 11.1 A qualitative comparison of responses to academic failures and game failures

Academic failures tend to lead to…	Game failures tend to lead to…
Summative assessments of the self	Formative assessments of abilities
A generalized fear of failing	A specific determination to achieve
Frustration and discouragement	Frustration and renewed effort
Lower intrinsic motivation	Higher intrinsic motivation
Decisions that are risk-averse	Decisions that are calculated

video game play predicted higher self-reported problem solving skills over time than less strategic video game play. Furthermore, strategic video game play predicted higher self-reported problem solving skills that predicted higher academic grades. In perhaps the most striking contrast to the fear of failing, game designers use the term 'fiero', Italian for pride, to describe how gamers feel when they overcome a difficult challenge. Experiencing fiero motivates a player by activating the reward pathways of the brain (Hoeft, Watson, Kesler, Bettinger, & Reiss, 2008). Imagine an academic world in which fearless students are mildly addicted to the pleasures of being academically challenged!

Can we actually create such a world? According to backward design principles (Wiggins & McTighe, 2005), we can by designing courses in a different way. Start with the course goals, then write student learning outcomes, design assessments that match each learning outcome—and only then decide on which pedagogical techniques will enable students to achieve those learning outcomes. This makes the construction of GBA much easier because each badge, achievement level, and grand quest relates to specific course content. In most games and in most jobs, you get to make a few rookie mistakes as you get the hang of your new responsibilities; the critical assessment is not that you failed but whether you learned from your failure. That is the more meaningful assessment we should be able to achieve through GBA.

11.7 Summary

Higher education is in trouble and our current assessment methods don't work very well. Game-based assessment is not the total answer, but it can be part of the answer, and there are at least five reasons why it is likely to work. First, people love to be assessed and social comparisons in games are an engaging, friendly way to gather such data (Suls, Martin, & Wheeler, 2002). Second, GBA's continuous, automatic feedback loop provides useful information in a timely manner. There is no more waiting 3 weeks for the professor or graduate student to correct the exams or enter grades. Third, games lend themselves to the psychometric requirements of specificity, multiple measures, and multiple methods. For example, Giannotti et al. (2013) compared first and second year surgical residents in a two-group design that used the Nintendo® Wii to evaluate 16 separate metrics related to surgical skills. Fourth, games motivate people to perform at their highest level. A well-designed game uses specific game mechanics, grounded in scientific psychology, to encourage students to do their best. Fifth, unlike traditional assessments, GBA makes failing informative and motivating. Birney, Burdick, and Teevan (1969) spent much of their careers studying fear of failure and the news, for the most part, isn't good. But it is the fear of failing, not failing itself, that seems to produce counter-productive decision-making. Higher education is already structured as a game. GBA applies the familiar, motivating techniques of games to the urgent task of authentic assessment in higher education.

References

Adachi, P., & Willoughby, T. (2013). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth & Adolescence, 42*, 1041–1052. doi:10.1007/s10964-013-9913-9.

American Psychological Association. (2007). *APA guidelines for the undergraduate psychology major.* Washington, DC: Author. Retrieved from www.apa.org/ed/resources.html

American Psychological Association. (2008). *Teaching, learning, and assessing in a developmentally coherent curriculum.* Washington, DC: Author. Retrieved from http://www.apa.org/ed/pcue/bea_coherent.pdf

American Psychological Association. (2009). *Summary of the Assessment Cyberguide for learning goals and outcomes in the undergraduate psychology major.* Washington, DC: Author. Retrieved from http://www.apa.org/ed/governance/bea/assess.aspx

American Psychological Association. (2013). *APA guidelines for the undergraduate psychology major*. Version 2.0. Washington, DC: Author. Retrieved from http://www.apa.org/ed/precollege/about/psymajor-guidelines.pdf

Arum, R., & Roksa, J. (2011a). *Academically adrift: Limited learning on college campuses*. Chicago: University of Chicago Press.

Arum, R., & Roksa, J. (2011b, January 28). Are undergraduates actually learning anything? *Chronicle of Higher Education, 57*(21), A30–A31.

Association for Career and Technical Education. (2010). *What is "career ready"?* Retrieved from http://www.acteonline.org/uploadedFiles/Publications_and_Online_ Media/files/Career_Readiness_Paper.pdf

Association of American Colleges and Universities. (2005). *Liberal education outcomes: A preliminary report on student achievement in college*. Washington, DC: Author.

Association of American Colleges and Universities. (2010). *Raising the bar: Employers' views on college learning in the wake of the economic downturn*. Washington, DC: Hart Research Associates.

Banta, T. W., Griffin, M., Flateby, T. L., & Kahn, S. (2009). Three promising alternatives for assessing college students' knowledge and skills. *National Institute for Learning Outcomes Assessment*. Retrieved from http://learningoutcomesassessment.org/documents/AlternativesforAssessment.pdf

Baum, S., & Ma, J. (2007). *Education pays: The benefits of higher education for individuals and society*. Washington, DC: College Board.

Berrett, D. (2012, November 23). Grades and tests may miss measuring what matters most in learning. *Chronicle of Higher Education, 59*(13), A12–A13.

Birney, R. C., Burdick, H., & Teevan, R. C. (1969). *Fear of failure*. New York: Van Nostrand-Reinhold.

Carey, K. (2010, December 17). Student learning: Measure or perish. *Chronicle of Higher Education, 57*(17), A72.

Carey, K. (2012, April 13). A future full of badges. *Chronicle of Higher Education, 58*(32), A60.

Chronicle of Higher Education. (2010, September 3). The new muscle: 5 quality-of-learning projects that didn't exist 5 years ago. *The Chronicle of Higher Education, 57*(2), A15.

Chronicle of Higher Education. (2011). *Surveys of the public and presidents*. Retrieved from http://chronicle.com/section/Pew-survey/531

Deniz, M. E., Tras, Z., & Aydogan, D. (2009). An investigation of academic procrastination, locus of control, and emotional intelligence. *Educational Sciences: Theory and Practice, 9*, 623–632.

Dunn, D. S., Baker, S. C., Landrum, E., Mehrotra, C. M., & McCarthy, M. (Eds.). (2012). *Assessing teaching and learning in psychology: Current and future perspectives*. Belmont, CA: Cengage.

Dunn, D. S., McCarthy, M. A., Baker, S. C., Halonen, J. S., & Boyer, S. (2011). Understanding faculty reluctance as reactance and opportunity for persuasion: A social psychology of assessment. In D. Mashek & E. Y. Hammer (Eds.), *Empirical research in teaching and learning: Contributions from social psychology* (pp. 143–159). New York: Wiley.

Dunn, D. S., McCarthy, M., Baker, S., Halonen, J. S., & Hill, G. W., IV. (2007). Quality benchmarks in undergraduate psychology programs. *American Psychologist, 62*(7), 650–670.

Dunn, D. S., McCarthy, M. A., Baker, S. C., & Halonen, J. S. (Eds.). (2011). *Using quality benchmarks for assessing and developing undergraduate programs*. San Francisco: Jossey-Bass.
Dunn, D. S., Mehrotra, C., & Halonen, J. S. (Eds.). (2004). *Measuring up: Educational assessment challenges and practices for psychology*. Washington, DC: American Psychological Association.
Dunning, D., Heath, C., & Suls, J. M. (2004). Flawed self-assessment. *Psychological Science in the Public Interest, 5*, 69–106. doi:10.1111/j.1529-1006.2004.00018.x.
Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*, 117–140.
Funk, S. C., & Dickson, K. L. (2011). Multiple-choice and short-answer exam performance in a college classroom. *Teaching of Psychology, 38*, 273–277. doi:10.1177/0098628311421329.
Gardner, P. (2007). *Moving up or moving out of the company? Factors that influence the promoting or firing of new college hires*. Collegiate Employment Research Institute, Michigan State University (Report 1-2007). East Lansing, MI: Michigan State University.
Giannotti D., Patrizi G., Di Rocco G., Vestri A.R., Semproni C.P. Fiengo, L., Pontone, S., Palazzini, G., & Redler, A. (2013) Play to Become a Surgeon: Impact of Nintendo WII Training on Laparoscopic Skills. PLoS ONE 8(2): e57372. doi:10.1371/journal.pone.0057372.
Hainey, T., Connolly, T., Stansfield, M., & Boyle, E. (2011). The differences in motivations on online game players and offline game players: A combined analysis of three studies at higher education level. *Computers and Education, 57*, 2197–2211.
Halonen, J. S., Bosack, T., Clay, S., & McCarthy, M. (2003). A rubric for learning, teaching, and assessing scientific inquiry in psychology. *Teaching of Psychology, 30*, 196–208.
Hoeft F et al., Gender differences in the mesocorticolimbic system during computer gameplay. *Journal of Psychiatric Research* (2008), Science Direct, Elsevier. doi:10.1016/j.jpsychires.2007.11.010.
Ifenthaler, D., Eseryel, D., & Ge, X. (2012). *Assessment in game-based learning: Foundations, innovations, and perspectives*. New York: Springer.
Institute for a Competitive Workforce. (2012). *Help wanted 2012: Addressing the skills gap*. Washington, DC: U.S. Chamber of Commerce.
Iskender, M. (2011). The influence of self-compassion on academic procrastination and dysfunctional attitudes. *Educational Research and Reviews, 6*, 230–234.
Kaya, T. (2010, 13 February, 2010). A 'stealth assessment' turns to video games to measure thinking skills. *Chronicle of Higher Education, 57*(12), A13.
Keeling, R. P., & Hersh, R. H. (2012 July/August). Where's the learning in higher learning? *Trusteeship, 20*(4), 16–21.
Klassen, R. M., & Kuzucu, E. (2009). Academic procrastination and motivation of adolescents in Turkey. *Educational Psychology, 29*, 69–81.
Klein-Collins, R. (2012). Competency-based degree programs in the U.S.: Postsecondary credentials for measurable student learning and performance. *Council for Adult and Experiential Learning*. Retrieved from http://www.cael.org/pdfs/2012_CompetencyBasedPrograms
Kuh, G. D., Kinzie, J., Schuh, J. H., Whitt, E. J., & Associates. (2010). *Student success in college: Creating conditions that matter* (2nd ed.). San Francisco: Jossey-Bass.
Liu, O. L., Bridgeman, B., & Adler, R. M. (2012). Measuring learning outcomes in higher education: Motivation matters. *Educational Researcher, 41*, 352–362. doi:10.3102/0013189X12459679.
Lumina Foundation for Education. (2010). *A draft degree qualifications profile: A transformational challenge for U.S. higher education*. Retrieved from http://www.insidehighered.com/content/download/365447/4449401/version/3/file/Degree+Profile+Working+Draft+2010.pdf
McGonigal, J. (2011). *Reality is broken*. New York: Penguin Books.
Muller, D., & Fayant, M.P. (2010). On being exposed to superior others: Consequences of self-threatening upward social comparisons. *Social and Personality Psychology Compass, 4*, 621–634.
Mumford, M. D., Baughman, W. A., Supinski, E. P., & Anderson, L. E. (1998). A construct approach to skill assessment: Procedures for assessing complex cognitive skills. In M. D. Hakel (Ed.), *Beyond multiple choice: Evaluating alternatives to traditional testing for selection* (pp. 75–112). Mahwah, NJ: Erlbaum.

Porter, S. R. (2012, September). Using student learning as a measure of quality in higher education. *HCM Strategists*. Retrieved from http://www.hcmstrategists.com/contextforsuccess/papers/PORTER_PAPER.pdf

Rice, K. G., Richardson, C. M. E., & Clark, D. (2012). Perfectionism, procrastination, and psychological distress. *Journal of Counseling Psychology, 59*, 288–302.

Schell, J. (2008). *The art of game design*. Boca Raton, FL: CRC Press.

Schneider, M. & Yin, L. (August, 2011). The high cost of low graduation rates. How much does dropping out of college really cost? Washington, DC: American Institutes for Research.

Sheldon, L. (2011). *The multi-player classroom: Designing coursework as a game*. Belmont, CA: Cengage Learning.

Shute, V., & Ventura, M. (2013). *Stealth assessment: Measuring and supporting learning in video games*. Cambridge, MA: MIT Press.

Snyder, T. D., & Dillow, S. A. (2012). *Digest of education statistics 2011*. National Center for Education Statistics (NCES 2012-001), Institute of Education Sciences. Washington, DC: U.S. Department of Education.

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Consulting Psychology, 31*, 503–509.

Strube, M. J. (2005). What did Triplett really find? A contemporary analysis of the first experiment in social psychology. *American Journal of Psychology, 118*, 271–286.

Suls, J., Martin, R., & Wheeler, C. (2002). Social comparison: Why, with whom, and with what effect? *Current Directions in Psychological Science, 11*, 159–163.

U.S. Department of Labor. (1991). *What work requires of schools: A SCANS report for America 2000.* The Secretary's Commission on Achieving Necessary Skills. Washington, DC: Author.

Wiggins, G. (1990). The case for authentic assessment. *Practical Assessment, Research & Evaluation*, 2(2). Retrieved August 3, 2012 from http://PAREonline.net/getvn.asp?v=2&n=2.

Wiggins, G., & McTighe, J. (2005). Understanding by design (2nd Ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Wilson, T. D., Centerbar, D. B., Kermer, D. A., & Gilbert, D. T. (2005). The pleasures of uncertainty: Prolonging positive moods in ways people do not anticipate. *Journal of Personality and Social Psychology, 88*, 5–21.

Chapter 12
A Gamification-Based Framework for Developing Learning Activities of Computational Thinking

Isabella Kotini and Sofia Tzelepi

12.1 Introduction

Modern students are familiar with digital technology and spend a lot of their free time to play video games (Carstens & Beck, 2005). Therefore, they have opened themselves to the use of game mechanics in their everyday life. On the other hand, the school reality does not reflect the same degree of involvement and engagement of students in learning activities. The involvement in activities, that normally students would have consider as boring and less tempting, can be interestingly attained through the incorporation of gamification.

The introduction of gamification in learning activities aims at making them more interesting and attractive to students. The term gamification refers to the integration of game design characteristics into activities not related to the game design field (Deterding, Dixon, Khaled, & Nacke, 2011). It is based on the fact that the use of games in the learning process not only helps the student in acquiring new knowledge, but developing and applying the already-acquired information as well, while having fun at the same time. Game standards such as imagination, control, challenge, curiosity and competition cause internal prompting (Cordova & Lepper, 1996; Malone, 1981). Not only do games offer challenges, rewards and cooperation chances, but they also offer potentiality of redevelopment of the society itself (McGonigal, 2011). Papert (1993) believes that it is via digital games that the teaching rate is succeeded, making, as a result, the learning activity more interesting.

The current educational games are based on the primal way of learning "play and learn" the benefits of which they reap as learning tool. Educational games usually implement modern theories of learning and innovative learning models, such as "discovery learning", "experiential learning" and "learning in communities" (Facer,

I. Kotini (✉) • S. Tzelepi
Educational Counselors for Informatics in Central Macedonia,
Leoforos Georgikis Sxolis 65, 57001 Thessaloniki, Greece
e-mail: ikotini@sch.gr; stzelepi@sch.gr

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_12

2003; Shaffer, Squire, Halverson, & Gee, 2004). At the same time, through social networking, students learn to respect their teammates, to identify their rights, to develop cooperation, friendship, justice, self-control and self-discipline and to develop their sociability.

Gamification constitutes a powerful tool through which educators can teach, persuade and motivate their students. Common application of gamification in the field of education, in order to encourage learning, is the integration of scoring video games, such as points, levels and achievements in learning activities. Activation of these external motives, however, at the expense of the internal ones, poses a long-term effect causing the decline of interest for learning. Provision of external motives improves the learning effect only when it comes to the short-term activities which aim in the development of a particular skill, for example, learning to operate text editing environments.

Computational thinking is considered to be something more than simple use of computers and technology. It constitutes a new approach to tackle our society's challenges for the years to come, applicable to all kinds of reasoning. It includes problem solving capabilities, system design and human behavior understanding (Wing, 2006). It is regarded as a resultant core competency which should constitute an integral part of education. Consequently, the active participation of students in computational thinking activities is of paramount importance.

In our approach, we focus on the encouragement of the students' interest, based on the gamification philosophy. Specifically, this work attempts to define a framework that supports the involvement of students in the learning process (Chen, 2003). The framework is based on the constructivist learning theory and on a gamification environment that sets its baselines on the interests and learning profile of each student. Through the combined exploration of the various theories of motivation and empowerment of external and internal motives on the one hand, and of game design and computational thinking applications on the other, we led to the development of a student-centered gamification framework that is meaningful for the students and therefore not dependent on external rewards. The emphasis is given on the way of thinking and on the work of the students. The evolution of the learning process is being assessed rather than the learning outcomes per se. The student is rewarded for his efforts and progress, and therefore not only for the conquest of cognitive and social objectives. This award is not only given to the student through his performance points and prizes but also provides the option for student engagement in authentic, exploratory gamification teamwork activities. Such teamwork activities enhance the student's curiosity, excite his imagination, and further challenge him to confront himself and make him responsible for better controlling his learning process.

The structure of this chapter is as follows. In Sect. 12.2, the main concepts of gamification, learning theories and computational thinking are presented. The main principles of organization and designing of computational thinking learning activities with the endorsement of gamification elements are explained in Sect. 12.3. In Sect. 12.4, the proposed student-centered gamification framework for developing learning activities is described, and the characteristics of the proposed framework such as constructivist learning theory pillars, gamification elements, a teacher's guideline, computational thinking skills, computational thinking dispositions and behaviors, and computational thinking vocabulary are analyzed. In Sect. 12.5, the use of the proposed framework is explicated and in Sect. 12.6 the application of the framework with three prototype scenarios is presented. Finally, Sect. 12.7 concludes the chapter.

12.2 Background

12.2.1 Gamification

Although the term gamification is relatively new, it has been dominated in the policies of various companies in their efforts to reach new customers and retain their existing clients through the notion of rewards and awards. For decades, companies have used their dynamics in the form of happy hours. However, it has only been in recent years that gamification has been widely used in business and technology. By utilizing practices, techniques and integrated concepts of the world of online gaming industry practitioners are trying to enhance business applications and communications tools. A representative example is the fixed customer reward program, such as the encashment of air miles. Such programs aim at both increasing the use of services and at shaping desired behavior, when in the same time the users seek to achieve specific goals, the satisfaction of which would lead them to gain external rewards (Zichermann & Cunningham, 2011).

Gamification uses game mechanics to increase commitment, dedication, and the enjoyment of players in a given environment. These mechanisms are directly related to the provision of rewards. In many cases, they provide rewards to players when they perform an action on a predetermined time depending on the levels of difficulty. Therefore, gamification is a powerful strategy that influences and motivates groups of people. Many applications of gamification can be found in the field of learning, education, personal growth and development. In such cases the goal is the intrinsic motivation by using extrinsic motivation tools such as virtual medals, gifts, avatars and achievements.

The word "game" gives to the character of the respective activity exciting experience characteristics. In reality, however, during the gamification process it is usually used the least interesting parts of games, such as the scoring system. For this reason, it is recommended to use the term "pointsification", instead of gamification, as a label for those gamification systems that the only element that they incorporate in their non-playful activities is indeed the scoring system (Robertson, 2010). Moreover, games have goals and structure (Maroney, 2001). The gamification that is only based on the scoring system is considered to be focused only on the objectives while it ignores other structural features of a game. Ian Bogost (2011) proposes the term to be changed to "exploitationware", considering that this term best describes what actually happens. The basic message of these criticisms of gamification is based on the fact that there are more effective ways than just a scoring system to attract users.

The orientation trend of organizations towards the gamification can be concerning especially in the case agencies are not aware of its potential long-term negative effects. The concept of gamification is tightly joint with the motivation. People can be driven to do things because of internal or external motives. A meta-analysis conducted by Deci, Koestner, and Ryan (2001) on motivation in educational environments, concluded in that almost every type of reward (apart from uncontrolled verbal rewards) decreases intrinsic motivation. Consequently, gamification, which aims to provide only external motives, contributes dramatically in the reduction of intrinsic motivation. If an organization starts using gamification techniques based only on external rewards and suddenly decides to stop the rewarding program, then the organization will be in a worse position than it was when it first started. In fact, it will be less likely for a user to return to the desired behavior without external reward (Deci et al., 2001). In the book “Gamification by Design” (Zichermann & Cunningham, 2011), the authors argue that the assumption that intrinsic motivation is more effective than external rewards is unfounded. They believe that gamification can be used by organizations to control users’ behavior by replacing intrinsic motivation with external rewards. They concede, however, that from the moment a person starts providing rewards, and then he will become part of an endless loop of reward-providing (Zichermann & Cunningham, 2011).

In the education area, gamification implements specific mechanisms to increase the participation and engagement of students in the learning process. Gamification converts activities not related to the game and fun to game-centered activities that are enjoyable. For example, it can be used to encourage students of a university to participate in a class lectures or to online learning communities to complete and submit their assignments on time and to retain this behavior for a long time. One of the most “famous” examples of the application of gamification in the higher education is also the one developed by Lee Sheldon, a Professor at Rensselaer Polytechnic Institute. In particular, he converted the points earned by the students into experience, their grades into different levels and created student-avatars. The result was to dramatically increase the participation and presence of students in the class and to increase the quality of the produced learning material produced (Laster, 2010). Other interesting examples are the online platforms of Khan Academy (2013) and CodeAcademy (2013) course providers that both utilize a variety of mechanisms such as games points and badges to reward participants for their course completion. The participants feel that they learn while having fun, and therefore they do not face courses as “work” or “compulsory exercise for their home.”

In the educational sector, however, it is important for students to be facilitated on the one hand in understanding how much the activity is important for themselves, and on the other in their self-determination for active participation (Deci & Ryan, 2004). The primary aim of the educational process should be to strengthen internal motives that give rise to spontaneous learning and behavior. This intrinsic motivation will stem from the students’ love for learning, the pleasure they will derive from their particular occupation as well as the satisfaction through their development and progress.

12.2.2 Learning Theories

The learning theories of behaviorism, cognitivism and constructivism have greatly influenced the teaching and pedagogical approaches applied in the classroom (Learning-Theories, 2013).

Behaviorism (Chen, 2003) is based on the “stimulus—response”. It considers the mind as a “black box”, meaning that the response to the stimulus can be observed quantitatively, by totally ignoring the possibility of thought processes occurring in the brain. Students passively accept the provided information and knowledge and need an external motive to be activated. The emphasis is given on the content and not to the student or the learning experience. Although this method has been the basis of education for centuries, have major drawbacks. The main criticism (Masuyama, 2006) refers to the fact that students have fewer opportunities to develop critical and analytical skills, which are vital to the digital world of today and tomorrow.

Cognitivism replaced behaviorism in 1960 and became the dominant example. Cognitive psychologists deny the limitations of behaviorism that focus primarily on the observable behavior. They argue that the “black box” of the human mind must be opened and examined and that mental processes such as thinking, memory, knowledge and problem solving should be explored. Cognitivism focuses directly on the structure and function of the human mind. People are not “programmed” beings who simply respond to stimuli from the environment; on the contrary they are rational beings that require active participation in order to learn and whose actions are results of thoughts. Changes in behavior are still observable, but only as an indication of what happen in the mind of the student.

Constructivism is an extension of cognitive science. It combines knowledge from a developmental perspective, with other important issues, such as motivations, self-directed learning and emphasis on social learning environment. Learning is a process of constructing knowledge. Students actively construct new ideas or concepts based on current and previous knowledge and experience by interacting with the social environment. The influence of constructivism (Thramboulidis, 2005) has expanded beyond the research and scientific community and affected the curricula of several advanced countries.

Gamification started as a process that embraces behaviorism but, through the teaching framework proposed in this paper, the utilization of gamification in the learning theories of constructivism will be illustrated.

12.2.3 Computational Thinking

The present era is characterized by an exceptionally high growth in the information and communication technologies (ICT). The rapid evolution of computers, especially in terms of performance and functionality of hardware and software led to new application domains and ways to utilize them in order to provide more efficient and safe systems to support human activities. At the same time, the increasing complexity of introducing advanced technology to large-scale automated systems necessitates the use of computer-based tools to support the processes of planning, implementation, auditing, monitoring and diagnosing such systems. The ability of using such tools to design systems, to predict the behavior of systems and to modeling them requires having capabilities such as computational thinking (Denning, 2009; Henderson, 2009; Wing, 2006; ClarkeJ & Wing 1996; Lu & Fletcher 2009).

Computational thinking is not a new idea. The algorithmic thinking flourished in the decades of 50 and 60 aiming mainly in standardizing problems for converting input to output and secondly in searching optimal algorithmic solutions of these conversions. Computational thinking has expanded as a concept and involves thinking at multiple levels of abstraction, using mathematical algorithms in the development and consideration of the complexity of the solution depending on the size of problems (Denning, 2009). Additionally, computational thinking is based on calculation procedures used in solving problems. It is considered as a fundamental process and therefore every child nowadays (and every person in the future), except the skills of writing, reading and arithmetic should have computational thinking skills, too.

Problem solving, designing systems, understanding of human behavior based on basic concepts and tools of computer science are included in the computational thinking skills (Wing, 2006). Computational thinking involves the use of abstraction, division of a problem into simpler, using heuristic methods, scheduling a project, use large amounts of data, etc. Moreover, it offers opportunities to create a new relationship with scientists from other fields, by offering them the fundamental principles of computer science and the incorporation of these principles in their own fields (Denning, 2009).

According to the above features, it is clear that computational thinking should be developed at early ages of man. Moreover, we believe that the development and cultivation of this ability should be dominating the entire spectrum of education.

12.3 Developing Learning Activities

Learning is a process of producing meaning. It occurs through the ingestion and processing of experiences as well as the harmonization of them with previous beliefs, experiences and knowledge that leads to behavior change. This process of transformative learning focuses on the search for meaning (Mezirow, 1991). Each student has a different frame of reference.

In a learning activity every student finds a different meaning depending on his needs, interests and abilities. In the proposed gamification framework we use those items from the game area that will help students to find meanings in non-playful learning activities (Kotini & Tzelepi, 2013a). These data are well accustomed so that can be used as a tool that supports students to learn through changing dispositions and beliefs.

In the proposed student-centered framework, the objectives of learning activities are jointly shaped with the students. This enables students to devise their own learning process and feel proud for achieving the objectives they set to themselves. Each student sets by himself his own style of learning and hence he is jointly responsible for the personalized learning approach. The student has to solve a problem through the learning activity according to his own pace settlement or he can select the type of feedback that suits to his individual learning style. The design of learning activities focused on the student can help to avoid meaningless or negative gamification. The use of external rewards to control behavior can create a negative feeling to the student regarding non-playful context. Therefore, the use of external rewards is not a feature of a design that is oriented towards the student. Meaningful gamification that is centered on the student leads to a positive change in disposition. The main question that runs through all phases of design and development of gamification is: "How does this benefit the student?"

Another critical element of designing learning activities focusing on the student is evaluation. In order for a student to understand what is happening, it is important not to link the assessment of learning outcomes only with the corresponding score of the student. The score per se does not allow the student to grasp the reality of the development of learning process. In this case, the student understands the gamification based system as an external control system since the scoring system is based on assumptions and prejudices of the educational sector. Designing systems to be more transparent with the main objective to provide descriptive formative assessment of the students' learning process instead of just the scores, we aim at creating the conditions that will enable the student to later carve his own learning path and set his own goals. Restrictions on these goals can be provided, if necessary, with appropriate justification, so that the student has the necessary information required for further decision making.

The opposite of meaningful gamification is meaningless gamification. In meaningless gamification, the design is based on the needs and goals of the educational curriculum without taking into account the needs of the student. The meaningless gamifications' policy is based on points and levels and leads to external rewards that have nothing to do with the underlying activity. These policies do not focus on the long-term learning benefits of the student. They only focus on the improvement of a threshold to achieve the learning outcomes in a short time. The main question that runs through all phases of the design and development of meaningless gamification is: "How does this benefit the education system?" The answer is by creating meaningful gamification that benefits the student, creates a positive impression on the non—playful frame and provides long term benefits to both the student and the educational system. The benefits to the education system are derived indirectly from the positive and significant benefits of its students.

Another meaningful threat to gamification is that of the design-oriented play mechanism. In this case, the design is not focused on what is best for the student, but on what is of latest version or easier to be applied by disregarding the basic needs and goals of the student. As a result, a gamification environment is created that provides to students meaningless experiences. The integration of new or interesting game mechanisms in education systems without prior study in depth can result in problematic learning activities. Although a new facility may be attractive to students, the lack of integration with the underlying learning activity may lead to non-participation of students. The aim of meaningful gamification is the linkage of the various elements of the game space with those aspects of the underlying learning activities that are meaningful to the student. These links can help students to match the aspects of the underlying activity with their own goals and desires.

In the proposed framework, the learning activities lead to the development of computational thinking skills, dispositions and vocabulary, which are considered by the students as a new approach not only for solving scientific problems but also for meeting challenges of their daily lives (Yadav, Zhou, Mayfield, Hambrusch, & Korb, 2011). The semi structured problems, the complexity of the solution and the discovery of the optimal solution can be found in all aspects of daily life and students with enhanced skills of computational thinking can start their careers on a professional and personal level with a significant lead.

The skills and concepts included in computational thinking can be nurtured and strengthened in all learning subjects through appropriate methods and ways of teaching (Barr & Stephenson, 2011). The analysis, collection and representation of data, splitting the problem into sub problems, abstraction, algorithms and processes, automation and simulation can be incorporated in other disciplines beyond computer science. Students can develop the basic abilities of computational thinking by actively participating in authentic, exploratory, teamwork activities that have meaning for them, seize the cultural and knowledge background and focus on modeling, simulation, robotics, and design and development of interactive multimedia (Brennan & Resnick, 2012; Lee et al., 2011). Activities that focus on the process of thinking and learning and give emphasis not only to what students learn but how they learn, transform students for users and consumers of technology to creators and self-expressed persons.

In the research work of Lee et al. (2011), the proposed activities have escalating difficulty. In particular, the activities are grouped in a three-dimensional form (use-modification-creation) and are implemented in rich learning environments through the downward guidance of the teachers (scaffolding). Initially, students perform experiments with pre-existing models, they execute a program that controls a robot or they play a computer game. Through the time they begin to modify the model, the game or the program by increasing its complexity. Then, students create their own projects and develop their own ideas through a series of repetitive control, analysis and improvement procedures. The passage from the stage of the modification to the process of creating original and complex project requires students with elevated levels of presentation, analytical and abstract reasoning skills. The participation of students in progressively more complex tasks is making them accountable for the progress of their learning and increases their self-esteem. With these modeling, simulating and designing of game development scopes, students can develop their computational thinking through abstraction, analysis and automation procedures.

In the field of modeling and simulation the students start from a situation problem and then plan and develop the corresponding model, while they also investigate, control, modify, extend and contrast it with other comparable models, those of their classmates. The students choose to represent the elements and factors that they consider most important in order to study the situation. In the field of robotics, students are involved in an abstraction process while they are trying to design and program a robotic device in such a way that they react under specific field conditions. Furthermore, in the field of design and game development students have the opportunity to use their capabilities for abstraction and modeling at multiple levels starting from the conceptualization of the problem and reaching the conversion of these concepts into individual characters and part of code. They can provide new methods of representing non-default character behaviors. Students are involved every time in the analysis process when trying to decide whether deductions were correct and effective according to predefined criteria. The processes of testing and debugging their game, as well as evaluating both their own works and those of their classmates, can enhance their analytical and critical abilities.

12.4 The Proposed Framework

In the definition of game by Dempsey, Haynes, Lucassen, and Casey (2002) as a set of activities with goals, constraints, rewards and consequences, where one or more players are involved, we aim at incorporating elements and instruments from the gaming and game design spaces in learning environments. The main idea of this proposal is based on the ability of the student to freely choose his learning path and to formulate an appropriate learning content. Better results can be achieved when the student, with the help of his teacher, decides for his own learning process without the influence of external controls of behavior. A classic reward system does not lead to increased performance in any case (Kohn, 1999). Students, who are accustomed to be actively engaged in learning activities due to benefit rewards, feel less willing to continue trying in the case the reward system is removed (Deci et al., 2001). However, the continuous use of the rewarding system can lead to a long decrease of the intrinsic motivation.

Working on this direction, we provide a student-centered gamification framework for enhancing the students' involvement in the learning procedure, based on a gamification environment (Kotini & Tzelepi, 2013b). For this student-centered gamification framework, we borrow elements from the area of game design and we introduce them, readjusting them, as appropriate, in a learning environment. These elements, as they are following presented in brief, constitute the central leadings upon which the learning activities for the computational thinking development are formed.

In our approach, learning activities are accompanied by a series of computational thinking characteristics and gamification elements that are based on the constructivist learning theory. The scope is focused in the area of teaching computer science. In more detail, the characteristics of the proposed framework include:

- **Constructivist Learning Theory Pillars**: The basic elements of constructivist learning theory can help the teacher to build students' knowledge by enhancing the existing ones.
- **Gamification Elements**: The brief description and reference to the corresponding gamification element helps the teacher to question himself about the scope of the proposed playful inquiring learning that is meaningful for students and for strengthening their autonomy.
- **Computational Thinking Skills**: Brief description of the corresponding skills of computational thinking and how they relate to the activity or why the activity is considered as an one that encourages computational thinking.
- **Computational Thinking Disposition and Behaviors**: The association of physical activity with a computational thinking disposition helps both the teacher and the student to identify dispositions and behaviors that are necessary for the conquest of the computational way of thinking.
- **Computational Thinking Vocabulary**: Using an appropriate vocabulary contributes to the recognition and to the successful transfer of knowledge to other tasks and learning subjects.

In the above features, we add the individual **cognitive objective** of an activity. Each teaching activity is based on the constructivist learning theory, after enriched with gamification elements. Enhancing the intrinsic motivation of students is reflected in the development of computational thinking skills, dispositions and vocabulary.

12.4.1 The Pillars of the Constructivist Learning Theory

The educational process is proposed to be based on a number of key pillars of the constructivist learning theory, in order to be capable of supporting in a playful way the active involvement of students in activities that develop their computational thinking abilities (Kotini & Tzelepi, 2013c). These main pillars are the following:

- Active participation of the students
- Scaffolding
- Activities that excite the student's interest and whose implementation is feasible
- Instruction is based on students' prior knowledge
- Use of notions met in everyday life
- Objectification of the notions
- Team learning
- Systematization of teaching scenarios
- Adaptation of learning procedures to the new technologies
- Spiral approach to teaching
- Freedom to choose the appropriate learning process
- Feedback
- Discovery, exploratory learning

- Self-assessment
- Activities with escalating levels of difficulty
- Students learn better when they know the purposes and objectives of the course
- Learning process is strengthened when it occurs within a social context
- Learning activities are based on students' interests.

As the goal of learning activities is creating learning outcomes, it is very important to follow constructive principles in creating such activities. A teacher in order to schedule and create an activity must take into account the following questions:

- Is the learning activity designed to meet student's learning goals and interests?
- Can students solve tasks in different ways by following clear, concrete and formed rules?
- Are there step-by-step instructions for each learning activity?
- Is the activity stimulating students' thinking?
- Is the activity supporting students' access prior knowledge?
- Is the cognitive level of a student taken into consideration?
- Is the activity appropriate for students with different learning styles and needs?
- Is there a progressive transition from easier task to more difficult and the most difficult task?
- Are tasks not too trivial and not too difficult for a student?
- Can the content be adapted to the cognitive level of a student?

12.4.2 Gamification Elements

The integration of gamification elements as described below makes learning activities more interesting. It attracts students by using a playful way to be actively engaged in the learning process. The proposed framework is aimed at increasing students' internal motivation rather than external. As a result, the gamification elements were selected under the light of constructivist learning theory and also to be compatible with learning activities. Each of these elements has been adjusted to the peculiarities of the learning environment in such a way as to promote the development of computational thinking skills. All gamification elements can be classified in three categories: elements of behavior, feedback and progression (Kumar, 2013). In the category of behavior gamification elements focus on human behaviors and intrinsic motives. In the category of progression gamification elements included are used to structure and stretch the accumulation of meaning skills and in the category of feedback gamification elements provide feedback on the learning activity.

12.4.2.1 Elements of Behavior Category

- **Open-type problems**: Original activities, for example, from the area of modeling, robotics and game designing, which are based on the ideas of computational thinking, boost the students' analytical thinking abilities and make these activities attractive, by enhancing in that way the student's internal motives. Open-type problems constitute a challenge for the students, because there are multiple solutions, and therefore enhance their interest, while, at the same time, activate their creative ability, innovation and critical thinking.

- **Framework**: Modern programming and multimedia environments wherein the students are invited to create, Such environments are not utilize the test and grading evaluations but rather stress the learning itself; the learning that is being made through presenting working plans makes students feeling that they work as young researchers/scientists (viz. "players" on scientific matters that are of their interest, leaving the grading stress behind). That is the main reason for not using a grading system in the proposed framework.
- **Freedom of choice**: Students have the possibility to select, among a wide variety of actions, those that fit to their own learning profiles. According to the self-determination theory, the greater control one has in choosing his actions, the greater the possibility of reinforcing his intrinsic motivation for participation and activation (Deci et al., 2001). Most students find greater meaning in a learning activity that is combined with fun than when they are going to get rewards or simply "to learn something". The learning outcomes are improved when the activities evolve in gamification contexts where students explore subjects according to their own rules instead of the teacher's rules.
- **Imaginary**: Students are easily getting bored. One reason they don't like the school study is because it is a tedious process. The involvement of imagination in development activities makes the whole process more interesting and therefore it operates as an internal motive for learning.
- **Emotion**: The designing of the learning activities, which is based on the philosophy of gaming aims at activating students' interest and curiosity via amusing activities. Various games are designed to engage the student's emotional (anxiety, curiosity, enthusiasm, tenacity) and therefore are more likely to be retained in the memory of the student for later use (LaBar & Cabeza, 2006). Creating emotions such as expectation (when the student has to face something new for the first time), surprise (when the student studies the same learning subject but through another point of view) and pleasure (when one feeling takes the place of the other) can lead in a fundamental understanding of the learning subject. By acquiring new knowledge and new skills, the confidence of students is being increased and they feel ready to undertake new challenges.
- **Rules**: Each learning activity demands the adding of rules. Rules need to be clear, concrete and formed according to the level and the interests of each student; rules also need to be formed in that way to make the learning activity attractive.
- **Action—Challenge**: Adding or emphasizing a challenging or action element makes the learning procedure more exiting and entertaining for the student. The action, for example, is highlighted in an educational process of learning programming when it is requested by the student to modify a game in Scratch (2013) in order to make it more difficult or more attractive. The simulation and modeling of real situations either from school or from their daily lives may be challenging for the students. Additionally, the creation of applications for mobile phones excites and interests most of the students because it focuses on a digital medium and is directly related to their daily routine in real world.

- **Discovering—Researching**: It is beneficial to give students the possibility to discover unexpectedly new abilities and meet challenges through the learning procedure. In the Kodu (2013) programming environment, for example, students believe that the games they can create are limited to collecting apples and to throwing rockets. However, during the learning process, the students may pleasantly discover that it is also possible to simulate the exploration of the planet Mars or how a football matches may evolve.
- **Student roles**: The learning procedure includes many roles for the students. Each student's roles can be altered during the learning procedure. Originally, the role of manager (for managing his own learning path) is assigned to every student and the assignment remains active till the end. Moreover, during the learning process he is able to undertake the tasks of mentor, supporter or feedback assistant to the members of his team, co-author of the action plan and coordinator of the whole session. In this way, the student forms a wider image and understanding of himself, regarding the learning subject as well as the limits within which they are learning.
- **Team cooperation**: Team work contributes in the development of the positive learning results, because learning is a sociable procedure. A student that observes the way according to which his classmates research and participates with the rest of the class in the realizing of a common activity, is exposed to more stimuli; as a result, the student will have more chances to give a purpose to the learning activity. For example, students can design and complete a job by working in groups to divide up their work online and to participate in online learning communities for supporting their classmates. This shared commitment increases the likelihood that students will find meaning in the activity because of the multiplication of the represented viewpoints.
- **Interaction**: The students are not passive receivers of the learning context but rather they play a main role in the "game of learning", within an environment that provides them with experiences. Working in teams, receiving feedback, programming interactive modern computational environments, researching, learning of acting and taking part in group discussions contain interaction elements and provide the learning procedure with substantial, powerful and attractive characteristics. For example, in a learning activity such as "Play—Modify—Create" students could write their experiences to help their classmates who are preparing to be engaged in a similar activity to prepare properly. The online platforms of synchronous and asynchronous e-learning and communication give the opportunity to students to find meaning in the learning activity through interaction with both their classmates and their teachers.
- **Pleasure**: Students like games because they make them enjoy themselves. The concept of gaming is a synonym to the free research and discovery. By resolving open, authentic problems, for example, stimulates the creative ability, innovation and critical thinking. Tackling new challenges in the limits of students' potential and the ability to solve them in different ways, provides the student with opportunities for further experimentation, exploration and personal expression. In this student-centered gamification framework, the student feels "the master of the game" because the learning activity is designed to meet his own learning needs, goals and interests.

12.4.2.2 Elements of Progression Category

- **Difficulty levels**: Through the difficulty levels, students are rewarded progressively for their learning achievements. It has been proved that by including this element in learning activities, an intrinsic motivation of the students is created, since they are helped to break apart the learning activities in small parts, giving them intermediary cognitive and recognitive abilities. For example, learning programming structures could involve three stages: "Play—Modify—Create". The "Create" stage has the highest difficulty and involves the development of metacognitive skills. It represents the final stage and the successful outcome presupposes the successful outcome of the two previous levels of "Modify" and "Execute". In the games, while the players are trying to achieve their goals, they realize what is happening and then they try something different. The same procedure is used in gamification where students are moving within a circular frame between investigation and reflection. It is worth noticing that at each stage the learning activities are relevant to the subject of the students.
- **Development—Progress**: There should be a visual representation of the progress of the student in the whole learning procedure. The representation of the student's progress should be descriptive enough and must indicate his progress on learning, thinking and creating. The student thus realizes continually the cognitive and metacognitive objectives of the educational process reached and understands his achievements at any time. The individual student file, which shows the progress and development of the student, is completed by the students with the help of their teacher. The descriptive assessment varies according to the type of action, and difficulty of the student's capabilities. Students have the ability to select among a wide range of activities those actions that fit their learning profile, in order to achieve their goal.
- **Renewal**: We almost never play a game only once. Moreover, every time we play it in a slightly different manner. Thus, the action of gaming can be more predictable every next time of playing. For this reason, the student in a class of computer science that is called to repeat, for example, a "Play-Modifying-Creating"-like learning activity should start searching every next time in a different variety of already prepared programs. These new programs will give him the feeling that he begins engaging for the first time to something completely different. The feeling of a new experience increases the positive learning outcomes while reduces the feeling of failures from previous attempts.

12.4.2.3 Elements of Feedback Category

- **Time limits**: In case the deadlines are passed, the student can lose grades or other advantages he gained through the activity. The introduction of time limits can make students more responsible for their actions and help them to realize attentively their mistakes and rearrange their learning development as to implement the next activity within the specified time.

- **Feedback**: There will be many times that the student will meet difficulties or fail to accomplish a particular activity. The immediate feedback from the teacher or its classmates will help the student to realize its mistakes and focus on the modification of its learning path. Students can seek for clarification of their work and discuss with their peers and teachers, by posting comments through an online platform. Students should receive notification via email in order to be able, for example, to respond quicker to posts and comments of their classmates. Students actively participate in the entire process through experimentation (test and error) that regenerative functions to realize their mistakes, correct them and learn from them.
- **Rewards**: Rewards might appear as a positive surprise to the students. Letting them continue the activity to a next "difficulty" level, giving them additional grades, or conferring them the "junior trainer" role for the rest teams of their classmates or a short extension of a project's deadline could count as such rewards. The rewards are given when they succeed in a series of challenges or when they are participating in some activities. Students are rewarded with experience points for undertaking various tasks. The choice of the desired reward is given to the student.

12.4.3 Teacher's Guideline of Gamification Elements

The proposed framework is aimed at increasing students' internal motivation rather than external. It is very important to incorporate intrinsic motivation because research shows that integration of intrinsic motivation in learning process creates an environment that allow students to have a fun and engaging learning experience. Taking all these into account, the scenario of a lesson must meet most of the following questions grouped in the above mentioned three categories:

- **Behavior**
  - Does the learning activity provide the student with opportunities for further experimentation, exploration and personal creative expression?
  - Is the activity attractive and fun?
  - Does the activity activate students' interest, curiosity, imaginary and enthusiasm?
  - Do students explore new areas of interest?
  - Do the activities encourage team work and interaction between members' group and teachers?
  - Do students focus on competing with themselves and recognizing self-achievement?
  - Have students the ability to select among a wide range of activities those actions that fit their learning profile, in order to achieve their goal?
  - Is the activity an open—ended and authentic problem?
  - Are students engaged to achieve something great, awesome and bigger than themselves within a specified time?
  - Does the learning procedure include many roles for the students?

- **Progression**
  - Is the representation of the student's progress descriptive enough?
  - Does the representation of the student's progress indicate his progress on learning, thinking and creating?
  - Is there a virtual or physical representation of having accomplished a learning activity?
- **Feedback**
  - Is there a recognition of achievement (such as by the sharing of created artifacts)?
  - Is there a differentiated list of rewards so that students can work towards something that interests them?
  - Is it given immediate feedback to students if they do a task wrong? Have students the chance to try it again?
  - Are students only given a certain amount of time to do something?
  - Is appropriate information released to the students at each level?
  - Are the rewards given when they succeed in a series of challenges or when they are participating in some activities?
  - A student that is called to repeat a learning activity should start accomplishing every next time with a variety of different tasks?

Only after responding these questions should the implementation of gamification elements be considered. These questions help the teacher define the possible weak points in the learning activities, and work around them. The above questions are designed to shine the light on gamification in a format familiar to teachers.

Any gamification effort beyond the extrinsic motivation elements requires design and analysis of multiple aspects like behavior, progression, feedback and possible interactions between them. The precision and efficiency of applying gamification elements to the teaching depends on the thoroughness of implementing these aspects. Also, it is important to meet most of the above mentioned questions in order not to lose these specific and important aspects.

12.4.4 Computational Thinking Skills

The computational thinking in education involves a process of problem solving that contains capacities development (Computational Thinking Teachers Resources, 2013). In the context of teaching the various subjects, the development of the following computational thinking skills is desirable (Kotini & Tzelepi, 2012):

- Formulating problems in a way that enables the use of hardware and software tools for solving them
- Modeling problems
- Logically organizing and analyzing data

- Representing data through abstractions, e.g. models and simulations
- Automating solutions through algorithmic thinking
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Synthesizing of individual solutions and searching for the optimal one
- Generalizing and transferring the problem-solving process to a wide variety of problems
- Developing of abstraction and pattern recognition abilities
- Testing and debugging processes
- Self-assessment

12.4.5 Dispositions and Behaviors of Computational Thinking

The above skills are supported and strengthened by a number of dispositions and behaviors that are essential features of computational thinking:

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- Ability to deal with open-type problems
- Ability to communicate and work with others to achieve a common goal or solution

12.4.6 Computational Thinking Vocabulary

The problem solving procedures used to enhance these skills in a cognitive—emotional context include an appropriate vocabulary that is useful for knowledge transferring to other cognitive subjects, as follows:

- Data collection
- Data analysis
- Data representation
- Problem decomposition
- Abstraction
- Algorithms and procedures
- Automation
- Simulation
- Parallel processing

12.5 Use of Proposed Framework

The above framework is designed to help teachers in the construction of their gamified lesson plans. Specifically, the main objectives of this framework are:

- to help teachers develop an understanding of gamification and recognize the gamification elements they are already including in their lessons
- to support teachers re-examine their current lessons with an eye to extending an activity with gamification elements. Teachers can use this framework as model for re-examining lesson plans to identify where gamification elements currently exist and where an added activity or extension could incorporate gamification into a learning experience.

The recognition of gamification elements can be achieved by the teacher, taking under consideration the questions provided in teacher's guideline section. A teacher should take into account the learning objectives of the scenario in order to be able to design appropriately a learning activity with gamification elements. Each learning activity is based on a main idea. This main idea is related to the desirable learning results. The scenario aims not only at targeting a learning outcome but to motivate, to entertain and to attract students' interest. As a result, teacher can create scenarios based on a gamified story using the pillars of Constructivist learning theory such as active participation of students which is also a gamification element. For example, teachers could teach the algorithm of "divide and conquer" by using a fictitious but serious problem: "A pair of dirty socks has accidently been wrapped in one of the gifts that Santa is ready to deliver, and he needs help to understand how to prevent a child getting an unpleasant surprise. How can we help Santa Claus resolve this problem?" The teacher has to answer the following three questions.

- Is the problem—scenario—main idea capturing the students' interest?
- Is the problem—scenario—main idea leading us in achieving a learning outcome?
- Are the gamified learning activities tightly connected to the learning goal?

The above questions are intended to help teachers correlate gamification elements with the learning activities. Teachers, who respond to each one of the questions as they plan their lesson, integrate gamification elements into teaching. At the end of the course and after the implementation of scenario the teacher can evaluate the scenario and reflect on the final results. If the results are desirable he/she can keep the scenario as it is written. Otherwise, he/she will need to make adjustments to the scenario where there are weaknesses and add an activity or an extension that could incorporate gamification into a learning experience.

12.6 Application Scenarios

The following three examples illustrate the application of the proposed framework and demonstrate the utilization of gamification as a mean to encourage the students to participate.

For each scenario, indicative correlations between learning activity and the proposed framework, with the following meaning are provided. Each description of activity is provided in a gray frame, followed by the achieved computational thinking skills, dispositions, or vocabulary and the related objectives of gamification and constructivist learning theory. Words or phrases surrounded by brackets (i.e. [Announce]) represent the particular actions on which the correlation is defined. To clarify whether an action is considered as a computational thinking or gamification one additional commentary is provided as needed.

For each principle and objective of gamification and constructivist learning theory, there is a disposition of computational thinking that is enhanced. This correlation leads to positive results in terms of disposition of computational thinking obtained through the proposed framework. Activities based on constructivist learning theory and embedded with gamification features are more attractive and can help the students to develop and improve computational thinking skills and disposition. Additionally, these activities provide students with the appropriate vocabulary in order to apply their skills and knowledge in other subjects. In this way, the diffusion of knowledge and skills of computational thinking is achieved.

12.6.1 First Scenario

The first scenario refers to teaching the structure of the "if-then" control statement in the programming environment Scratch (Scratch, 2013). The correlation to the computational thinking, gamification elements and constructivism learning theory objectives throughout the learning activity is depicted below. An introduction to conditional statement "If". The teacher [*announces*] to the students the purpose and objectives of the lesson.

[**Announce**]

- Gamification (Rules): In the field of game design and in the educational field, the rules should be known from the beginning to ensure a balanced and a fun learning framework.
- Constructivist Objective: Students learn better when they know the purposes and the objectives of their lesson.
- Computational Thinking Disposition: Confidence in dealing with complexity

- Students [*work in groups*] of two. They [*identify*] and record [*examples from everyday life*], but also from their interaction with the digital world, where the realization of an action is the result of an event that has happened before. Then they are asked to [*formulate*] the examples in the form of "If … then …". Then, students [*present and discuss*] in the class the results of their work.

Cognitive Objective: Realization, recognition and modeling of the conditional statement by using events of everyday life.

[**Work in groups**]

- Gamification (team work): The social interaction is important for building a learning community and enhancing the cooperation.
- Constructivist Objective: The learning process is enhanced when it occurs in a social context.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

[Identify]

- Gamification (discovering -Researching): Students naturally love to explore. Providing multiple opportunities for discovery learning experiences contributes to the active participation of students.
- Computational Thinking Skill: Development of reasoning and pattern recognition abilities.
- Computational Thinking Vocabulary: Data organization
- Computational thinking Disposition: Tolerance for ambiguity

[Examples from everyday life]

- Constructivist Objective: Building on the previous knowledge of the students.
- Computational Thinking Disposition: The ability to deal with open-ended problems
- Computational Thinking Vocabulary: Data collection

[Formulate]

- Computational Thinking Skill: Development of the ability of modeling
- Computational Thinking Vocabulary: Data representation through abstractions
- Computational Thinking Disposition: Confidence in dealing with complexity

[Present and discuss]

- Constructivist Objective: Learning is enhanced when it occurs in a social context.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

- [*Extracts of texts*] in electronic form from the fields of technology, sports, entertainment and media are given *to students*. The students are asked to [*choose*] one of the proposed extract in order to [*identify*]: (i) the conditional statements, (ii) the form of the conditional statements and (iii) the set of *actions* they perform as a result of the conditional statements. The students are asked to [*formulate*] the conditional statements in the form of "If … then …" or in the form of "If … then … else …". Then, the students [*present and discuss*] in the class the results of their work.

Cognitive Objective: Realization, recognition and modeling of the conditional statements and their characteristics that are presented in written texts.

[Extracts of texts]

- Constructivist Objective: Activities are based on the students' interests.
- Computational Thinking Disposition: Tolerance for ambiguity.

[Choose]

- Gamification (Freedom of Choice): Students get involved in the activity of their choice.
- Computational Thinking Disposition: Confidence in dealing with complexity.

[Identify]

- Computational Thinking Skill: Logically organizing and analyzing data.
- Computational Thinking Disposition: Tolerance for ambiguity. Confidence in dealing with complexity.

- Descriptions of Scratch projects are given to students. The Scratch projects are from the area of games, animations and stories. Students have the opportunity to [*choose*] the project they prefer. Students are asked to [*identify*] actions that suggest structures of control and [*formulate*] them in the form "If … then… else". The students "run" the associated projects and [*observe*] the conduct of the characters as well as how it changes. The students [*compare*] and discuss their notes. They have the possibility to [*ask for help*] from their classmates or the teacher whenever they face difficulties. After they [*have examined*] the statements, they try to [*identify*] the part of the statements that "breaks" the serial flow of the execution and diverts the "scenario" from its direction. The students [*correlate*] this part of the statements with the previous grouping. Their projects [*are presented and discussed in class*].

Cognitive Objective: awareness, recognition and modeling of conditional statement and its characteristics in Scratch projects. The students are able to recognize the conditional statement by either reading the source code or "running" the "executable".

[Ask for help]

- Gamification (Feedback): Without proper feedback students feel lost and after some time they give up the effort.
- Computational Thinking Disposition: Persistence in working with difficult problems.

[Compare] [have examined], [observe], [identify], [correlate]

- Computational Thinking Skill: Development of analytical and synthetic ability.
- Computational Thinking Vocabulary: Abstraction.
- Computational Thinking Disposition: Persistence in working with difficult problems.

- The teacher in [*collaboration with students*] introduces the conditional statement, its characteristics and its necessity.

[Collaboration with students]

- Gamification (Roles of Student): During the activities students take the roles of the author, the contributor, the teacher and the coordinator. Each of these roles cultivates and develops a broad set of skills and dispositions. The feelings of satisfaction and pleasure dominate in all roles.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

- Scratch projects from the *area of games, animations and stories are given to students. Students are asked* to [*choose*] the project on which they would like to work. They [*modify and/or expand*] this project, following specific criteria. Their projects [*are presented and discussed in class*].

[Modify/expand]

- Gamification (Discovering –Researching): The process of modification and extension challenges students to discover, explore, create and self-express.
- Computational Thinking Skill: Development of analytical and synthetic ability.

– Computational Thinking Vocabulary: Abstraction.
– Computational Thinking Disposition: Persistence in working with difficult problems.

- Students [*create*] their own projects of a certain subject with specific requirements. They can start from scratch or use a given set of commands. Their projects [*are presented and discussed in class*].

Cognitive Objective: ability to use and integrate the various conditional statements.

[Create]

– Gamification (Imagination): Creativity stimulates the imagination. Students use their imagination to provide innovative solutions to problems.
– Computational Thinking Skill: Development of analytical and synthetic ability.
– Computational Thinking Disposition: Persistence in working with difficult problems.
– Computational Thinking Vocabulary: Automation.

- [*Self-Assessment*]. Students describe how they have worked, the difficulties they encountered, what they liked, what they would like to change both at the individual level and at the level of instruction.

Cognitive Objective**:** ability to self-regulation

[Self-Assessment]

– Gamification (Freedom of choice): Students are responsible for their learning path.
– Computational Thinking Disposition: Confidence in dealing with complexity.

- Students upload their projects on the Internet at the respective [*electronic learning community*]. Each project is accompanied by a description about their working methodology in text or video form. Thereafter, students organize a series of seminars to introduce programming to students from other schools. Seminars are supported by distance synchronous and asynchronous learning platforms.

Cognitive Objective: Diffusion of knowledge, skills, experiences and projects of students in other school communities.

[Electronic learning community]

– Gamification (Rewards): Reward does not come through points and degrees but by the possibility of engaging in other educational areas and transferring knowledge, skills and experiences.
– Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

12.6.2 Second Scenario

The second scenario refers to the course "Introduction to Programming", as a part of a set of teaching activities of an interdisciplinary scenario on the food chain. Similarly, the correlation to the computational thinking, gamification and constructivist learning theory objectives throughout the learning activity is presented below.

- The students [*work in groups*] of two. They [*create*] an interactive story of their choice that represents the food chain. They [*select*] a programming environment that they will use to implement the food chain. They can [*ask for help*] from their classmates and the teacher. They [*divide their stories*] into sections. Characters have specific behavior and interact with each other in a specific order. The students should [*think*] what they want their characters to do. How will their costumes and the backgrounds be; Then, they [*implement*] their ideas. They create at least three characters and use all the algorithmic structures and concepts that they have learned. This scenario demands [*advanced knowledge*] in the field of the programming concepts. They run the program and [*ensure*] that the interactive story progresses as they had planned it. Otherwise, the students [*find and correct their mistakes*] in order to represent in an integrated way the model of the relationship between the characters. The students [*present*] and [*discuss*] the progress they have made in the classroom. In the end, they complete, and add in *their* [*e-portfolio*] the self-assessment sheet.

Cognitive Objective: The students are able to create an interactive story representing the food chain using Scratch the programming environment of their choice.

[Group]

– Constructivist Objective: The learning is enhanced when it occurs within a social context.

- Gamification (Team cooperation): Students learn best when they work in groups, because the communication among them can be amusing.
- Computational thinking Disposition: Ability to communicate and cooperate with others in order to achieve a common goal.

[Create]

- Gamification (Open-type problems): Activities solving authentic open-type problems are challenging for students. The challenge makes these activities interesting and attractive, enhancing in this way the intrinsic motivation of the students.
- Computational Thinking Skill: Automating solutions through algorithmic thinking.
- Computational Thinking Disposition: Tolerance for ambiguity.
- Computational Thinking Vocabulary: Automation

[Select]

- Gamification (Freedom of Choice): Students have the opportunity to choose from a wide range of programming environments, those environments that suit their learning profile.
- Computational Thinking Skill: Identification, analysis and implementation of alternative solutions to achieve the most efficient and effective combination of solution time and resources.
- Computational Thinking Disposition: Ability to deal with open-type problems.

[Ask for help]

- Gamification (Feedback): The immediate and clear feedback reduces the stress of students and helps them to focus on their work. Students want to know the reasons why their solution is correct or not. The immediate informative feedback is different from a simple reward system. It gives opportunities to students to make sense of their experiences and to reflect on their work.
- Constructivist Objective: The teacher has a consultative and guiding role and helps students to master new knowledge.
- Computational Thinking Disposition: Ability to communicate and cooperate with others to achieve a common goal.

[Divide their stories]

- Computational Thinking Skill: Students analyze their stories into smaller subsections (Abstract Ability).
- Computational Thinking Disposition: Confidence in dealing with complexity.
- Computational Thinking Vocabulary: Breaking down a problem into smaller more manageable parts.

[Think]

- Gamification (Imagination): Students activate their imagination by creating characters and attaching behaviors in them. The excitement of the imagination is a motivating force for learning. At the same time, the skills of observation, the synthetic capacity and evaluation are cultivated.
- Computational Thinking Skill: Modeling of the problem.
- Computational Thinking Disposition: Tolerance for ambiguity.
- Computational Thinking Vocabulary: Simulation

[Implement]

- Computational Thinking Skill: One objective of this activity is the dynamic representation of the model of the food chain in a programming environment. Achieving this objective requires skills algorithmic thinking (for programming) and simulation (representation of the mental model).
- Computational Thinking Disposition: Confidence in dealing with complexity.
- Computational Thinking Vocabulary: Algorithms and Procedures, Automation.

[Advanced knowledge]

- Gamification (Level of difficulty): A basic principle of game design is the challenge. Games are inherently satisfactory because the challenge is modulated according to the skill level of the player. Respectively in the education space, initially the activities are easy because the challenges are basic. With the passage of time and as acquiring more learning experiences, the challenges become more difficult, keeping students at the optimum level of engagement.
- Computational Thinking Disposition: Persistence in working with difficult problems.

[Ensure]

- Gamification (Development—Progress): In the games the player's performance is clear and is part of the dynamic of the game itself such as the score in football. Similarly, in a programming environment the successful completion of the project is an immediate feedback, and a representative sample of the evolution of the student. The student derives satisfaction from his own effort and the work he has done.
- Computational Thinking Skill: Testing and debugging procedures.
- Computational Thinking Disposition: Persistence in working with difficult problems.

[Find and correct your mistakes]

- Computational Thinking Skill: Testing and debugging procedures.
- Computational Thinking Disposition: Persistence in working with difficult problems.

[Present]

- Gamification (Pleasure): The effort that is made and the completion of the project in accordance with the capabilities of students has led to the strengthening of self-confidence and intrinsic satisfaction. The student derives pleasure from his own work rather than external rewards.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

[Discuss]

- Gamification (Feedback): The debate, the presentation and the exchange of ideas reconstructs new knowledge, reinforces the self-confidence and enhances the communication skills.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

[E-portfolio]

- Gamification (Development—Progress): Students are themselves responsible for their learning process.
- Computational Thinking Skill: Self-assessment
- Computational Thinking Disposition: Persistence in working with difficult problems.

12.6.3 Third Scenario

In this scenario, students see how often they use abstraction in their everyday life. So, the learning activity combine students' everyday routine and a Mad-Lib style thinking game to help class learn about the effectiveness of abstraction. Students work in groups using papers, pencils, and printed copies of "fill-in-the-blank" stories to:

(1) have the opportunity to internalize the idea of "abstraction"
(2) combine writing and abstraction to express their own creativity and
(3) analyze their day to find differences that they can turn into similarities.

Project ownership and team participation fosters student engagement. The learning activities come from the everyday life of students and have the form of solving open ended problems. Solving open-ended authentic problems that require imagination, inventiveness, inquiry, exploration and analysis enhance and reinforce the intrinsic motivation of students.

12.6.3.1 Activity 1

- Prompt students with: “So, what did you have for [waffles this morning]? No one? Okay, what did you have for [toast yesterday]?”

[waffles this morning]

– Gamification (Emotion): Students might look confused and curious.
– Constructivist Objective: Use of notions met in everyday time

[toast yesterday]

– Constructivist Objective: Active participation of the students.
– Gamification (Interaction): Some students are starting raise their hands. They are willing to share and to agree, because they want to participate, but probably not because they understand

- If students do not come up with answers, provide a few prompts: “See what I was doing there? I identified my experience in a very specific manner, and that made it harder for everyone else to relate to”. “[What could I have said] that more people would have related to?”

[What could I have said]

– Gamification (Freedom of Choice): Asking “what” questions lead students to very different possible solutions
– Constructivist Objective: Active participation of the students

- At some point, students will start to come up with the idea of using “breakfast” in place of the actual food that was consumed. The immediate feedback from the teacher or its classmates will help student to realize an alternative perspective of problem solving. In a way, the word ‘breakfast’ is like a variable that we use to hold a space for whatever it is we ate this morning. By taking the specific word out and replacing the space it leaves with “breakfast”, we are using abstraction to make something work for multiple people. “[Could you give me some examples] of other places that they may naturally use abstraction to allow more people to understand them?” “Is there anything *not* food [related]?”

[Could you give me some examples]

– Constructivist Objective: use notions met in everyday time

[related]

– Gamification (Difficulty Levels) There is a progressive transition from easier task to more difficult and to the most difficult task.
– Constructivist Objective: Scaffolding

- [Can you explain] the concept of abstraction?

[Can you explain]

– Computational Thinking skills: Self-assessment
– Computational Thinking Vocabulary: Abstraction

12.6.3.2 Activity 2

- Prompt students with these questions: [Work on groups]. "I will pass out a fill-in-the-blank [story]". "First you take your _____ then add a layer of _____ before you pour on a hearty dose of _____. Next, press some _____ down into the _____ before covering with a sprinkle of _____. That's how I make a _____!" It is a specific story about one thing, but we can use abstraction to turn some of the specific words into blanks, and now the story can be about lots of things. [What can you make] your story about? Share your ideas with your classmates.

[story]

– Gamification (Freedom of Choice): Students have the ability to select among a wide range of stories those paragraphs that fit their learning profile.

[What can you make]

– Gamification (Open-type problems) can be challenging for students inexperienced with this learning strategy. Explicitly state that this problem does not have the "correct answer" students typically work for.
– Constructivist Objective: The learning process is enhanced when it occurs in a social context.

[Work on groups]

- Gamification (team work): The social interaction is important for building a learning community and enhancing the cooperation.
- Constructivist Objective: The learning process is enhanced when it occurs in a social context.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

- I will you give a page that has two different stories that were created from the same template. Can you figure out what places need to be abstracted? What does their abstracted story look like? Can you create a third story, using the abstracted template? Can you abstract the template even further, even if the three versions of the stories don't require it? What might that look like? Does a more abstract template have more or less flexibility? Is there a point when abstracting a template is no longer helpful? What about when the entire story is blank? [Can you explain] the concept of abstraction?

[Can you explain]

- Constructivist Objective: (Spiral Approach in Teaching): This is given to the student a second chance to try again to explain the concept of abstraction.
- Gamification (Freedom of Choice): The student himself according to its learning profile decides if he will give a definition or an example application.

- "Let's have fun. [You can create your own templates] from scratch and share them with your classmates." [Each group could demonstrate] its solution to the class. For example, you can write a short [comic story] with many key words replaced with blanks. Ask the other classmates, in turn, to contribute some word for each blank and read aloud the completed story.

[You can create your own templates]

- Gamification (Discovering—Researching): The learning activity provides the student with opportunities for further experimentation, exploration and personal creative expression.

[Each group could demonstrate]

- Gamification (team work): The social interaction is important for building a learning community and enhancing the cooperation.

- Constructivist Objective: The learning process is enhanced when it occurs in a social context.
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution

[comic story]

- Gamification (Pleasure): Students have fun and utilize their imagination as they learn. Abstraction can be fun!
- Constructivist Objective: The learning process is enhanced when it occurs in a social context.
- Computational Thinking Skills: Developing of Abstraction
- Computational Thinking Disposition: The ability to communicate and work with others to achieve a common goal or solution.

12.7 Conclusions and Future Work

The educational systems are primarily designed to provide students with in-depth knowledge of the cognitive subject, while developing skills, dispositions and behaviors of computational thinking. These skills will give them the necessary ability to cope with the demands and challenges of the near future. The process of increasing student exposure to computational thinking is complex and is based mainly on student engagement and motivation. Positive impact on students' learning can be achieved through the involvement of students in gamified learning activities that are based on the development of computational thinking skills. Our suggestion is to design learning activities, embracing the concept of gameful design and the principles of computational thinking and constructivism theory from the very beginning age, to make them more interesting for students and to improve learning outcomes.

In this article, a student-centered gamification framework to enhance the active participation of students based on intrinsic motivation was presented. The student plays a major role in this context. Moreover, his participation in organizing, designing and evaluating learning activities can increase the chances of finding meaning in learning activities and enhance intrinsic motivation learning. In the proposed framework, students are free to fail experiment and learn at their own pace according to their own rules instead of the teacher's rules.

Our framework proposes new ways of gamification that are more meaningful for students. Reducing the overall importance of extrinsic rewards and introducing cooperative and social learning activities including "open" problems increases student motivation and engagement. In order to enhance students' intrinsic motivation concerning learning, we leverage key constructs of gamification such as curiosity, challenge, imagination, team cooperation, self-expression, feedback, emotion and rewards. All the gamification elements used have been selected under the light of constructivist learning theory and they are also compatible with learning activities.

Each of these elements has been adjusted to the peculiarities of the learning environment in such a way as to promote the development of computational thinking skills. By applying gamification elements to computational thinking learning, opportunities for changing the climate in the classroom and shaping learning metacognitive abilities (learning how to learn) are increasing.

The suggested framework attempts to change lesson plan design and structure in order to help teachers in the construction of their gamified lesson plans. Specifically, the main objectives of this framework are helping teachers understand gamification and recognize the gamification elements that are already included in their lessons and encouraging teachers to re-examine their current lessons with an eye to extending an activity with gamification elements. Teachers can use this framework as a model for re-examined lesson plans to identify where gamification and computational thinking elements currently exist and where an added activity or extension could incorporate gamification into a learning experience. Three prototype scenarios and the corresponding correlations to the computational thinking, gamification and constructivist learning theory goals throughout the learning activities were presented as a guide to framework application. The first two scenarios are from the field of Computer Science and the third scenario is dialing with the notion of abstraction. By wrapping the appropriate set of gamification design and constructivist learning theory principles around the educational process, a computational thinking learning experience can be created that motivates students during the learning process.

The framework we have developed for gamification of Computer Science courses is flexible and can be extended easily to other scientific areas where interventions to increase engagement and retention are desire, as it is presented in the third scenario. In our suggested model, the benefits of gamification are not limited to the "learning fun" but also are extended on the development of complex problem solving skills, creativity and persistence in working with difficult problems.

Our empirical experience has shown that the proposed framework has had a positive influence on the procedure of learning. We are interested in assuring the beneficial effects of the suggested model through qualitative surveys. Our proposed framework is still evolving. We are mainly aiming at answering the following 'open' research question; which gamification element has the greatest impact on learning procedure and why. Although gamification effect on the cognitive aspects of educative content seems to be successful, we think that by finding the success rate of the individual gamification elements in the students' engagement and in the development of cognitive skills we could ameliorate our proposed framework. To assist teachers incorporate gamification, computational thinking and constructivism into their courses, we are planning to design and develop a web-based gamified lesson planning system. This online system will enable teachers to create easily, discuss, share, and disseminate lesson plans. There is a need to help teachers who are new to the concept of gamification to understand the meaning and give them the opportunity to experiment with the framework that will help them to implement gamification and computational thinking in lesson plan design.

References

Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: What is involved and what is the role of the computer science education community. *ACM InRoads, 2*(1), 48–54.

Bogost, I. (2011). Gamification is bullshit. The Atlantic: Technology. Retrieved August 2013, from http://www.theatlantic.com/technology/archive/2011/08/gamification-is-bullshit/243338/

Brennan, K., & Resnick, M. (2012). *Using artifact-based interviews to study the development of computational thinking in interactive media design*. Paper presented at annual AERA meeting, Vancouver, BC, Canada.

Carstens, A., & Beck, J. (2005). Get ready for the gamer generation. *TechTrends, 49*(3), 22–25.

Chen, C. A. (2003). Constructivist approach to teaching: Implications in teaching computer networking. *Information Technology, Learning and Performance Journal, 21*(2), 17–27.

Clarke, E., & Wing, J. M. (1996). Formal methods: State of the art and future directions. *ACM Computing Surveys, 28*(4), 626–643. Special issue.

Codeacademy. (2013). Retrieved September 2013, http://www.codecademy.com/

Computational Thinking Teachers Resources. (2013). Retrieved September 2013, from http://csta.acm.org/Curriculum/sub/CurrFiles/471.11CTLeadershiptToolkit-SP-vF.pdf

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology, 88*, 715–730.

Deci, E., Koestner, R., & Ryan, R. (2001). Extrinsic rewards and intrinsic motivations in education: Reconsidered once again. *Review of Educational Research, 71*(1), 1–27.

Deci, E., & Ryan, R. (2004). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Dempsey, J. V., Haynes, L., Lucassen, B. A., & Casey, M. S. (2002). Forty simple computer and what they could mean to educators. *Simulation and Gaming, 33*(2), 157–168.

Denning, P. (2009). The profession of IT: Beyond computational thinking. *Communications of the ACM, 52*(6).

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “Gamification”. *Proceedings from MindTrek ‘11*. Tampere, Finland: ACM.

Facer, K. (2003). *Computer games and learning*. Retrieved August 2013, from http://www.nestafuturelab.org/research/discuss/02discuss01.htm

Henderson, P. B. (2009). Ubiquitous computational thinking. *Computer, 42*(10), 100–102. Retrieved from http://www.computer.org/portal/web/csdl/doi/10.1109/MC.2009.334

KhanAcademy. (2013). Retrieved September 2013, from http://www.khanacademy.org/

Kodu. (2013). Retrieved September 2013, from http://research.microsoft.com/en-us/projects/kodu/

Kohn, A. (1999). *Punished by rewards: The trouble with gold stars, incentive plans, A’s, praise, and other bribes*. Boston: Houghton Mifflin.

Kotini, I., & Tzelepi, S. (2012). *The contribution of computational thinking in the preparation of future citizens. Proceedings of the 4th Conference on Informatics in Education 2012, 5-7 October 2012 Piraeus, Greek* (pp. 221–228).

Kotini, I., & Tzelepi, S. (2013a). Theoretical student-centered gamification model for the active participation of students in computational thinking—developing activities. *Proceedings of the 7th Panhellenic Conference of Teachers in Informatics, Thessaloniki, Greek.*

Kotini, I., & Tzelepi, S. (2013b). Designing an education lesson of Informatics based on the principles of constructivism, computational thinking and gamification. *Proceedings of the 5th Conference on Informatics in Education 2013, 15-17 October 2013 Piraeus, Greek*

Kotini, I., & Tzelepi, S. (2013c). Constructivist learning theory as education model in informatics. *Proceedings of the 5th Conference on Informatics in Education 2013, 15-17 October 2013 Piraeus, Greek.*

Kumar, N. B. (2013). A framework for designing gamification in the enterprise. *Infosys Labs Briefings, 11*(3), 8–13.

LaBar, K. S., & Cabeza, R. (2006). Cognitive neuroscience of emotional memory. *Nature Reviews Neuroscience, 7*, 54–64.

Laster, J. (2010). *A class on game design has students playing to win*. Retrieved January 2013, fromhttp://chronicle.com/blogs/wiredcampus/at-indiana-u-a-class-on-game-design-has-students-playing-to-win/21981

Learning-Theories. (2013). Retrieved from http://www.learningtheories.com

Lee, I., Martin, F., Denner, J., Coulter, B., Allan, W., Erickson, J., et al. (2011). Computational thinking for youth in practice. *ACM InRoads, 2*(1), 32–37.

Lu, J. J., & Fletcher, G. H. L. (2009). Thinking about computational thinking. *ACM SIGCSE Bulletin, 41*(1), 260–264.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 4*, 333–369.

Maroney, K. (2001, May). My entire waking life. *The Games Journal*. Retrieved January 2013, from http://www.thegamesjournal.com/articles/MyEntireWakingLife.shtml

Masuyama, K. (2006). Constructive or instructive approach? Which online pedagogy is better in a foreign language course? In E. Pearson, & P. Bohman (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications*

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin Press.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco, CA: Josey-Bass.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computers*. New York: Basic Books.

Robertson, M. (2010). *Can't play, won't play*. Hide & Seek: Inventing New Kinds of Play. Retrieved July 2013, from http://www.hideandseek.net/2010/10/06/cant-play-wont-play/

Scratch. (2013, September). *Scratch*. Retrieved from http://scratch.mit.edu/

Shaffer, D., Squire, K., Halverson, R. & Gee, J. (2004). *Video games and the future of learning*. University of Wisconsin Madison and Academic Advanced Distributed Learning Co-Laboratory. Retrieved from http://www.academiccolab.org/resources/gappspaper1.pdf

Thramboulidis, K. (2005). Teaching advanced computing concepts in Java: A constructivism-based approach. *Journal of Informatics Education and Research, 7*(3).

Wing, J. M. (2006). Computational thinking. *Communications of the ACM, 49*(3), 33–35.

Yadav, A., Zhou, N., Mayfield, C., Hambrusch, S., & Korb, J. T. (2011). Introducing computational thinking in education courses. *SIGCSE '11 Proceedings of the 42nd ACM Technical Symposium on Computer Science Education* (pp. 465–470).

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Chapter 13
Educational Gamified Science Simulations

Johanna Pirker and Christian Gütl

13.1 Introduction and Motivation

Teaching conceptual content such as is found in STEM (Science, Technology, Engineering and Mathematics) fields represents a challenge for many educators. Modern instructors use pedagogical approaches based on constructivism and interactive engagement (Hake, 1988; Sanders, 2009). It is important to not only recite formulas, but to teach how to solve problems and apply these formulas. Major issues include the level of abstraction and the invisibility of phenomena such as electromagnetism. In this context, visualization of concept can improve students' understanding.

Interactive simulations are one of the most powerful tools for teaching, learning, and understanding the behaviour and characteristics of physical laws, processes or systems. Computer-animated science simulations allow users to observe a variety of phenomena more easily while also supporting the conduction of expensive or dangerous experiments (Sanders, 2009). But even a well-designed simulation can be frustrating and does not sufficiently focus on motivational aspects. This can reduce the learning outcome and efficiency. Motivational, interactive engagement formats, such as a game-based or collaborative design, can be used to overcome or at least mitigate this issue and not only improve the students' understanding of the concepts, but also increase their enthusiasm for the field.

J. Pirker (✉)
Institute for Information Systems and New Media (IICM),
Graz University of Technology, Inffeldgasse 16c, Graz 8010, Austria
e-mail: jpirker@iicm.edu

C. Gütl
Institute for Information Systems and New Media (IICM),
Graz University of Technology, Inffeldgasse 16c, Graz 8010, Austria

School of Information Systems, Curtin University, Perth, Western Australia,
Inffeldgasse 16c, Graz 8010, Austria
e-mail: cguetl@iicm.edu

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_13

The introduction of gaming strategies and game elements in these simulations can help to overcome the issue of insufficient motivation and engagement. Creating a motivational simulation which reminds the students of a computer game, however, requires an elaborate design process (Schell, 2008). Many studies provide information about designing games, learning games, or simulations but say little about design principles to integrate game-design strategies into simulations which are in line with pedagogical and instructional design heuristics.

In this chapter we propose a gamification framework with a focus on educational simulations in STEM fields. The aim is to support designing, creating, and even converting an existing simulation into a gamified, motivational simulation, which considers educational implications in a cost and time-efficient way. The second part of this chapter introduces a first application of the model demonstrating the gamification process using the example of the Java-based educational visualization and simulation framework TEALsim. The last section concludes with lessons learned and further.

13.2 Background

13.2.1 Educational Simulations in Science Education

One major challenge in STEM education is the presentation and discussion of abstract concepts, such as physical laws and phenomena, which are difficult to conceptualize and visualize. One example might be the interaction of electric fields with charges (Dori & Belcher, 2005). Neither textbooks nor the explanation of talented instructors can replace computer-based dynamic visualizations such as animations or simulations, which can conceptualize these effects. Invisible effects can be made visible, time and space can be stretched, and even dangerous or otherwise impossible experiments can be easily conducted (Lunce, 2006). Aldrich (2009) defines educational simulations as "[…] structured environments, abstracted from some specific real-life activity, with stated levels and goals."

Dori and Belcher (2005) reflect on their impressions of simulations in the field of physics as follows: "These visualizations enable students to develop intuition about various electromagnetic phenomena by making the unseen seen in game playing and experimentation." (p. 252) Animations are passive representations of principles and phenomena, and are only designed for students to watch. Instead, simulations have a more interactive character and allow the manipulation of the conditions of the principles and the parameters modeled, and therefore the behavior of the visualizations (Lunce, 2006). Exploring and experiencing principles and phenomena on their own help students to link the abstract formulas with visible behaviors. Different educational tools such as Physlets (Christian, 2005) and online platforms and collections such as Open Source Physics (OSP, 2003), or PhET (PhET, 2011) are available to support the STEM curriculum. Another important example is TEALsim, which focuses on the visualization of abstract physical concepts in the area of electromagnetism (TEALsim Website, 2004).

Research revealed that simply showing simulations to students does not enhance or prompt deeper understanding of concepts. Depending on the context of the learning content, the interactive character of simulations, however, can serve as an excellent tool to engage students and encourage them to explore difficult topics in more details. In an interview study with 89 students using different PhET simulations, Adams et al. (2008a) observed that "simulations can be highly engaging and educationally effective, but only if the student's interaction with the simulation is directed by the student's own questioning" (p. 1). They also suggest that if students only observe simulations and do not interact, they do not ask questions and cannot make new connections.

Different research groups have identified strategies and guidelines for enhancing the quality of educational simulations. Bell and Smetana (2008) highlight the importance of student-centered instructions, which mean that simulations supplement, but do not replace instructional modes. Windschitl and Andre (1998) found that constructivist simulations with exploratory character are "more effective in altering learners' misconceptions" in comparison to confirmatory simulations, where students are following clear instructions. The importance of adding exploration-based activities to enhance the students' understanding of the learning concepts was also observed by Adams et al. (2008a, 2008b). The authors found that factors such as interactivity, presence of little puzzles, visual aids such as labels, and fun and playful elements influence the students' engagement.

In the light of the discussion above, the following heuristics can be applied to guide the design process of instructional simulations:

- Educational simulations should be constructivist with exploratory character.
- Educational simulations should supplement and not replace instructions
- Instructions should be student-centered
- Limitations of simulations should be pointed out
- Simulations should be designed in an engaging manner to support conceptual learning

Student engagement is a powerful tool for enhancing understanding and motivation to learn with the simulation. In the next section we will discuss this idea in more detail.

13.2.2 Motivation and Learning

According to Graham and Weiner (1972) "motivation is the study of why people think and behave as they do. In the context of academic achievement, motivational concerns would be addressed if we were to ask, for example, why some students complete tasks despite enormous difficulty, while others give up at the slightest provocation, or why some students set such unrealistically high goals for themselves that failure is bound to occur." An important term hereby is *intrinsic motivation* (*IM*), which refers to doing activities because of their satisfying, fun, and interesting nature (Deci, 1975; Vallerand et al., 1992). IM is an important concept for instructional designers and teachers, because it results in "*high-quality learning and creativity, it is especially important to detail the factors and forces that engender versus undermine it*" (Ryan & Deci, 2000). In the context of learning, three types of IM are identified: (I.1) Intrinsic motivation to know, (I.2) intrinsic motivation toward accomplishments, and (I.3) intrinsic motivation to experience stimulating sensations such as sensory pleasure or excitement (e.g., through excitement from active class discussion). In contrast to IM, *extrinsic motivation* (*EM*) represents behavior which does not stem from personal interest. It is possible to differentiate between three types of EM: (E.1) External regulation (e.g., child learns because the parents force him to), (E.2.) Introjection (the individual has already internalized the reasons for the action), and (E.3.) Identification (the actions are perceived as chosen by the individual). Beside IM and EM, *amotivation* (*AM*) is used to describe the state where individuals are neither intrinsically nor extrinsically motivated and do not experience any external or internal motivators (Vallerand et al., 1992).

Vallerand et al. (1992) introduce the *Advanced Motivation Scale* (*AMS*) as a scale for measuring motivation in educational settings. It is based on the Echelle de Motivation en Education (EME) and helps to measure the three types of intrinsic motivation, the three types of extrinsic motivation, and amotivation.

Csikiszentmihalyi (1990) identified eight major components that cause enjoyment: (1) Tasks we have a chance of completing, (2) ability to concentrate on what we are doing, (3) tasks with clear goals, (4) tasks with immediate feedback, (5) deep and effortless concentration, (6) sense of control over actions, (7) loss of self-consciousness, (8) sense of the duration of time is altered. Csikiszentmihalyi describes experiences which are full of enjoyment as “so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult, or dangerous” (Csikiszentmihalyi, 1990, p. 71). These experiences can be described as state of flow. Csikszentmihalyi (1975) introduced the term flow as an optimal experience characterized by full attention and maximum performance on an activity. Flow can be found in different activities such as experiencing a book, sports activities, art, or music. Plays, games, and computer games are obvious activities which are likely to promote such flow states. Many of the eight components that cause enjoyment can be found in games. Using these strategies, games and game-based teaching methods can be a powerful way to achieve higher student motivation in different learning environments, such as in classrooms, in online environments, or in blended systems.

13.2.3 Games and Gamification in Education

The idea of using digital games in contexts other than fun, leisure, and entertainment is not a new one. The first experiments with games with a serious purpose were grounded in military training (Deterding, Dixon, Khaled, R, & Nacke, 2011). In the last year, more and more gaming strategies were also making their way into the classroom to enhance intrinsic student motivation. With key statements such as “Games are a more natural way to learn than traditional classrooms” (Aldrich, 2009), various ideas emerged how to integrate games or game elements into learning settings in classrooms and online learning environments. James Paul Gee (2007) suggests that educators might benefit from studying how game players learn through

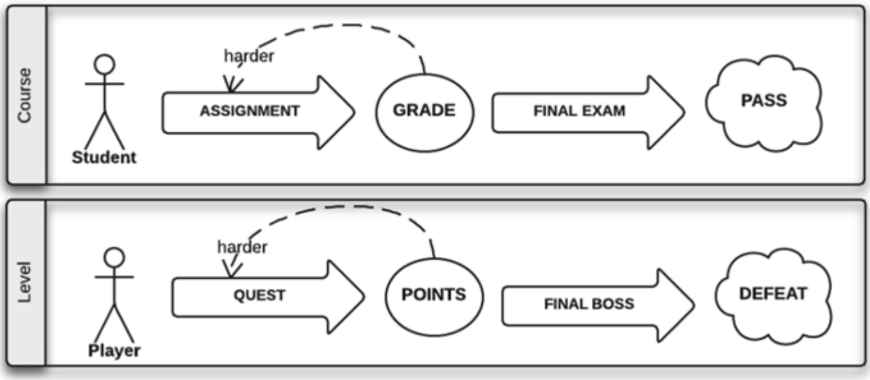


Fig. 13.1 Traditional class educational systems are arranged like games (Pirker, 2013)

game play. Schell (2008) even compared the traditional classroom design with a game (see Fig. 13.1).

Playing a game is already a powerful learning tool in itself: players have to learn new skills in a new (but safe) environment (Koster, 2004). Mayo (2007) summarizes five reasons to not only support small computer games, but also to invest into large scale parallel education in science and engineering via video games: (1) a single game can reach more people than one single lecture. (2) Video game-based education would attract students outside the classroom. (3) Video games stimulate chemical changes in the brain that promote learning. (4) Video games achieve higher effectiveness than a classic lecture. (5) Video games are designed according to effective learning paradigms such as experimental learning, inquiry-based learning, self-efficacy, goal setting, cooperation, continuous feedback, tailored instruction and cognitive modeling.

We have learned that games can be a powerful tool to support learning behavior. So, why aren't today's classrooms and learning strategies fully supported by these fun and motivation triggers? Schell (2008) summarizes the following challenges of introducing games and game-based approaches to learning settings:

1. Time constraints: Games usually require more time to impart the learning content.
2. Age constraints: Usually, games are designed to attract the gamer generation, and therefore focus on learners who have experience with this kind of multimedia.
3. Expenses: Usually, good games include a long and deliberate design process, which involves many developers, artists, and designers. This design and development process can be highly expensive.
4. Design challenges: Designing a game which is fun for players but still educational is challenging.

In the next section we analyze different aspects which can help to improve the design process and facilitate the involvement of games, game elements or game strategies in learning environments.

13.2.3.1 Designing Instructional Environments with Game Elements

When using game elements, strategies or fully-fledged games to support the educational strategies, various implications must be considered. When introducing games to teach content, it is important to find out which topics can and should be covered by a game, and which areas are either not suitable or would be too time- and cost-intensive for a game-based approach. Randel, Morris, Wezuel, and Whitehill (1992) examined different studies comparing the learning outcomes of simulations and games with those of conventional instructions and found that "subject matter areas where very specific content can be targeted are more likely to show beneficial effects for gaming." In particular, studies involving STEM fields such as math and physics showed that the instructional effectiveness of games was higher than that of conventional classroom instruction.

Early studies have already resulted in taxonomies and strategies to enhance intrinsic motivations for learning based on fun elements of games. Malone and Lepper (1987) have identified heuristics for designing intrinsically motivating instructional environments based on studies identifying fun elements of games. They range from interpersonal motivators, including motivation, to cooperative or competitive activities or the receipt of social recognition, and individual motivators. Individual motivators can be one of the following. First, students should experience challenges, which require a balanced level of difficulty. Students should have goals, encounter uncertain outcomes (such as variable difficulty levels, multiple levels of goals, hidden information, or randomness) and need frequent, clear, constructive and encouraging performance feedback, including positive feedback to enhance self-esteem. Second, the curiosity of students should be encouraged. It is important to balance the level of informational complexity according to the students' current state of knowledge. Third, students should have a sense of control and a feeling of self-determination. Fourth, inspirational, playful environments and the involvement of imagination can promote intrinsic motivation.

Another approach to make the learning experience more incentive and enhance the students' motivation is the use of gamification strategies. Instead of designing an entire game, what is expensive and requires lots of resources and specialists, gamification is the "use of game design elements in non-game context" (Deterding et al., 2011, p. 2426). Adding these elements is a comparatively cost-effective way of adapting existing processes and services to make them more fun. One famous example of gamification in classroom education is Quest to Learning (Q2L). Q2L is a school in New York City which uses gamification strategies as a basis for the curriculum design. Instead of learning for exams, students learn by solving riddles, finishing missions, or enacting role-playing scenarios. Students are rewarded for their effort by getting points, instead of getting frustrated and stressed through failing exams (McGonigal, 2011).

An example for an online educational platform grounded in gamification strategies is Khan Academy. Khan Academy is a collection of different learning resources connected to courses created with the purpose of enabling users to learn different topics, such as STEM fields, history, languages, or finance. It helps people to track their learning progress and uses gamification strategies such as points, badges, and awards to create a more fun, exciting, and motivating environment (Thompson, 2011).

In the next section we introduce different mechanics for both game design and gamification strategies.

13.2.4 *Game Design and Gamification Strategies*

Different authors have proposed different sets of game design strategies and frameworks for creating games and gamified scenarios for various purposes. The purpose of this section is to outline various ideas from different authors and to pave the way for analyzing science-based games, simulations, and gamified applications on the basis of these strategies.

13.2.4.1 Game Design Elements

Looking at the structure and elements of games, it can be seen that most are made up of the same or similar kind of principles. An early description of game elements was introduced by Avedon and Sutton-Smith (1981). They identify ten structural elements of games: purpose, procedure for action, rules governing action, number of participants, roles of participants, results, required skills for action, interaction patterns, physical settings, environmental requirements, and required equipment. Koster (2004) summarized the following game elements: preparation before a challenge (such as choosing cards for a card game), a sense of space (such as the environment or the game board), a solid core mechanic or game rule, a range of challenges, a range of abilities required to solve the encounter, and skills which are required to use the abilities.

To make a game into a learning experience, he also suggests including features such as a variable feedback system, balance between player level and game difficulty, and consequences for failures.

Schell (2008) breaks down a game into four main elements, which he describes according to their visibility to the player (see Fig. 13.2). The most visible element is the *aesthetics* of a game. This includes aspects such as the interface, the sounds, and the game atmosphere. Less visible, but still tangible for the player are the *game mechanics*, which describe the goal and rules of the game, and the *game story*. Barely visible for the players is the *technology*, which Schell describes as the "*medium in which the aesthetics take place*". To design a game, all four elements are important and must be designed in line with each other.

13.2.4.2 Gamification Strategies

Gamification uses different game design elements that are characteristic to games (Deterding et al., 2011). Gamification frameworks focus on game components which are considered as fun and ignore concepts which are based on Schell's story element (see Fig. 13.2). Zichermann and Cunningham (2011) refer to the game

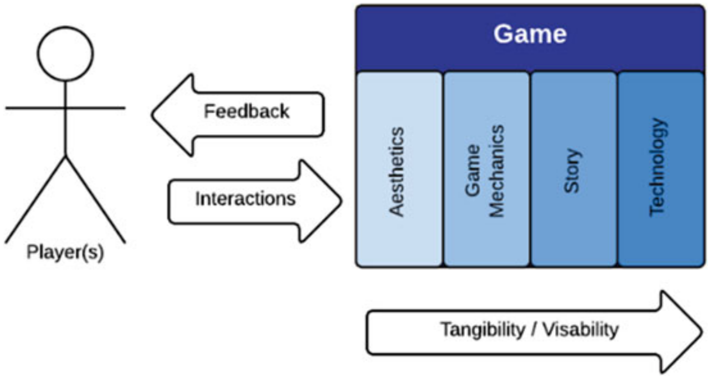


Fig. 13.2 Schell (2008) describes the four main game elements. Moving away from the player, their visibility and tangibility drops. The player communicates with these elements through interaction and system feedback

design framework MDA (Mechanics, Dynamics, and Aesthetics) as a basis for gamification strategies:

1. Game Mechanics are used as single atoms. Typical elements for gamification include points, levels, leaderboards, badges, onboarding strategies, challenges and quests, social engagement, and customization (see below).
2. Dynamics represent the player interactions with the mechanics.
3. Aesthetics involve the feelings of the players towards the application.

To apply these strategies to applications, these elements can either be implemented from scratch or an existing framework can be used. Many services already provide instant gamification frameworks such as badgeville, which provides mechanics such as badges and reward programs to simplify the gamification process (Zichermann & Cunningham, 2011).

13.2.4.3 Game Mechanics in more Detail

Since game mechanics are discussed by most game design authors, and since it is also a crucial part of understanding gamification strategies, we should take a closer look at this concept. Instead of describing single atoms of game mechanics Schell (2008) introduces six main categories of game mechanics: (1) the space where the game takes place; (2) objects, attributes, and states which are in the space; (3) actions as an operative or resultant of the player; (4) rules to define the relationships between space, objects, and actions; (5) skill of the player; (6) chance to make game outcomes uncertain. It is crucial for the game experience that all mechanics are in balance. More advanced mechanics include interactive story elements or puzzles. Puzzles should be easy to use, should reward the skills of the player and should have meaningful consequences in the main game (Brathwaite and Schreibe, 2009).

Zichermann and Cunningham (2011) describe game mechanics as a "series of tools that, when used correctly, promise to yield a meaningful response" (p.36). In the context of gamification the authors especially refer to elements such as scoring elements (e.g. points), progress elements (e.g. levels, progress bar), competitive elements (e.g. leaderboards, high scores), onboarding strategies (to help users learning the games and acquiring new skills), badges (to support user pleasure such as when collecting items and signaling status, or as a surprise element), small activities with a clear goal (e.g. challenges, mission, and quests), or social engagement.

13.3 Gamification of Simulations and Simulation Games

In this section we want to enrich the educational simulations with game design elements, and therefore introduce a separation between gamified educational simulations and educational simulation games. Whereas educational simulation games describe, similar to serious games, fully-fledged games, gamified educational simulations are designed with game elements. Often the differentiation however, is not easy, and the boundaries can be blurred (Deterding et al., 2011).

13.3.1 Towards a Definition

Many educational simulation games were designed from scratch as a game to enhance the understanding and motivation of students while learning concepts such as physical laws. Supercharged, for example, is a 3D simulation game developed by game researchers together with a MIT physicist that enables players to control a ship by altering its charge (Squire, Barnett, Grant, & Higginbotham, 2004). Designing an educational simulation game with pedagogical aims does not only require an elaborate game design process, but also needs experienced pedagogues and domain experts (Laurel, 2008). Educational simulations, however, can serve as an excellent basis for designing games or gamifying them without the need to rival commercial entertainment games (Squire et al., 2004). Their interactive character can make the integration of playful activities and game mechanics easier. Several simulation games are based on specific game mechanics such as puzzle elements and motivate the user to solve a problem with the simulation. While a gamified simulation mainly uses game elements such as reward systems and points to enrich the simulation, the simulation game often changes the purpose of the single task to create entire game scenarios and a game environment, and include different game-specific activities (game play). A well-designed simulation game is a valuable educational resource but has drawbacks, such as the need of an elaborate design which leads to high design and implementation costs. A gamified simulation can overcome those issues to some extend as long as it does not miss out the fun and engaging aspects, by simply adding high scores, points, and badges without taking the design into account (Koster, 2004).

Fig. 13.3 While simulation games include game activities and story elements, in gamified simulations game mechanic atoms are applied to simulations

Gamified simulations use the original simulation as a basis and enrich it with different game elements (such as progress bars, points, and challenges) without the need for an elaborate game design. Figure 13.3 illustrates the coherence of game elements and game activities (such as core mechanics, game rules, game goal, and game type) in the simulation type. The differences between a gamified simulation and a fully-fledged simulation game can be blurry. A gamified simulation can still have some game activities, such as solving puzzles, but it mainly applies the game design elements to the simulation to make the single tasks more engaging.

Simulation games tend to have a more playful character and can be more engaging than gamified simulations. However, due to the modification of the purpose of the simulation, game-based implementation such as simulation games tend to privilege engagement over accuracy and completeness of content (Van Eck, 2006).

Martens, Diener, and Malo (2008) offer a similar representation, demonstrating the interplay of pedagogy, computer science, and games, but do not include elements typical for the different types. Another way to differentiate between simulation games and gamified simulations is by referring to Schell's (2008) main game design elements which include mechanics and a story. While gamified simulations use the original simulation and enrich it with game mechanics, a simulation game also needs additional design aspects such as a story with elements such as goals, obstacles, and conflicts.

In the next section, different game design and gamification strategies are outlined and discussed based on successful examples to find a common basis for design heuristics suitable for educational simulations (Fig. 13.4).

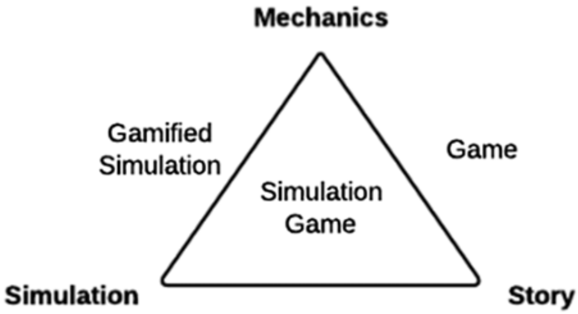


Fig. 13.4 While simulation games include the aspects of the simulation, game mechanics, and a story, in gamified simulations game mechanics are simply applied to simulations

13.3.2 Educational Simulation Games

Several authors have described different educational simulation games. In this section we will introduce selected games and analyze their main concepts. Following this, we will discuss existing guidelines for the design of simulation games with a focus on instructional aspects.

13.3.2.1 Analyzing Successful Examples

***Supercharged*!** is an educational simulation game developed in consultation with a MIT physicist which challenges players to use electromagnetic forces to navigate a ship through a maze. The gameplay is structured in the two phases of planning and playing, and consists of several levels. In the planning phase, the players can place a limited set of charges to set a navigation path for the ship. In the play phase the player can change the charges to change the direction of the ship. In a study with students, Squire et al. (2004) found out that playing the game "enabled some students to confront their conceptions of electrostatics, as they played through levels that contradicted their understandings" (p. 518). However, many students had problems memorizing different physical concepts and terminology which was introduced in cut scenes, which were skipped by many students (Squire et al., 2004).

PhET provides several freely available online simulation games for learning physics. Most of the simulations use a similar user interface with drag and drop mechanics (Adams et al., 2008a, 2008b). PhET simulations remind the player of real world objects and familiar setups, thereby enhancing understanding. Instead of traditional simulations, PhET uses a comic-like representation to visualize objects and setups. Students are free to explore the environment and start the animations and interactivities. Most of the simulations involve small puzzles with clues to help students to understand the concepts (Adams, Perkins, & Wieman, 2006).

13.3.2.2 Educational Simulation Game Design

Several authors describe design guidelines for creating educational simulation games. PhET simulations, for example, follow design guidelines for creating new simulations that were based on a user study with over 200 students (Adams et al., 2008a, 2008b). In this look and feel guide, the authors describe important aspects for successfully creating educational simulations which focus on imparting conceptual knowledge. These guidelines focus on applying an attractive layout, encouraging exploration, and including intuitive controls, representational aspects and help items (Adams et al., 2006). The simulation design process is based on a cyclic principle, which starts by setting learning goals. In the next steps the design gets iteratively enhanced after student interviews. After achieving the final desired design, the simulation can be used and evaluated in classroom scenarios (PhET Simulation Design Process, 2013).

13.3.3 Educational Gamified Simulations

Recently developed "citizen-science" games such as Foldit became famous for their ability to not only educate people about scientific phenomena, but also to help researchers to develop new scientifically valid theories or models. Even though the main purpose of these gamified simulations is not to educate, but rather to encourage involvement in the scientific process, it is still necessary to apply educational strategies to impart basic knowledge to the players, so that they are able to play and advance. In the next sections we will introduce some of these gamified science simulations and analyze their design according to the mechanics and strategies discussed in the previous section.

13.3.3.1 Analyzing Successful Examples

Foldit Website, (2012) is a multiplayer application, which has successfully gamified a real-world problem in the form of a simulation game. It uses the power of "human intuition and three-dimensional pattern-matching skills to solve challenging scientific problems" (Khatib et al., 2011). The main mission is the creation of complex buildings. Foldit is designed as a puzzle game with points and ranks. It uses typical game elements, such as rankings, scores and progress bars. To learn the game mechanics, Foldit uses a typical onboarding strategy, where users learn about the gameplay and the single elements via small missions. It uses ranking information, points, and progress bars as integrated game mechanics.

EteRNA is a project developed by Stanford and Carnegie Mellon that enables the playful design of RNAs. With the slogan "played by humans, scored by nature" EteRNA tries to highlight its realism. It is an online game, where users manipulate nucleotides to decipher real RNA problems (Wired, 2012).

Similar to Foldit, EteRNA uses a puzzle-based game strategy to attract players. The users learn about RNA during the first tutorials which are used as onboarding and which introduce new game elements. The game uses social engagement strategies such as a live chat. The gamification mechanics can be summarized as onboarding, missions, points, leaderboard information, social engagement and progress feedback.

Phlyo is a science game which allows the comparison of genomes of different species. It is designed to solve the Multiple Sequence Alignment problem (Kawrykow et al., 2012). Similar to the previous science games, Phylio is based on a puzzle game design. It uses tutorials to teach both the initial content and constant instructional content during the first missions. Leaderboard information and points provide the player with constant feedback about their status, and players receive new "talents" when solving new puzzles.

13.3.3.2 Educational Gamified Simulation Design

While many authors have described how to design educational simulations, educational games, or educational simulation games (Ibrahim & Jaafar, 2009 and Teed, 2012), only a few have provided guidelines on how to gamify an existing simulation or educational simulation. An exception is the gamified simulation design process described by Becker and Parker (2011). The authors suggest six steps. First, the needs are analyzed. The second phase is the research and preparation phase, to identify observable elements, and gather data. In the third phase, elements such as the interface, gameplay, game mechanics, or the structure are designed and evaluated. Step four and five involve the production of the conceptual model, and the programming phase to create the operational model. Finally, the process ends with the testing phase. A model showing how to use existing simulations to create gamified educational simulations, however, is still missing.

13.3.4 Analyzing Design Characteristics of Gamified Simulations

Educational gamified simulations and educational simulation games share one important common issue: They require not only players and game developers, but also scientific and pedagogical experts for the design process (Cooper, Khatib et al., 2010; Cooper, Treuille et al., 2010). In the previous section we introduced some gamified simulations with a scientific background. Most of these exemplary games applied gamification and game design strategies based on genres with problem-solving characteristics such as puzzle game elements to challenge individuals with a scientific background to accomplish higher goals. To teach the required learning content they usually use small tutorials followed by a small quest which forces the player to apply the new knowledge. After that, the users earn points, achievements, and/or badges as feedback on their learning and mastery progress. An important feature of gamified science applications such as Foldit is the meaningful context. Players do not only have fun, they also learn, and in some of the examples they can even solve real world problems. Another important element found in these science games is the freedom to explore and experiment. These games support both collaborative plays, where players can exchange tips via an online chat, and competitive plays, triggered through leaderboard information.

Based on the observations stated above, game design, and gamification mechanics, the following selection of important and frequently used game elements found in educational science games (either simulation games or gamified simulation) can be summarized as follows:

- Instructional Missions (Onboarding): Players should be strongly encouraged to do instructional missions with an onboarding and explanatory character. Players are likely to skip or ignore cut scenes, so important learning content shouldn't be placed there, and players should instead learn the content during small missions.
- Interactive Challenges: Constant missions and challenges with an interactive character should engage users to ensure that they continue to play. Missions can get harder, but they have a clear objective and the rules do not change.
- Puzzle Character: Challenges and missions can be designed as a puzzle mechanism, which challenges players to solve different small activities with a clear goal.
- Collaborative Challenges: Working together on problems and solving riddles together can help players to understand the phenomena in more detail.
- Competitive Challenges: Leaderboard information, rankings, points, and versus games support competitive play.
- Feedback: Feedback types such as points, achievements, and badges give players valuable feedback on their current skill level. Also, players are more likely to repeat levels with a lower score and can recap and reinforce what they have learned.

13.4 Design Principles for Educational Gamified Simulations

When designing a simulation with game elements it is important to integrate the game design elements and scenarios without losing sight of the pedagogical goal. There are three different strategies that can be used to create a simulation with game mechanics. (1) Design the gamification simulation from scratch, (2) build a separate gamification framework around the existing simulation, and (3) integrate game elements into the existing simulation. In each of these situations it is crucial that the gameplay strategy supports the learning objectives to make the game an interesting and fun experience for the player (Kelly et al., 2007).

13.4.1 Design Elements

We can identify three major design elements for educational gamified simulations based on the observations in the previous section.

- Interactivity: This includes elements and activities which challenge players to actively interact with the simulation. This includes instructional missions, interactive challenges, and puzzle missions.
- Feedback: Feedback elements are triggered by user behavior and interactions with the simulations. They should help the user to find the correct solution or to get information about their performance.

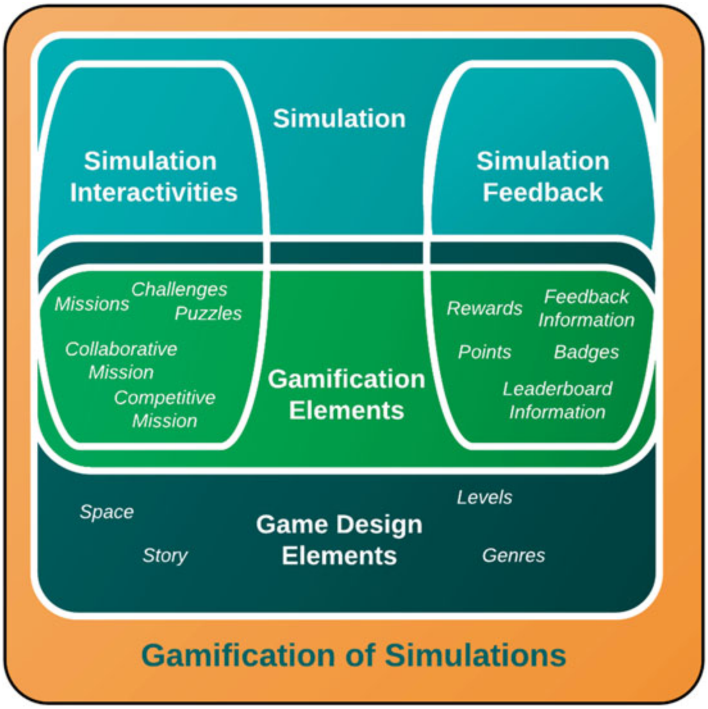


Fig. 13.5 Overview of the interactive and feedback elements used to gamify simulations

- Game Participants: This indicates how many players are involved in the game activities. The gamified simulations can be designed either for single player, competitive, or collaborative activities.

Figure 13.5 demonstrates the relationship between the interactive behavior and feedback possibilities of simulations and gamification mechanics (which are demonstrated as a selection of game design elements). The number of potential players can influence the gamification strategy by allowing for advanced feedback information in the form of leaderboards and high scores, and by allowing missions to be designed that involve group assignments, either in a collaborative or a competitive way.

13.4.2 Design Process

Based on these assumptions, we can define five major steps for the design process (see Fig. 13.6). First, the pedagogical goal is outlined and defined. Second, the interaction possibilities within the simulation are defined. Third, potential cooperative and collaborative strategies are specified. Fourth, feedback possibilities of the

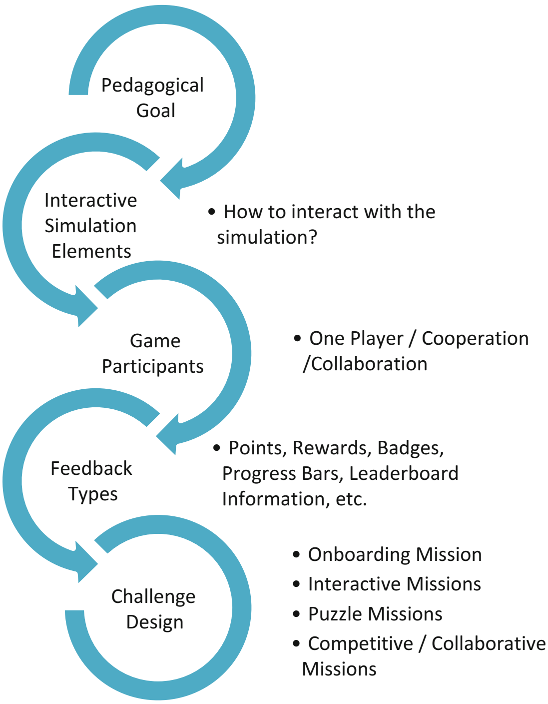


Fig. 13.6 Major steps used to gamify an educational simulation

simulation and missions are identified and linked to feedback types such as points, badges, or similar. In the last step the challenges are designed and linked to the feedback systems.

In the next section we will discuss how to apply the gamification elements and the gamification process in the three different strategies of gamification.

13.4.3 Gamification Strategies

We already defined the three possible strategies for gamifying educational simulations. It is possible to either start from scratch with the simulation design and apply gamification strategies to it at this stage, or to gamify an existing simulation. Here we can also differentiate between two strategies: In the first case, gamification mechanics and elements are directly integrated into the simulations. The second possibility is to integrate the simulation into an existing gamification framework or other tools or applications which support gamification strategies. In this paper we are especially interested in the process of adapting existing simulations and will describe the last two strategies in more detail. However, many of the processes and elements described above can still be applied to simulations which should be already designed in a gameful way. A simulation can be redesigned more gamefully without changing, redeveloping and redesigning it by adding more (i) interactive challenges, and (ii) a feedback system.

13.4.3.1 Integrate Game Elements into the Existing Simulation

Interactivities and feedback elements are directly connected to the simulation framework and can communicate with each other. This enables direct and immediate feedback which is an important aspect of learning success. To use this method, the simulation must feature an interface to directly communicate with the gamification framework, or must be adaptable to be directly capable of being integrated.

Interactive Challenges. Interactivities and according events can be directly linked to the simulation behavior. Missions or challenges, but also advanced interactivities with the simulation can be added directly to the simulation.

Feedback System. Feedback information and behavior corrections can be automatically triggered by simulation events. This enables direct and immediate feedback for an improved learning experience.

Usually this integration requires programming knowledge, which reduces the ability of instructors to easily adapt the single elements, add additional content, or gamify a simulation without support.

13.4.3.2 Build a Gamification Framework Around the Existing Simulation

Issues such as adding missing simulation interactivities or missing interfaces to the simulation, or additional requirements, such as simple extensibility and adaptability require the designers to use other tools to support gamification mechanics. This requires a separate stand-alone tool for the gamification ideas. These tools should be manageable by the instructor.

Interactive Challenges. Even though a simulation does not provide the possibility of arranging playful interactivities with players, the instructor can still prepare different interactivities such as word problems, which force the students to interact with or observe the simulation.

Feedback System. Interactive challenges can be linked to an external pointing system. Based on this information, different gamification elements, such as rewards, leaderboard information, or badges can be applied.

These arrangements can be applied to different learning environments and are not limited to instant gamification platforms, online, or e-learning tools. The challenges and feedback information can be calculated automatically by tools such an e-learning system but can also be provided personally in-class by the instructors.

An advantage is the adaptability that is also possible for instructors without programming knowledge. However, the system does not provide immediate feedback on simulation activities. The user behavior within the simulation cannot be observed and assessed or corrected using feedback. This strategy is suitable for simulations which offer limited interaction possibilities with the user.

13.5 Case Study: Gamified TEALsim

One example of our own research is based on the simulation framework TEALsim. It is a java-based open-source framework for creating physical simulations in the area of electromagnetism and was developed at the Center for Educational Computing Initiatives at the Massachusetts Institute of Technology (TEALsim Website, 2004). TEALsim allows users to create new simulations (Fig. 13.7, left shows a simulation of Faraday's Law) or simulations games (Fig. 13.8 shows a pin ball based game with charges)

In the next section we discuss the application of the gamification strategies with the related elements and the process on one selected simulation of the TEALsim framework.

13.5.1 Integrate Game Elements into the Existing Simulation

To add interactivities and related feedback methods, a TEALsim simulation demonstrating Faraday's Law was used, which allows user input in the form of moving the magnet. Figure 13.8 shows the original simulation.

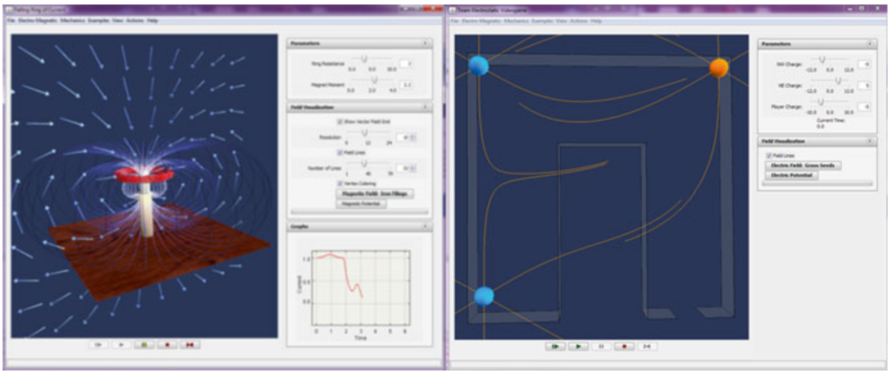


Fig. 13.7 *Left*: a simulation of Faraday's law. *Right*: a simulation game based on pin ball

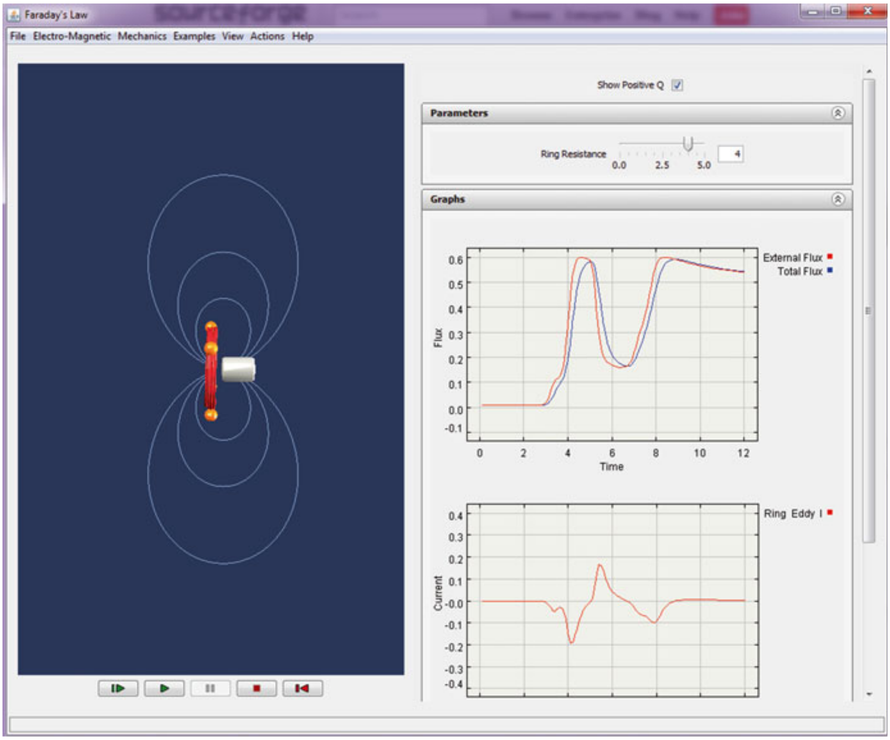


Fig. 13.8 Original TEALsim simulation of Faraday's Law

Based on the gamification process model the single steps of the gamification process (see Figure 13.6) are outlined:

1. Defining a pedagogical goal: The student should learn the first principles of Faraday's Law and should learn about current and flux in this context.
2. Identifying interactive simulation elements: The user can move the magnet or the coil and change the resistance of the ring. Over time the simulation delivers information about flux and current as output on the graphs.
3. Game participants: The gamified simulation will be designed for one person challenges. However, the interactions and possible missions would support both collaborative and competitive challenges.
4. Feedback types: The simulation is a rather small one, and its pedagogical goals are also accomplished in a short time. Only progress information and notification about finished challenges are integrated.
5. Challenge design: One small onboarding mission to familiarize the user with the possibilities of interaction. Other missions include small quizzes which require the user to work with the graphs and the ring resistance settings.

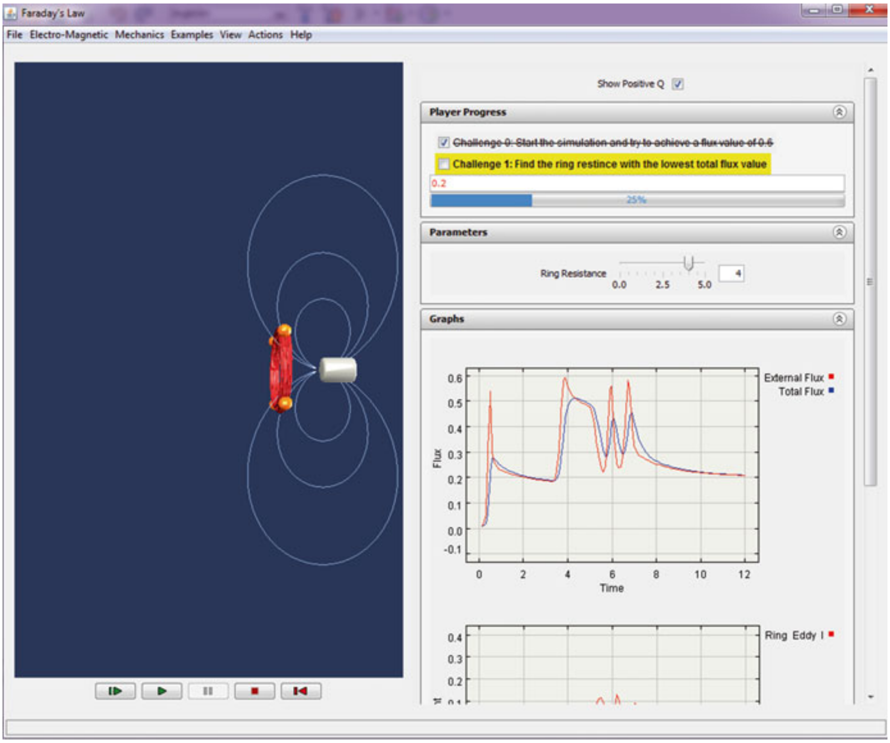


Fig. 13.9 TEALsim simulation with integrated player interaction behavior

Figure 13.9 shows the advanced Faraday's Law simulations which integrated a player progress module on the upper right, which informs the user about his progress and communicates new challenges and missions.

This small simulation could be one of many in a series of simulations demonstrating and teaching Faraday's Law. Further feedback types such as badges could be used to reward the user after they have successfully completed the task.

13.5.2 Build a gamification framework around the existing simulation

The concepts stated above can also be used to gamify simulations without adapting the original code, or using an interface for the simulation. Direct interactions are not possible but the missions can be integrated into an online system such as the learning management system Moodle, which supports progress representations, points, and also reward systems such as badges.

13.6 Conclusions

Most pedagogical experts and game designers agree with the statement that games have high potential for teaching new concepts and can make learning fun. Koster (2004) even states that "*with games*, *learning is the drug*". Based on the example of very successful gamified scientific simulations such as FoldIt, we have learned that gamification strategies can be a good way to adapt scientific simulations and processes to make them more motivating and engaging, and to attract larger user groups.

When developing a gamified simulation it is important to focus on the interactive aspects in order to attract the user's attention. In contrast to traditional simulations, it is not only the user who should interact with the simulation. Instead it is equally crucial that the simulation motivates the user through constant interaction and feedback possibilities.

Many frameworks support the embellishment of different applications with gamification strategies. However, especially in educational scenarios it is important to avoid losing the focus on the main educational objectives and to create game mechanics such as missions, which are both fun and educational.

In this chapter we have discussed the single elements that are important when creating educational simulations which are both fun and of pedagogical value. Furthermore, we have described a step-by-step process for combining these elements to create simulations without losing sight of the pedagogical goal. This model was particularly designed for science simulations and is strongly dependent on the interactive elements of the simulation. However, the model can also be applied to other areas if a clear pedagogical goal exists and if there is the possibility of interacting with the application.

Acknowledgements We would like to thank the CECI at MIT for initiating this research. Special thanks to John W. Belcher and Phil H. Bailey for their valuable expertise in pedagogical simulation design. We would also like to acknowledge the anonymous reviewers for their constructive feedback.

References

Adams, W. K., Perkins, K. K., & Wieman, C. E. (2006). PhET look and feel. Retrieved August 13, 2013, from http://phet.colorado.edu/web-pages/publications/PhET.

Adams, W. K., Reid, S., LeMaster, R., McKagan, S. B., Perkins, K. K., Dubson, M., et al. (2008a). A study of educational simulations part I: Engagement and learning. *Journal of Interactive Learning Research, 19*(3).

Adams, W. K., Reid, S., LeMaster, R., McKagan, S. B., Perkins, K. K., Dubson, M., et al. (2008b). A study of educational simulations part II: Engagement and learning. *Journal of Interactive Learning Research, 19*(4).

Aldrich, C. (2009). *Learning online with games, simulations, and virtual worlds*. San Francisco: Wiley.

Avedon, E. M., & Sutton-Smith, B. (1981). *The study of games*. New York: Wiley.

Becker, K., & Parker, J. R. (2011). *The guide to computer simulations and games*. Indianapolis, IN: Wiley.

Bell, R. L., & Smetana, L. K. (2008). Using computer simulations to enhance science teaching and learning. *National Science Teachers Association, 3*, 23–32.

Brathweite B. & Schreibe I. (2009) Challenges For Game Designers. Boston: MA. Charles River Media.

Christian, W., (2005). Davidson College WebPhysics server. Retrieved August 13, 2013, from http://webphysics.davidson.edu/Applets/Applets.html.

Cooper, S., Khatib, F., Treuille, A., Barbero, J., Lee, J., Beenen, M., Leaver-Fay, A., Baker, D., Popovi´c, Z., & Foldit Players. (2010) Predicting protein structures with a multiplayer online game. *Nature*. 2010/08/05.

Cooper, S., Treuille, A., Barbero, J., Leaver-Fay, A., Tuite, K., Khatib, F., Snyder, A.C., Beenen, M., Salesin, D., Baker, D., Popovic, Z., & 57.000 Foldit players. (2010). The challenge of designing scientific discovery games. In *Proceedings of the Fifth International Conference on the Foundations of Digital Games (FDG'10)*. ACM, New York, pp. 40-47.

Csikiszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: Experiencing flow in work and play*. San Francisco: Jossey-Bass.

Deci, E. L. (1975). *Intrinsic motivation*. New York: Plenum Press.

Deterding, S., Dixon, D. Khaled, R., & Nacke, L. (2011) From Game Design Elements to Gamefulness: Defining "Gamification". In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (MindTrek'11). ACM, New York, pp. 9-15.

Dori, Y. J., & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate Students' understanding of electromagnetism concepts? *The Journal of Learning Sciences, 14*(2), 243–279.

Foldit Website. (2012). Retrieved August 13, 2013, from http://fold.it

Gee, J. P. (2007). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Graham, S., & Weiner, B. (1972). *Theories and principles of motivation*. Oxford, UK: Markham.

Hake, R. (1988). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64–74.

Howard Hughes Medical Institute. (2010). Protein-folding game taps power of worldwide audience to solve difficult puzzles. Retrieved August 13, 2013, from http://www.eurekalert.org/pub_releases/2010-08/hhmi-pgt080310.php

Ibrahim, R., & Jaafar, A. (2009). Educational Games (EG) design framework: Combination of game design, pedagogy and content modeling. In *Proceedings of the 2009 International Conference on Electrical Engineering and Informations*. Selangor, Malaysia

Kawrykow, A., Roumanis, G., Kam, A., Kwak, D., Leung, C., Wu, C., et al. (2012). Phylo: A citizen science approach for improving multiple sequence alignment. *PLoS One, 7*(3), e31362. doi:10.1371/journal.pone.0031362.

Kelly, H., Howell, K., Glinert, E., Holding, L., Swain, C., Burrowbridge, A., et al. (2007). How to build serious games. *Communications of the ACM-Creating a Science Of Game, 50*(7).

Khatib, F., Dimaio, F., Cooper, S., Kazmierczyk, M., Gilski, M., Krzywda, S., Zabranska, H., Pichova, I., Thompson, J., Popović, Z., Jaskolski, M., & Baker, D. Crystal structure of a monomeric retroviral protease solved by protein folding game players. *Nature Structural & Molecular Biology*. Retrieved September 2011, ISSN 1545-9985. doi:10.1038/nsmb.2119 DOI:10.1038%2Fnsmb.2119 . PMID 21926992.

Koster, R. (2004). *A theory of fun for game design*. Sebastopol, CA: Paraglyph Press.

Lunce, L. M. (2006). Simulations: Bringing the benefits of situated learning to the traditional classroom. *Journal of Applied Educational Technology, 3*, 37–45.

Laurel, B. (2008). *Design research: Methods and perspectives*. Cambridge, MA: MIT Press.

Malone, T. W. & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In: *Aptitude, learning, and instruction vol 3: Conative and affactive process analyses*.

Martens, A., Diener, H., & Malo, S. (2008). *Transactions on Edutainment LNCS, 5080*, 176–190.

Mayo, M. J. (2007). Games for science and engineering education. *Communications of the ACM-Creating a Science of Games, 50*(7).

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. London: Penguin Press HC.

OSP. (2003). Retrieved September 1, 2012, from http://www.compadre.org/osp/.

PhET. (2011). Retrieved September 15, 2012, from http://phet.colorado.edu.

PhET Simulation Design Process. (2013). Retrieved September 15, 2012, from http://phet.colorado.edu/publications/phet_design_process.pdf

Pirker, J. (2013). Virtual TEAL World. Master Thesis, Graz University of Technology, Februrary 2013.

Randel, J. M., Morris, B. A., Wezuel, C. D., & Whitehill, B. V. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation & Gaming, 23*(3).

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and New directions. *Contemporary Educational Psychology, 25*, 54–67.

Sanders, M. (2009). STEM, STEM education, STEMmania. *The Technology Teacher, 68*(4), 20–26.

Schell, J. (2008). *The art of game design: A book of lenses*. Burlington, MA: Elsevier/Morgan Kaufmann.

Squire, K., Barnett, M., Grant, J. M., & Higginbotham, T. (2004). Electromagnetism Supercharged!: Learning physics with digital simulation games. In: *Proceedings of the 6th International Conference on Learning Sciences*.

TEALsim Website. (2004). Retrieved August 15, 2013, from http://web.mit.edu/viz/soft/visualizations/TEALsim/index.html

Teed, R. (2012). Game-Based Learning. (Science Education Resource Center Carleton College) Retrieved September 15, 2012, from http://serc.carleton.edu/introgeo/games

Thompson, C. (2011). How Khan Academy is changing the rules of education. *Wired Magazine, 126*.

Vallerand, R., Pelletier, L., Blais, M., Briere, N., Senecal, C., & Vallieres, E. (1992). The academic motivation scale: A measure of intrinsic, extrinsic, and amotivation. *Educational and Psychological Measurement, 52*, 1003–1017.

Van Eck, R. (2006). Digitial game-based learning. It's not just the digital natives who are restless. *Educause Review, 41*, 16–30.

Windschitl, M., & Andre, T. (1998). Using computer simulations to enhance conceptual change: The roles of constructivist instruction and student epistemological beliefs. *Journal of Research in Science Teaching, 35*(2), 145–160.

Wired. (2012), Wired: New videogame lets amateur researchers mess with RNA. Retrieved January 12, 2014, from http://www.wired.com/wiredscience/2012/07/ff_rnagame/

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Chapter 14
From Market Place to Collusion Detection: Case Studies of Gamification in Education

Pinata Winoto and Tiffany Y. Tang

14.1 Introduction

During CHI 2011, a number of researchers attempted to define gamification (Deterding, Khaled, Nacke, & Dixon, 2011; Jacobs, 2013; Lee & Hammer, 2011). While most of these definitions have focused on the use of such game elements as game mechanics, attributes, game-thinking, and many others in non-game environments. Jacobs (2013) and Bunchball (2010) point to an additional key aspect of elements that should be prioritized: to influence player behaviors, which has been widely adopted in the business community to build customer community and loyalty, improve customer engagement, reinforce brand identity, and many others at various levels (Bunchball, 2010). Gartner pointed out that more than 50 % of businesses will use gamification as the driving mechanism to transform business operations by 2015 (Burke, 2011).

With the success of gamification in business, educators also have started to consider gamifying the learning environment (Domínguez et al., 2013; González & Area, 2013; Raymer, 2011; Simões, Redondo, & Vilas, 2013). Reward systems (including trophies, badges, experience or reward points, etc.) and leaderboards are the most commonly found game dynamics implemented in these studies (Domínguez et al., 2013; Simões et al., 2013). Mixed results were reported in (Domínguez et al., 2013) that documents student engagement for a university-level course. While gamification encourages learner interest and participations on one hand, on the other hand, it failed to improve the cognitive performance of some learners. That is, there is no direct correlation between learner academic performance and their involvement in the game-like activities. Simões et al. (2013), González and Area (2013) and Raymer (2011) present the design guidelines and suggest key rules while

P. Winoto • T.Y. Tang (✉)
Department of Computer Science, Kean University, Wenzhou, China
e-mail: pwinoto@kean.edu; yatang@kean.edu

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_14

gamifying learning and teaching. A recent book by Kapp (2010) probes in greater details into the many aspects of game dynamics, explores the design theories such as the cognitive apprenticeship to support the instructional use of games, and highlights the many advantages of the use of gamification in learning and instruction.

There is no doubt that gamification in education has the potential to encourage learner participation and engagement, trigger learner interest and induce more fun during the learning process. But gamification in education is not to simply adopt game mechanisms such as leader-boards and reward systems as largely implemented in (Domínguez et al., 2013; Simões et al., 2013). In fact, it is far from that as criticized by Robertson (2010) who pointedly argued that 'games ≠ points'. Poorly or inappropriately designed learning activities lead to the overall failure of gamifying the classroom. Although Domínguez et al. (2013) did not explain why the system failed to facilitate learner performance (the ultimate goal of any educational systems), a lack of integrating more game dynamics directly into the learning activities might be the main reason. Because points, levels, badges, rewards and player status might directly or indirectly force learners to pursue the goal of achieving these instead of paying more attention to the learning process itself. Besides, not every learner will find it appealing to engage in game-like environments (Domínguez et al., 2013). The learning experiences and pedagogy should not be suppressed during gamification. Unfortunately, to the best of our knowledge, there are few empirical studies which look from inside the learning activities to study the intrinsic behaviors and attitudes of learners, which motivate our studies. Specifically, we will present several case studies that spanning over the past several years on the impact of the game-play dynamics and game mechanics on maintaining group behaviors and dynamics.

Since the case studies differ in the purpose on which each serves, the mechanisms and the environment in which gamification is designed and implemented are different:

1. Case Study One attempts to observe the price of helps and how social rewards can drive competition among learners as intrinsic motivation to facilitate learning;
2. Case Study Two continues to working on Case Study One to look into how the competition and collaboration against the same team can have an impact on fair play between teams;
3. Case Study Three explores how a simple reward-point formula can be used to encourage fair-grouping;
4. Case Study Four creates a market place for group of learners to trade in their programs in an attempt to understand learner groups' behaviors from the behavioral economics' view; and
5. Case Study Five attempts to deter group plagiarism and collusion in the gamification environment.

The theories drawn to implement gamification mechanisms in our studies include game theory, behavioral economics and social psychology.

This chapter is organized as follows. In the next section, we will present the five case studies, including brief discussions on the obtained results and related works. Lessons learned from all five cases will appear in section 3. Section 4 concludes this chapter.

14.2 Case Studies

14.2.1 Case Study One: Peer Tutoring (The Price of Helps)

In this study, we conducted three separate yet related experiments to examine how willful learners help. In each experiment, a programming task with different difficulty level is given to each group to complete. For example, in task 1, group of learners were asked to design a simple game using Visual Basic.NET (the user interfaces of the game are shown in (a–e) of Figs. 14.1 and 14.2). In order to study how willful they help, 20 % of their marks will be drawn from their participations in a discussion forum where helps and answers will be valued higher than questions.

In the setting, each learner is allowed to seek help from other learner(s) to solve some programming tasks. Each helpee is required to acknowledge his/her helper(s) by recording their name. If several learners work together in a group, each may record all other group members as his/her helpers. As the rewards for the most helpful learners, they would receive "insurance" points, which could be used to guarantee their minimum score in midterm/final exams, that is, a minimum "C+" grade would be given when their exam score is below a "C+". Figure 14.3 shows the average number of helpers and the ratio of helpee seeking help from others in a class of 53 learners after 8 consecutive in-class practices.

Each practice could be finished within 20–50 min depending on learner programming skills, while the allocated time is 60 min. Learners who have finished the practice before the class ended may choose to leave the class or help others.

Figure 14.3 illustrates results showing the number of helpers and the ratio of helpees during the 8-week learning period. We conclude that both the ratio of learners looking for help and the number of helpers for each helpee are increasing over time, which are between 0.5 and 0.85 and between 1.7 and 2.5, respectively. This phenomenon is intuitive because more learners felt comfortable of asking help and helping others over time. However, the most helpful learners (that is, six learners who helped others more than 16 times in total) are top learners who do not need insurance at all. It appears that they were not driven by the insurance of grade "C+", but other aspects, such as altruism, pride, reputation, friendship, or others. On the other hands, weaker learners mostly fall into the helpee group because they might not be able to finish the tasks on time and therefore gained less reputation than the helpers. Among those 53 learners, 7 learners neither seek help from others nor help others. And among those 7 "solitary" learners, only one participated in all practices,

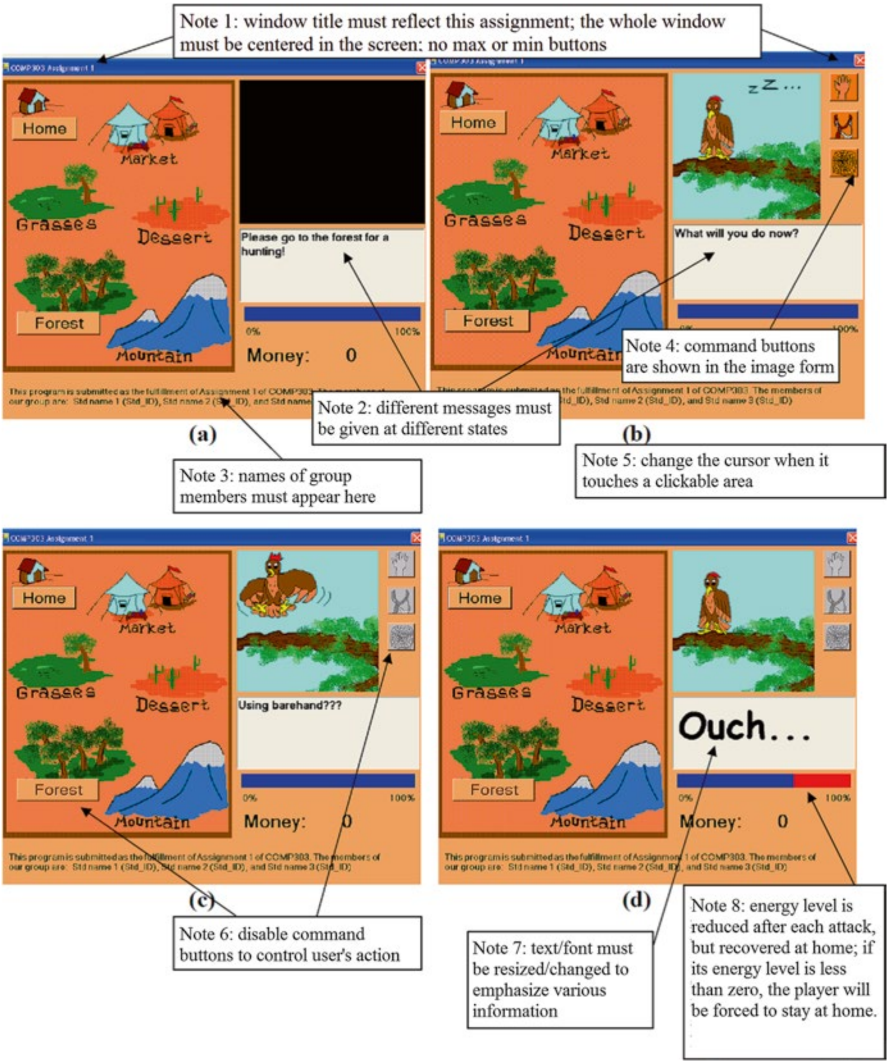
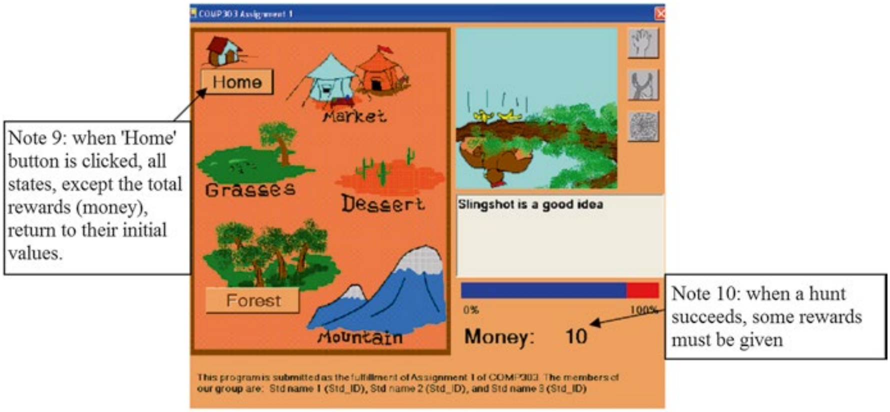


Fig. 14.1 The game interface (1)

while the rests only participated occasionally (4 learners had attended less than four times during the 8-week program). Hence, near 90 % of active learners (had attended at least 50 % of the classes) had either helped or seeked help from other(s) in at least one occasion.

From some of the most active helpers, we plot their helping trends shown in Fig. 14.4. Apparently, they were very active in the 5th and 6th week. The primary factor affecting this pattern is due to their ability to solve the tasks earlier than others (note: CH. Koh and JH. Hwang were mostly working in the same team in



(e)

Fig. 14.2 The game interface (2)

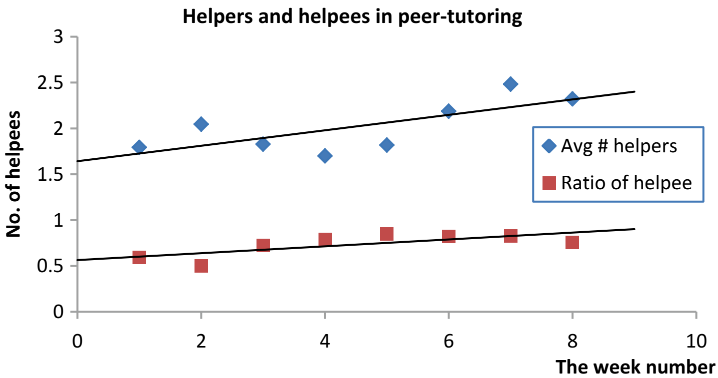


Fig. 14.3 Helpers and helpees in peer-tutoring

Fig. 14.4), which depends on the difficulty level of weekly problems. This trend is consistent for all six top helpers, which suggest a stable trait among helpers.

14.2.1.1 Discussion

Peer-tutoring program inside classrooms has been widely promoted since long time ago, in which it works best when learners with various skills or abilities are working together (Gartner & Riessman, 1994; Kunsch, Jitendra, & Sood, 2007; Topping, 2008). Earlier research stated that peer helps might be motivated by rewards including monetary, academic reward such as class credits (Greer et al., 1998); however, helps were largely established through agents and knowledge matchmaking; and the focus has been on the benefits of peer helps in problem-based learning and extrinsic

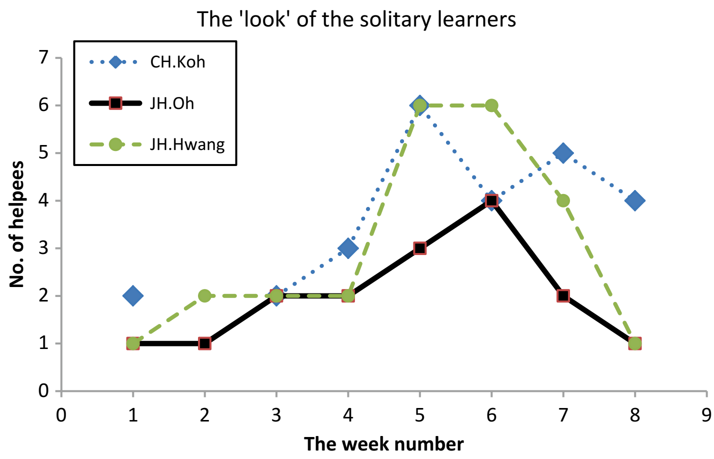


Fig. 14.4 The number of helpees of top solitary learners

motivation of peer helps, and not on the intrinsic motivation (Chan & Chou, 1995; Constant, Sproull, & Kiesler, 1996; Greer et al., 1998; Johnson, 2002; McLean, 2004; Terrion & Leonard, 2010). Lepper and Hodell (1989) dealt with intrinsic motivation and suggested four methods to enhance intrinsic motivation, two of them are what motivates one of our studies here: designing challenging class activities for learners to complete so as to indirectly identify learners with competitive skills and engage learners in a series of fantasy games. In our simulated study, we conclude that learners may be motivated to help others using social incentive (pride, fame, friendship, etc.), which drives competition among helpers. However, it will take some "playing" rounds before it could motivate them work in this setting. Also, a small fraction of learners may prefer to work alone, primarily due to their personal characteristics, which may reduce their engagement in peer-learning activity.

14.2.2 Case Study Two: Pairwise Competition on Programming Tasks

Competition and cooperation in learning has been fruitfully examined in a number of previous studies, among them Lawrence (2004), Regueras et al. (2009, 2011); Regueras, Verdú, Verdú, and de Castro (2011), Muñoz-Merino, Molina, Muñoz-Organero, and Kloos (2012), and Cantador and Conde (2010). Regueras et al. (2011) employed a wikispace for the collaboration part while a series of contest for the competition part, and results showed the blended methodological approach motivates learner participations, as also reported in Lawrence (2004). Muñoz-Merino et al. (2012) documented the use of a series of tournaments alternately through both inter-group competition and intra-group collaboration; unfortunately evaluation studies were not conducted. Although Regueras et al. (2009) integrated competition in class activities, the experiments are not sufficient to demonstrate the effectiveness of competition, especially with respect to learning outcomes; that is, there is no direct correlation regarding learners' academic performances with the scores obtained from the competitive games. Cantador and Conde (2010) argued that although competitive learning has the potential to motivate learners and improve learners' overall academic performances, the focus of the competitive elements should be on the learning goals instead of the competition itself. While these earlier efforts recognized the importance of integrating both collaboration and competition, there are few studies peeling from inside the competitive and collaborative groups and examined the effect of a learner competing and collaborating with the (same) other learner. In this section, we briefly discuss the design of this case study and show the initial results of it.

Learners are divided into groups of two, and asked to solve four test problems and four practical problems. The first problem is a test problem, which is followed by a practical problem, then by the next test problem, and by another practical problem, and so on. Each pair of learners competes in solving the test problem, but collaborates to solve the practical problem. The winner of test problem will get 5 points, and the loser will receive zero. And the winner must help the loser in solving the subsequent practical problem. Only after the problem solved, both will get 20 points and they proceed to compete on the next test problem, if any. They must solve all problems consecutively, and the way to solve practical problems is indeed the common practice in pair-programming paradigm. However, unlike in the common pair-programming practice in which a turn-taking is used to decide who is the helper (or observer) (Williams, 2011; Williams, Kessler, Cunningham, & Jeffries, 2000), in this classroom setting we used competition to decide it. The purpose of competition is to maintain the balance of learning outcome and to motivate learner's participation, where the stronger learners are expected to give opportunity to and help their peer to learn better. As an incentive to induce competition, a maximum of 20 points is provided from four test problems. However, since all pairs are formed by learners themselves, we are aware that some of them will adopt egalitarian principle to share the points (Erdal & Whiten, 1996). Figure 14.5 illustrates the tasks and their rewards respectively.

The results of our implementation are as follows: 8 out of 13 pairs split the competition reward evenly at 2:2 (won twice lost twice). Three pairs split the reward at 3:1, and only in one pair at 4:0 (a stronger learner won all four test problems). Another pair's result is 2:1 because they fail to finish the third practical problem which makes them not able to proceed to solve the last test problem.

While the majority of pairs seems to adopt egalitarian principle to split the reward, around a quarter of learners had taken the competition seriously. Indeed, the evenly split reward might be the result of a fair competition, that is, there is a 50 % chance $((4!/2!)/4! = 0.5)$ to get this outcome when learners are equally good in solving test problems. Given this chance, about four pairs of them might compete fairly or we may speculate that the total of 9 pairs out of 13 had actually competed fairly, which is not a bad result. It is common for learners to compete for a higher mark.

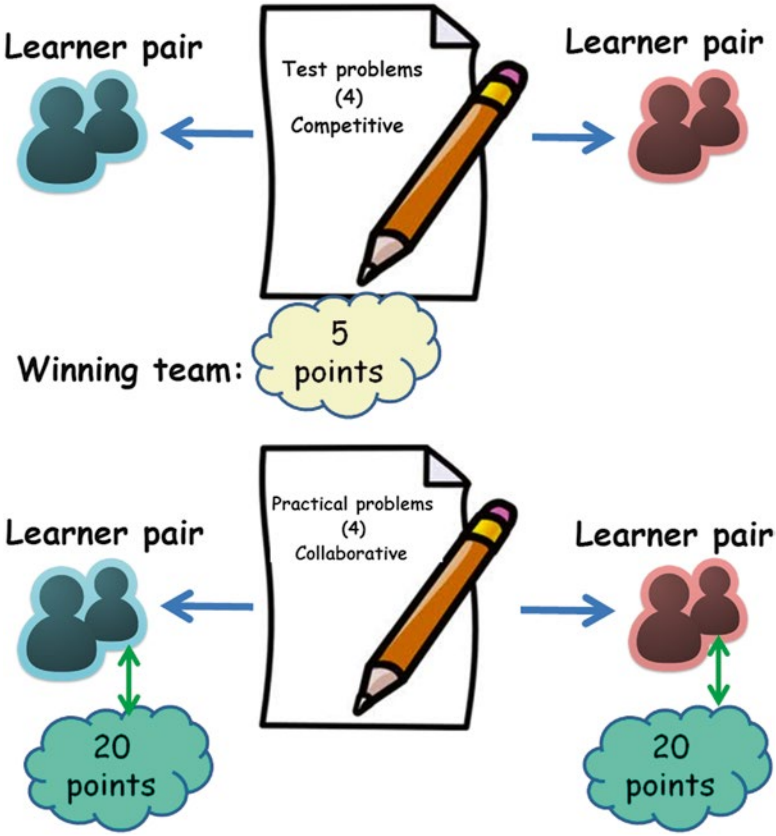


Fig. 14.5 The collaborative and competitive group tasks and their corresponding rewards

However, competing and collaborating with the same person(s) at the same time is what we hope our learners to taste and has rarely been studied. However, it is unclear how the mechanism will affect learner performance both as a whole and individually. More experiments need to be conducted to answer this question.

14.2.3 Case Study Three: Fair Grouping Issue

In a team project, learners tend to choose peers with similar characteristics; for instance, smart learners are more likely to pair with other smart learners, which is known as "the reflection problem" (Manski, 1993). This phenomenon may cause 'unfair' feeling among weak learners toward the grading criteria, similar to the Matthew effect: the rich get richer, the poor get poorer (Rigney, 2010). To remedy the problem, instructors may assign the group members, yet, in some situation this approach may impede the learning progress of smart learners to their sub-optimal level, especially when they are assigned to work with those they would not collaborate with in the first place. In order to provide freedom to them while reducing the unfair grouping, in our third setting we adopted the following linear formula to adjust the group points:

$$Adjusted_G = base_G + \frac{(100 - base_G) \times earned_G}{100}$$

Where G is the set of group members, $earned_G$ denotes the points [0, 100] earned by this group, and

$$base_G = 100 - \frac{\pounds_{i \in G} Prev_i}{|G|}$$

where $Prev_i$ refers to the previous points of member i.

Given this formula, the smarter the group members, the higher their average individual test points, and the lower their group base points. Conversely, the weaker the group members, the higher their base points; hence, the higher their chance to remedy their point. Therefore, we are not only facilitating weaker groups to earn higher points, but also providing incentive for smart learners to be in the same group with weaker learners.

However, from our implementation in two classes in Korea we only observe a small fraction of smart learners willing to accept weak learners in their group. So far, only one group had successfully blended two 'smart' learners with two 'weak' learners and achieved exceptional performance in the end in terms of team spirit and project outcome. In the other groups, only 'smart' learners solved the problem, leaving 'weak' learners as free riders or doing trivial jobs such as printing, binding, testing, etc. Nonetheless, weak learners feel more comfortable under this marking scheme and none of them complained about the unfair marking issue since the policy was implemented. To avoid unreasonable free-riding behavior, we allow a group leader to 'expel' her/his member under condition that s/he could prove that the 'free-rider' had not fulfilled his/her assigned duties resulting in an irreparable damage to the team project. In such case, we usually will assign the expelled members an individual work to substitute their group project. Knowing such unfavorable situation, only a handful of learners were expelled in our past experience, mainly because they had dropped the class!

14.2.4 Case Study Four: Simulated Market (An Outsourcing Game)

This simulation is part of Software Project Management class when the author taught at a university in Hong Kong. In this setting, learners are divided into several groups and each group plays both roles as an outsourcer and software developer.

As an outsourcer, the group will be endowed with certain amount of points transferrable to developer(s) for implementing the proposed project (in terms of software requirements). The transferrable points (represented as the outsourcing fee which could be converted into points later) are determined in an open auction, where multiple outsourcers meet multiple developers and negotiate the outsourcing price. When a developer could deliver the software on time (or earlier) some bonus points will be given to the outsourcer. In addition, the completed project itself will be evaluated to earn points. Hence, it is the outsourcer's interest of looking for a good developer with the lowest price, and the developer's interest would be to get as many orders as possible from outsourcer(s).

In order to provide more information to both outsourcers and developers, we allow all parties to meet and market their proposals and their programming skills. Such opportunity could also be used to reduce the market friction, so as to maximize its efficiency. From an experiment conducted, only two groups of developers successfully reach agreement with two outsourcers, while more than ten other groups failed to negotiate their developing costs. The two main reasons are, 1) an excessive demand by developers in accepting the contract; 2) a lack of trust by outsourcers in the ability of developers. After all, they were all learners who had known each other about their skills.

Regardless of a small number of successful transactions, the simulation has achieved its primary goal of demonstrating the common outsourcing problems, such as the lack of trust between developer and outsourcers, which could be remedied by building a good reputation and accepting a lower developing fee. And in order to build reputations, the game should be extended to a longer time so as to allow each party to get to know each other and be ready to outsource.

14.2.5 Case Study Five: Preventing Cheating (Sharing Answers) During Exams

Among the many cheating deterrence strategies in classrooms including installing a small program called Remote Proctor (Bedford, Gregg, & Clinton, 2009), the use of essay question form exam (King, Guyette, & Piotrowski, 2009), employing a class mole created under an alias name by the class instructor him/herself (Christe, 2003), shorter test taking time (King et al., 2009), one of the easiest ways to prevent cheating during exams is to provide various problem sets (Bedford, Gregg, & Clinton, 2011; Chiesl, 2007); yet, the problem becomes harder in computer science classes than in others, because sometimes we may allow learners to access connected computer during the test or allow them to do it at home, especially for some complex programming tasks. To prevent them from sharing their answers with other(s) in an in-class exam, we will not inform learners of the number of different problem sets, leaving them in ill-informed state, and altering as least items as possible so that differences cannot be noticed easily. This can be done in programming problems; for instance, altering the code from "z = x − y + 1" into "z = x + y + 1" could not be easily noticed when there are more than ten lines of code. From our experience, cheating learners might notice it later after receiving their exam papers and compared them carefully with their cohorts. Usually, almost none of them would cheat again after being fooled by this strategy.

In order to prevent cheating on take-home exams, we tend to assign sharable bonus reward to those who submitted the exams earlier than others, where more reward could be received by each when fewer learners receive it—a zero-sum game (von Neumann & Morgenstern, 1944). The following formula is adopted to calculate the reward received by learner *i*:

$$r_i = \frac{t_i}{\sum_S t_s} \times R$$

where *S* is the set of all learners who have submitted their work before the deadline and their mark is greater than 60 %, t_i is the remaining time left from the submitted time of learner *i* to the deadline, and *R* is the total rewards. The reward can only be collected by learners whose exam scores are above 60 %. This is important to avoid submission of premature work.

It is clear here that the more learners submitted before the deadline, the larger the denominator, hence, the lower the reward by each learner. Also, the larger the value of t_i, the larger the value of r_i. Therefore, learners tend to have incentive to submit their work as earliest as possible and prevent others from submitting before the deadline, or, they have incentive to avoid sharing their work with others before the deadline. To avoid learners from sharing their work with others few hours before the deadline, we adopted a fuzzy deadline, for example, the deadline could be any time between October 10 and October 13, which will be decided randomly after October 13. Learners who submitted after the deadline will be penalized -20 each day. Given this scenario, most learners will submit their work on or before October 10 for the sake of rewards and to avoid penalty, but they may only share their work with others after October 13 to reduce the competition for the rewards; hence, increasing the risk for cheaters from waiting help from others.

We had adopted this setting in many occasions while teaching in Korea, yet, no verification of its effectiveness could be carried out due to that fact that we were not able to detect a violation, if any.

14.3 Discussions

From our previous experiences in classroom gamification, two important aspects should be taken into account when designing better gamification rules, especially in programming courses involving many group tasks. Firstly, some learners may not be truly ready for a 'fair play', that is, they may see winning the game as their main goal (above learning goal), which lead to the downplaying of the learning process. We have observed such behavior that some learners may deviate from seeking the truth of knowledge in order to win the game in our experiments. Secondly, to a certain degree, promoting collaborative activities among learners may improve learners learning outcome; yet, a careful evaluation should be taken to avoid 'unfair' grading due to 'the reflection problem' and other cheating forms.

Although Cantador and Conde (2010) pointed out the importance of implementing a fair or healthy game where an outcome should be trivial while the winning process should be stressed, there are few research efforts rigorously examine how to achieve it. As lessons learned from our experiments we suggest not attaching points earned from the game to the gameplay per se, but directly to the learning outcome. By doing so, learners may not have the chance to earn game points from other than achieving better learning outcome. If earning game points could not be directly attached to learning outcome, an indirect reward could be provided such as an insurance of getting a certain grade in an exam, obtaining the right to drop the worst assignment grade or being able to be late in submitting an assignment, etc.

The solution of the second problem is much more complicated than the first one due to many other external factors affecting the subjective view of 'unfairness' in the group tasks. For example, it is common that a group member complained that other group members were not contributing as much as him/her; thus, they should not earn the same mark, even the group was formed by learners themselves. Arbitration may not always be successful; and providing incentive to include weak learners is not a good solution either. Self-reporting mechanism about their individual contribution may not help much either because some learners may exaggerate their contributions while others may under-report it, which might lead to unfair evaluation. From our experience, it would be much more efficient to give all group members the same mark but allow them to expel the member who had severely damaged the group progress, and let them decide their individual tasks. At the end, we will pick and share some interesting issues from each group project in the class, and use them as the optional questions in the final exam. In this case, all learners in a group are forced to understand the whole issues since they might be asked to solve it in the final exam.

14.4 Concluding Remarks and Future Studies

There is no doubt that gamification in education has the potential to encourage learner participation and engagement, trigger learner interest and induce more fun during the learning process. But gamification in education is not to simply adopt game mechanisms such as leader-boards and reward systems. Instead, in order to prevent learners from simply pursuing the various game goals such as achieving certain levels, points, status or other goals, more efforts should be invested on the appropriate pedagogically designed learning activities to facilitate teaching and learning as a whole. Research findings drawn from such areas as game theory, behavioral economics and social psychology can illuminate design strategies of these activities. In this chapter, we presented several case studies that spanning over the past several years on the impact of the game-play dynamics and game mechanics on maintaining group behaviors and dynamics. More empirical studies in this line of research should be conducted in order to gain a more thorough understanding of both the benefits and drawbacks of gamification in education.

References

Bedford, D. W., Gregg, J. R., & Clinton, M. S. (2009). Implementing technology to prevent online cheating: A case study at a small southern regional university (SSRU). *MERLOT Journal Online Learning and Teaching, 5*(2), 230–238.

Bedford, D. W., Gregg, J. R., & Clinton, M. S. (2011). Preventing online cheating with technology: A pilot study of remote proctor and an update of its use. *Journal of Higher Education Theory and Practice, 11*(2), 41–58.

Bunchball (2010) Gamification 101: An introduction to the use of game dynamics to influence behavior. Retrieved January 10, 2014, from http://www.bunchball.com/sites/default/files/downloads/gamification101.pdf.

Burke, B., (2011) What's next: the gamification of everything. Retrieved January 10, 2014, from http://blogs.gartner.com/brian_burke/2011/01/27/whats-next-the-gamification-of-everything/.

Cantador, I., Conde, J. M., (2010). Effects of competition in education: a case study in an e-learning environment. In: *Proceedings of the IADIS international conference e-learning 2010*, Freiburg, 2010.

Chan, T., Chou, C., (1995). Simulating a learning companion in reciprocal tutoring systems. In: *Proceedings of the international conference on computer support for collaborative learning(CSCL'95)*, pp. 49-56.

Chiesl, N. (2007). Pragmatic methods to reduce dishonesty in web-based courses. *Quarterly Review of Distance Education, 8*(4), 203–211.

Christe, B. (2003). Designing online courses to discourage dishonesty: Incorporate a multilayered approach to promote honest student learning. *Educause Quarterly, 11*(4), 54–58.

Constant, D., Sproull, L., & Kiesler, S. (1996). The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organization Science, 7*, 119–135.

Deterding, S., Khaled, R., Nacke, L. E., Dixon, D., (2011). Gamification: toward a definition. In: *Proceedings of CHI 2011 Gamification Workshop,* Vancouver, BC, 2011

Domínguez, A., Saenz-de-Navarrete, J., Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J.-J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers and Education, 63*, 380–392.

Erdal, D., & Whiten, A. (1996). Egalitarianism and Machiavellian intelligence in human evolution. In P. Mellars & K. Gibson (Eds.), *Modeling the early human mind*. Cambridge, MA: MacDonald Monograph Series.

Gartner, A., & Riessman, F. (1994). Tutoring helps those who give, those who receive. *Educational Leadership, 52*(3), 58–60.

González, C., Area, M., (2013). Breaking the rules: Gamification of learning and educational materials. In: *Proceedings of the 2nd international workshop on interaction design in educational environments*, pp. 7-53.

Greer, J., McCalla, G., Collins, J., Kumar, V., Meagher, P., & Vassileva, J. (1998). Supporting peer help and collaboration in distributed workplace environments. *International Journal of Artificial Intelligence in Education, 9*, 159–177.

Jacobs, M., (2013) Gamification: Moving from addition to creation. In: *CHI 2013 Workshop on Designing gamification: creating gameful and playful experiences.*

Johnson, W. B. (2002). The intentional mentor: Strategies and guidelines for the practice of mentoring. *Professional Psychology: Research and Practice, 33*, 88–96.

Kapp, K. L. (2010). *The gamification of learning and instruction*. San Francisco: Pfeiffer.

King, C. G., Guyette, R. W., & Piotrowski, C. (2009). Online exams and cheating: An empirical analysis of business students' views. *J Educators Online, 6*(1), 1–11.

Kunsch, C., Jitendra, A., & Sood, S. (2007). The effects of peer-mediated instruction in mathematics for students with learning problems: A research synthesis. *Learning Disabilities Research & Practice, 22*(1), 1–12.

Lawrence, R. (2004). Teaching data structures using competitive games. *IEEE T Education, 47*(4), 459–466.

Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*, 2.

Lepper, M. R., & Hodell, M. (1989). Intrinsic motivation in the classroom. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 73–105). San Diego, CA: Academic.

Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. *Review Economic Studies, 60*(3), 531–542.

McLean, M. (2004). Does the curriculum matter in peer mentoring? From mentee to mentor in problem-based learning: A unique case study. *Mentoring & Tutoring, 12*, 173–186.

Muñoz-Merino, P. J., Molina, M. F., Muñoz-Organero, M., & Kloos, C. D. (2012). An adaptive and innovative question-driven competition-based intelligent tutoring system for learning. *Expert Systems with Applications, 39*(8), 6932–6948.

Raymer, R., (2011) Gamification: using game mechanics to enhance e-learning. eLearn Magazine. Retrieved January 10, 2014, from http://elearnmag.acm.org/featured.cfm?aid=2031772.

Regueras, L. M., Verdú, E., Muñoz, M. F., Pérez, M. A., de Castro, J. P., & Verdú, M. J. (2009). Effects of competitive E-learning tools on higher education students: a case study. *IEEE T Education, 52*(2), 279–285.

Regueras, L. M., Verdú, E., Verdú, M. J., & de Castro, J. P. (2011). Design of a competitive and collaborative learning strategy in a communication networks course. *IEEE T Education, 54*(2), 302–307.

Rigney, D. (2010). *The Matthew effect: How advantage begets further advantage*. New York: Columbia University Press.

Robertson, M., (2010) Can't play, won't play. Retrieved January 10, 2014, from http://www.hide-andseek.net/2010/10/06/cant-play-wont-play/.

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior, 29*(2), 345–353.

Terrion, J. L., & Leonard, D. (2010). Motivation of paid peer mentors and unpaid peer helpers in higher education. *International Journal of Evidence Based Coaching and Mentoring, 8*(1), 85–103.

Topping, K. (2008). *Peer-assisted learning: A practical guide for teachers*. Newton, MA: Brookline Books.

von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton, NJ: Princeton University Press.

Williams, L. (2011). Pair programming. In A. Oram & G. Wilso (Eds.), *Making software: What really works, and why we believe it*. Sebastopol, CA: O'Reilly Media.

Williams, L., Kessler, R. R., Cunningham, W., & Jeffries, R. (2000). Strengthening the case for pair programming. *IEEE Software, 17*(4), 19–25.

Chapter 15
Physical Skills and Digital Gaming: The Relationship between Basketball and an Augmented Reality Adaption

Andreas Hebbel-Seeger

15.1 Introduction

In the first instance "Gamification" and "Game-based-learning" or "Serious Games" are indicating different things. Gamification "is different to other concepts, such as 'serious games', which is concerned with the incorporation of non-entertainment elements into game-environments (Liu et al., 2011) where a task is incorporated into the game so that the task is accomplished (Oja and Riekki 2012, p. 138)" (Wood & Reiners, 2012, p. 102). In the sense of Gamification game principals and game elements were particularly used for motivational reasons. They should support the engagement within tasks or should support the coping of tasks on a preferably high level of activity while the target group hasn't any or not enough intrinsic motivation to do so. Application designers are taking"the motivational properties of games and layers them on top of other learning activities, integrating the human desire to communicate and share accomplishment with goal-setting to direct the attention of learners and motivate" (Landers & Callan, 2011, p. 421).

Thereby the work on learning objects is just one application option. Other options are focusing on administration- or management challenges, sporty workout or typical tasks within the framework of business like the work on an assembly line, data processing and so on.

But if learning should be conveyed through the use of game elements, beyond motivation psychology (see Hebbel-Seeger, 2012, 2013) it has to by clarified which other factors are effective. Especially questions about transfer and the transfer conditional variables are meaningful if digital applications are used.

A. Hebbel-Seeger (✉)
MHMK—University of Applied Sciences Media and Communication,
Campus Hamburg, Gertrudenstraße 3, Hamburg 20095, Germany
e-mail: andreas.hebbel-seeger@mhmk.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_15

15.2 Transferability between real and digital worlds

> "At first players always learn something about the game they play. Next to explicit and implicit rules, they aquire specific game skills. By playing regularly you just get better (Juul, 2005). But apart from these learning moments, computer and videogames are overstepping the framework of the game itself and can overspill into other areas of life" (Breuer, 2010, p. 13).

A connection in-between digital games and motor-driven abilities is usually explored in scientific studies of neurophysiology. Walter et al. (2001) examined neural activities of probands in a driving-simulator while Whright & jackson (2007) explored the neural activities and the learning success of test persons who needed to react on video projections of tennis rackets.

Rosenberg, Landsittel, and Averch (2005) and Rosser et al. (2007) showed that the use of digital games is connected to efficiency and quality in the context of endoscopic interventions by surgeons. The authors trace back this fact to the additional release of dopamine in the area of the striatum and the frontal cortex during game: both are areas which are connected to eye-hand coordination. By playing games of certain ability Rosser et al. state the possibility that nerve tracts can develop in a way which enhances eye-hand coordination and visual depth imagination to later on improve minimal invasive skills such as described in the example of learning skills by surgeons for surgical interventions.

Influences of digital games on sport motor-driven skills were reviewed for the first time by Fery and Ponserre (2001) using the example of golf. They observed a positive transfer shift from the digital game to the real golf drive movement caused and enhanced by the pre-given visualization in the digital form which prepared the test person by imaging the movement before its execution. This thesis is also represented by Witting (2010) who sums up different studies in following results: "Even if so many schemes of action which are presented in video games, are not consciously practiced by gamers, they can still be observed and absorbed as available action schemes" (Witting, 2010, p. 11).

Cassavaugh and Kramer (2009) prove a connection to the training of a digital driver's simulation and the driving performance of a car in the real world, while Dörrfuß et al. (2008) state a significant influence of training with the game "Wii-Sports Bowling" regarding the performance of novices in the context of real world bowling. The effect of the game is interpreted via the sensomotoric layer caused by the game-interface with focus on the event of full bodily control: "The fact that the Wii allows for the player to use a style of control which enables them to carry out a motion much like in the real bowling game put us in the position to employ it as a means of coordinative training" (Dörrfuß et al., 2008, S. 3).

The Same result is described by Sohnsmeyer (2011) using the example of table tennis. He also choose the game console "Wii" for his studies and observes, " that the engagement with digital table-tennis is leading to better reaction time. This result underscores the assumption of possible potential in digital games on subareas of anticipation skills" (Sohnsmeyer, 2011, p. 218).

Apart from the proof of transferability on the sensomotoric layer, Sohnsmeyer also detects a highly significant cognitive impact in terms of table tennis specific instructional knowledge and takes it as evidence for the plausibility of Fritz's (2011) model of transferability (comp. Sohnsmeyer, 2011, p. 218). This result match to the meta-analysis from Vogel et al. (2006) which reports a general advantage of games and interactive simulations for cognitive gain outcomes.

Also Miller, Tsui, Dearden, Wolthuis, and Stanley (2010) discover references for a transfer from digital gameplay to real world performance by the example of bowling in real world and on the "Wii" console. They not only compare a Wii-treatment-group with a control-group but also look on a real-world-Bowling-treatment-group asking for the role of efficiency and situation-dependency in digital learning. They came to the result, "the Wii group outperformed the regular group in terms of their bowling scores within their own medium, but when tested in regular bowling the Wii group underperformed the group trained in regular bowling" (Miller et al., 2010, S. 3).

Wiemeyer and Schneider (2012) also observe training effects in a study with experienced basketball players in the context of a real pitching training and virtual training with Nintendo's "Wii" console and the game "Sports Resort". In analogy to the results of Miller et al. Wiemeyer and Schneider confirm a specific domain related superiority in performance by the virtual training group vis-à-vis the real training group but the performance evens out in the real training situation: "The results show that there is on the one hand a general effect of virtual and real training on both real and virtual throwing performance. Furthermore, the VT [Virtual Training] group showed specific improvements in the VTT [Virtual Throwing Test], whereas the RT [Real Training] just caught up with the VT in the RTT [Real Throwing Test]" (Wiemeyer & Schneider, 2012, p. 68).

The authors, however, point out the fact caused by the lack of a control group that cannot be excluded and the observed effect is simply based on the repetition of the test and does not result from treatment. On the other hand, the results can be interpreted in such a way that the specific pre-experiences of all probands—all experienced basketball players—show that digital adaption is more effective in comparison to a short-term treatment of 5 weeks with 10 training units.

Apart from the perspective on transferability of digital games to real world perception and coordination skills, a lot of studies are exploring the sanitary constitution and influences on players. Gamberini, Barresi, Majer, and Scarpetta (2008) results on the base of a meta-analysis of relevant studies that there are two general effects in the context of "Healthcare" and digital games: "First they are entertaining. In contexts where health rehabilitation or health support processes can be painful or boring, computer games act as motivators. Secondly, computer games provide alternative worlds, which can be shaped on the target's needs, facilitating the development of adequate behaviors transferable in to the real world" (Gamberini et al., 2008, S. 139).

Wiemeyer (2010) notices in a meta-analysis: "Also the therapy of cancer, diabetes, asthma, burn-ups, cerebral injuries profit from Serious Games" (Wiemeyer, 2010, p. 252), even if he expresses his concerns that "the given studies rarely meet scientific quality criteria. Besides a lot of questions are open: Dose-Reaction-Relation, sustainability and useful setting" (ibid).

15.3 Transfer effects, transfer layers and forms of transfer

While most part of empirical studies in context of digital games explore the interdependency of virtual application to the real world, Araújo, Davids, and Serpa (2005) invert this perspective. The authors investigate in their study the relation between proficiency level of sailors and their decision making in a computer simulated sailing regatta. They observe a connection between the sailing skills and the proficiency level of the probands and the performance in the computer based sailing regatta, i.e. the ranking and time needed. Experienced sailors, so the result, use the given information about wind and competitors more successfully than unexperienced probands.

In reverse the authors assume that the future use of computer simulations in the field of professional sailing can bring a lot of advantages. An exemplary application is named by Araújo et al. in the field of talent recruitment and promotion because in the course of the investigation the novices who started to concentrate earlier on relevant sources of information where those who at the end became more successful than those who didn't.

According to the authors perspective, computer simulations can in addition be used to provide training in a safe environment and to avoid possible problems and restrictions of a natural environment while exploring the dynamics of decision processes. Furthermore, they assume an effect in specific and situated training situations and, by manipulating a training situation, an effect of setting the learners focus on the important source of information.

My own studies of sailing and the influence of cognitive exercise and practical decision taking (comp. Hebbel-Seeger, 2008) back up this supposition: It has been shown that the confrontation with a sailing simulation where the theoretical methods and approaches have been adapted to practical education for novices (comp. Hebbel-Seeger, 2006) have led to more successful performance in real-world sailing experience.

On the one hand those results correspond with Wiemeyer (2009) assumption "… that effects of transfer in sports primarily are to be expected on two layers:

- Sensomotoric or rather the perceptive layer (elementary performance)
- Cognitive layer (knowledge, decision and strategy)" (Wiemeyer, 2009, S. 123).

The basic action in the sensomotoric performance of sailing a boot can be considered to be elementary even though a coordination of elementary partial movement requires a) the positioning of body weight by sitting on the edge of the boat, b) the necessary impact on the tiller for guidance and direction and 3) influencing the position of the canvas so as to tighten and/or loosen the sheet. The simulation mediates the knowledge as to how those partial movements are to be harmonized such as orientation to the wind in a complex human-boat-environment relationship, applied to a strategic layer.

On the other hand, the results of the sailing study also can be interpreted in the way of Fritz's (1997) postulated transferability model making a differentiation of five transfer layers and ten possible forms of transfer. According to this, a transfer can basically take part on every five layers:

- Aspects of the real world are represented in the sailing simulation on the "fact-layer", where users can exemplary derives information about the setup of a sailing dinghy, given elements of navigation and right of way on the water.
- On the "script-layer" the user gains specific practical sailing knowledge with complex attributes which e.g., describes the interplay of the three basic steering elements on a sailing boat—comparably influencing driving, velocity and the upright of the boat and the direct and indirect piloting of a target.
- The difference of the "print-layer" compared to the "script-layer" is defined by "a restricted action depth and a short contextual anchoring" (Fritz, 1997, p. 234). It is about simple action patterns which support holding the upright position of the boat or performing basic maneuvers like turns and jibes (turning the boats across and with the wind).
- "While transfers on the script-layer are relatively based on precise schemes of actions, the metaphoric transfer is allocated on a more abstract layer. Scripts connected to direct experience were not directly transferred from the real world. They were used in a way of "as if" by a structural compliance.
- On the "dynamic-layer" the "direct impulse of action" is traced back to its "core": based on a basic orientation of action with validation in the real world just as much as in the virtual world because the basic patterns in its function, forms of action according human basic needs are autonomy, relatedness and competence" (Fritz, 1997, p. 237). In sports like sailing, where complex and situational variables are especially at the beginning constantly contributing to excessive demands to the learning process, a "safe" environment/space in a digital adaption can have a positive effect on the feeling of gained competences and autonomy in practical doing.

In regard of possible forms of transfer in the meaning of Fritz's (1997) model, the sailing simulation at first is laid out on "problem solving transfer" where the basic functions and interdependencies of the three elements of control (steering elements) in sailing sport—tiller, sheet and bodyweight—are not given but tasks to be worked out. Problems in the virtual world and corresponding developed solving pattern like piloting towards an aim in direction of the wind could be transferred to the practical sailing performance as mentioned in the study above.

An "Emotional transfer" might emerge if joy over the task in the virtual world is transferred to practical sailing. There are no valid results concerning this study at the moment. An "instrumental action orientated transfer" exists in the transfer of (symbolic) procedures from the virtual world to motoric movement in the practical sailing experience, e.g. in context of basic sailing maneuvers and "if—then" references.

While an "ethic-moral transfer"in general shouldn't be part of sport simulations, unless topics like fairness or tolerance in sport are affected by rules, an "associative transfer" happens when "perception in the virtual world converges with the perception of the real world" (Fritz, 1997, p. 238).

In this particular sailing simulation a "reality structured transfer" is targeted by transferring functional coherence like the use of specific control elements and the behavior of the boat explored in the virtual world and adapted to the practical sailing practice. The successful acting of the probands who experienced the treatment by the sailing simulation compared to the control group, is to be stated as proof. The same thing counts for the "informational transfer", e.g. by transferring knowledge, the naming and functions of equipment in the virtual world of the sailing simulation to the real world experience.

After all, the problem solving and "informational transfer" represent cognitive transfer performances. Nevertheless Fritz (1997, p. 238) introduces an additional layer to all the mentioned forms of transfer with the "cognitive transfer" which mainly addresses the aspects of memory and sustainability.

With "time-transfer" Fritz describes the shift of time-experiences e.g. based on a time pressure based urge to act from a virtual world to a real setting using the example of sailing sport which probably causes a relief in the practical experience if expected handicaps are already known.

The tenth and last form of transfer which is named by Fritz (1997) describes the "fantasy-related transfer". "Impressions in the game (elements, storyline, roles, actions and processes) are post-imagined in the own world of minds" (Fritz, 1997, p. 238). In the signifiance of a "Serious Game", the creative preoccupation with the learning asset, in particular if the imagination provides more "freedom", can be understood as a contribution to a wider perspective and can create new solutions, providing meaning to the real world.

Processes of transfer are not self-dynamic. "It's important for a player on the one hand to show willingness for transfer and on the other hand to accept it." (Sohnsmeyer, 2011, p. 61). "The Key driver" for successful transfer is based on the attention of a player in facing the event in a virtual world (Fritz, 1997): "The virtual world should catch my attention and trigger the impulse to "step inside"… The more this world captures my attention, the more this world catches my attention, … so much better is my readiness for a transfer (Fritz, 1997, p. 241f.).

The stimulative nature, casted by a virtual world, is determined by the own personal character whose individual and motivational disposition is addressed (comp. e.g. Hebbel-Seeger, 2012). Sohnsmeyer concretizes this example based on the genre of a digital game by stating it a prior-ranking role for the willingness of transfer (comp. Sohnsmeyer, 2011, p. 61). On the other hand the realization of a game, the realistic representation, the game mechanics (comp. Jantke, 2007) and the user-interface (comp. Limperos, Schmierbach, Kegerise, & Dardis, 2011) are crucial for providing the incentives for transferability and acceptance.

15.4 Theories of schemes as explanatory models for (sport motoric) transfers

> Cognitive schemes provide a basic aspect to the model of transferability. Schemes organize our sensual impressions, experiences and adventures so they can contribute to stable schemes of perception and action, based on reasonable experiences. Schemes therefore are cognitive structures summing up typical coherences in an area (Sohnsmeyer, 2011, p. 49).

In sport science the works of Schmidt (comp. Schmidt, 1975, 1994) were -in general - still on the leading edge. He solved the problems of capacity and variability with the model of generalized motor programs, that actions can't be analogically memorized (1:1) because of the amount of information, and observed variances during the act of performing stable movement skills which do not question the control of movement of a mental representation. In line with his scheme-oriented modeling Schmidt assumes processes of abstraction in which the identification of rule observance is based on and summed up in similar movement categories: "A Scheme is the characteristic of a population of objects which consists of a set of rules, which are applied as briefing for serving the creation of a prototype for this population." (Schmidt, 1994, p. 24).

A motoric memory stores what is needed to be done to achieve desired results under special preconditions. Here, the motoric memory is divided according to Schmidt (1994) into two units: The "Recognition scheme" contains the program (such as running, throwing, etc.) with the selection and combiantion of involved muscle bundles while the "Recall scheme" incorporates its parameters (which provides the necessary force). "Schmidt takes over these two states of memory from the psychology of memory by making a distinction between the active recall (recall) and the passive recognition (recognition)" (Künzell, 2002, p. 21.f).

Motorized sport skills require corresponding learning processes in which a human comes into contact with the environment and gets information from which he generates the necessary skills, knowledge of movement and the ability to perform. The knowledge about the "performance of movement … is only one aspect of the movement knowledge. Knowledge about the task, the setting, context and individual requirements represents other elements of the movement knowledge" (Munzert, 1992, p. 352). Only in this specification, which overcomes the postulated separation between perception and action, a connection capability regarding to the assumption of schemes in sports and a transfer-related modification of the same through a cognitive occupation within virtual realities, is possible, because "the cognition of certain environmental events and upcoming wishes and plans … 'automatically' [evoke] suggestions and plans, how a realization can be achieved "(Roth, 2001, p. 412.) this means there isn't a fully disconnected scheme for cognition and action, but in principle a continuity and compatibility in between both areas" (Fritz, 2011, p. 99).

Following the understanding of the term of information as Leist (1993) suggests in the context of movement and sports, information isn't only formed of small knowledge particles which "only" need to be absorbed by different channels of cognition. "Information" is much better described as "what a competent receiver" can understand from a message; or: … what can be understood and itself again can generate information" (Leist, 1993, p. 135). Hereby another analogy in the field of educational sciences can be drafted postulating Piaget's perspective: "While thinking is adapting to the given things, it is structuring itself and while doing so, it also organizes and structures the things" (Piaget, 1976, p.18).

According to Fritz (2011) this process needs an effort of abstraction beforehand: 'The specific situation with its abundance of details and peculiarities has to be tranformed to its patterns and structures which can be "weaved" in the neural net of the human brain. In other words: the stimulus effect will only be added, as he adjusts to what is already configured as a structure in the brain' (Fritz, 2011, p. 94).

Piaget hereby says that the shaping and adaption of action driven structures (schemes) is irrelevant whether based on physical or mental construction: "Any typed behavior—regardless of external action or internalized action—means and depicts for us an adaption or re-adaption" (Piaget, 1976, p. 6). Based on this, the modification of real world relevant schemes of cognition and schemes of action in context of virtual realities and the transferability between different worlds appears to be plausible.

15.5 Transfer and transformation

In this contribution Fritz's model of transfer (1997, 2011) in general represents more the heuristic model but a universally valid theory of transfer (comp. also Sohnsmeyer, 2011, p. 60). Hence, this approach seems to be suitable in describing and explaining the "diversity and complexity of the phenomenon "transfer" in conjunction to virtual gaming worlds" (Witting, 2010, p. 56) and as a sample for interpretation of interdependencies between reality and virtual worlds.

The starting point of a possible transfer according to Fritz (1997, 2011) is his expectation of different living environments in which humans act; next to the real world there exists the "dream world", the "gaming or playing world", the "mental world" the "media world" and the "virtual world" whereas over layering e.g. between "gaming world" and the "virtual world" is possible. Experiences and knowledge or therefrom abstracted schemes can also be transferred within and between the worlds. In context of motion and sport "Transference… can be described as positive interrelation between acquired action patterns and the application of those patterns in new contexts of motions and situations" (Hebbel-Seeger, Lietdke, & Lüssow, 2003, S.8).

Fritz speaks of "intramondial transfer" if a scheme transfer happens within a living environment:

> "If a human learned to develop schemes in the real world for specific situations which are helpful for acting, those schemes are amplified when similar situations appear more often. If a human is more often exposed to similar impulses, then he develops the tendency to act according the perceived scheme" (Fritz, 2011, p. 93).

Fritz describes the use of schemes beyond the limitation of singular living environments as "intermondial Transfer": 'Schemes which own validity and meaning for a specific world (e.g. the real world), [are] applied to another world (e.g. the virtual world)" (ibid). Such a transfer in general doesn't "only" happen from one to another instance but also owns the characteristics of interdependency. In particular users of digital games in the context of sport already own domain specific knowledge (e.g. rules) and context relevant schemes of cognition (e.g. interpretation of tactics) which can be used for virtual gameplay. At same time, the experiences in the virtual world are shaping modifications of previous imported schemes, which are modified and retroact into the real context: „The player of a videogame already owns a specific stock of knowledge from the common sense world before he enters a virtual world and which can be helpful during the videogame. During his stay in the virtual world, he will be enriched with canned knowledge (the player gets knowledge from the virtual world, e.g. strategy of acting, factual knowledge, use of input devices etc.). Occurences of transfer happens' (Wesener, 2006, p. 3f.).

Since the fundamental context of the intra- and the intermondial transfer differ from the setting the kind of circumstances a scheme originally has been acquired, the transferred entity needs to be modified to gain meaning in the other world when applied to a new (transfer) situation" (Kempter, 2009, p. 16); "For transferring, transformation is needed—especially in schemes of specific cases with characteristics, which are able to provide abstract structures to offer space for similarities. Only by such transformation a transfer between the worlds is possible because impulses from the one world to the other world are charged with meaning" (Fritz, 2011, p. 94).

Witting (2010) explores transferability of digital games via a questionnaire of the target group. She notices a huge intermondial potential of transferability caused by the high degree of interaction, while the players themselves are mostly aware of an intramondial transfer. "Upfront players reported about the transfer within the virtual gaming world between games of similar types: Virtual gaming worlds require a genre specific pattern of acting so one can successful act in the game" (Witting, 2010, p. 10). "The players express that they are developing specific cognitive schemes for a specific type of genre, helping them to set focus on the elementary aspects and the course of the game" (Witting, 2010, p. 13).

According to Fritz (2011) the depth of transfer for intramondial transfer is not as large in comparison to a transfer from one living environment to the other because the contextual similarities are larger. Accordingly the "adjustment of the transfer content to the equivalent shape of reality …, to harness knowledge and thus actions" (Wesener, 2006, p. 4) in the transfer process can turn out less. To this Witting's finding matches that player mainly verbalize the "more simple" intramondial transfer. A structural adaption "via transformation in the process of transfer happens as long as it evens out on a similar level" (specific level) fitting specific schemes (Fritz, 2011, p. 94). Fritz draws the conclusion that an "intermondial transfer in general only can succeed on a general abstract degree" (ibid). At the same time Fritz doesn't exclude a transfer on a higher level and sums up further transvariables with an open mindset: "Which transfers in which form can be realized in the process of the game is dependent on the game (and its scheme offer) and on the player, his structure, motivations, the rang and the differentiation of his schemes" (Fritz, 2010, p. 101).

Variables of a transfer in a virtual world can be seen as "moments of alikeness between virtual and real world" (Witting, 2010, p. 14). Those moments of similarity don't urgently need to emerge from a realistic visualization; nevertheless such visualization is potentially very helpful for guidance and orientation.

In fact those moments of alikeness can be created by specific interface designs e.g. improved motion controls in sport games (like game consoles Wii©, XboxKinect© or PS3 Move©), the adaption of real world control devices in the shape of steering wheels, joysticks, foot pedals for driving and flight simulations in analogy to the real world and like metaphors of space to "identify" and "assign" the choices of "acting "and "orientation" (comp. Hebbel-Seeger, 2011, p. 333). Nacke and Lindsey (2009) did an electroencephalographic measurement with gamers using a movement sensitive interface. They show that such an interface aided the feeling of action.

The embedment of virtual gaming elements in a real world setting as augmented reality application becomes relevant when both realities merge to new hybrid world. Moments of alikeness from a real world used in a virtual setting create a cognitive relief for the user because they create continuity and transport the internalized function of real world based objects enabling the player to get much better "immersed" into the setting in combination with interaction creating a sense of telepresence (comp. Slater & Wilbur, 1997; Pietschmann, 2009, p. 68ff.). "Telepresence therefore is described as profoundly positive feeling of immersion with a medium" (Huber, Hamprecht, & Heise, 2012, p. 43): "The player … gets into what is for him a very pleasant state quite quickly. He merges with the game and is completely absorbed by it" (Fritz & Fehr, 1997, p. 37).

> "That experience was "flow", first identified by Mihaly Csikszentmihalyi in die 1970s. Flow theory describes a very focused, energized, an effective mental state that takes place when a person is fully involved in an activity" (Edery & Mollick, 2008, p. 158).

Even if time, space and the moments of alikeness step into background during the state of "flow" the users are usually able to make the difference between the worlds they are located in and their matching action patterns. This ability of differentiation is called "framing competency" (comp. Fritz, 1997, 2004, 2011; Schmitt, 2011, p. 33). Gamers describe in interviews that framing competency potentially owns a repressive impact (comp. Witting, 2010, p. 16). Nevertheless Witting comes to the result that "the framing competency listed by users … doesn't basically prevent transfers but … [empowers] the player to create awareness for the clear distinction of the different worlds" (Witting, 2010, p. 16).

This assessment is congruent with Fritz's assumptions who assigns users of virtual worlds a "stable framing competency". "This doesn't exclude that transfers (more or less conscious) do happen" (Fritz, 2011, p. 158). "The detailed sequence of a transfer process and in particular the factors which suspend the controlling of transfer and the framing competency are yet not clarified" (Schenk, 2007, p. 237).

15.6 Intermondial transfer by the example of basketball

The question of intermondial transfer in the context of motion and sport is explored in a study using the example of basketball. The question which accompanied our experiment was to find out and prove the interdependencies between a specific performance in basketball, operationalized via the success of "penalty shots" and the performance in a digital adaption.

The digital adaption is designed as an augmented reality application ("AR Basktball" by Simiotica"[1] vers. 1.2.0) for iOS mobile devices.

[1] http://itunes.apple.com/de/app/arbasketball/id393333529?mt=8.

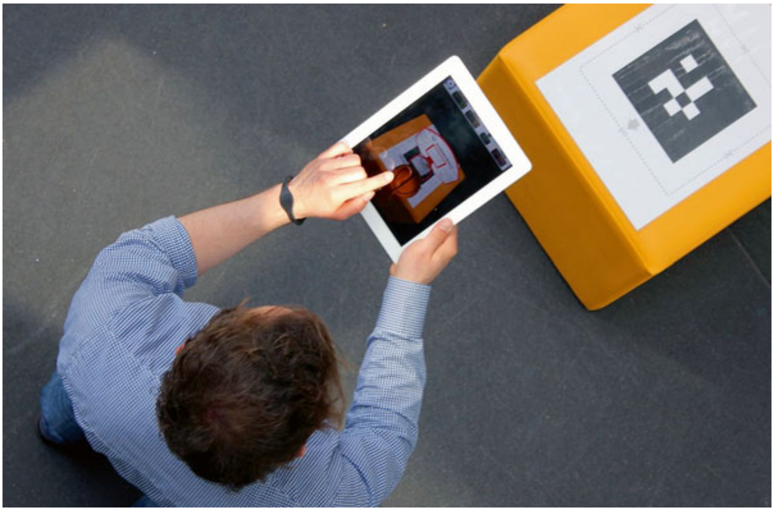


Fig. 15.1 “AR Basketball”—2D-marker and visualized basket on iPad

A basketball basket is displayed on the screen of the device by interpreting the external 2D-markers via integrated camera (see Fig. 15.1). The digital game adopts the game principle of the real world (aiming and shooting) and visualizes it adequately (especially colors and textures of the basketball and the appearance of the basket).

The motion of shooting is performed by a wiping gesture with the finger and serves only as symbolic reference to motion of the real world. The AR adaption of the basketball game provides a dynamic augmented virtual setting where the variables of distance, angle and velocity is always different according to the location of the player, determined by the 2D-marker. Those interdependencies are calculated into a physics-model which provides the simulation of a reality-close flying behavior of the basketball. The physics-model also calculates the proportions and rendering of the basketball and basket.

The aim of the study is the exploration of intermondial transferability of (throwing)schemes from the real to the virtual world. With the specific interface design, a user experience by the probands of nearly zero in combination with a relatively new technology device (iPad) and the AR adaption as new form of virtualization, the application “AR Basketball” were very well suited to this experiment. A possible intramondial transfer, means transfer of genre specific cognitive schemes (comp. Witting, 2010), therefore could be excluded from the study as far as possible.

In combination with real and virtual elements, interaction in real time and the registration of action in three-dimensional space, the application fulfills the three main criteria for augmented reality (comp. Azuma, 1997; Azuma et al., 2001). Within this augmented reality the game “AR Basketball” offers three different modes of game: “Training”, “Classic” and “Action“.

In the “Training Modus” the system counts all successful strikes in a period of 5 min. Distance and position to the marker is freely selectable. A display informs about the current score, a previously made high score and the running countdown. The training modus starts with the first throw of a basketball. The counting of score is only interrupted if the signal of the 2D marker is lost during the gameplay and it immediately restarts once the recognition of the marker is back again.

Compared to the “Training Modus” different throwing positions are predetermined in the „Classic Modus”. In addition the playground is divided into six zones corresponding to the position of the device and the 2D marker. A map at the bottom of the screen provides information about the current position and gives visual feedback when the correct location is reached. The task in classic modus is to perform three successful shots from each of the six zones. A time limit is not given but points are subtracted when performing a mission shot.

Also in the “Action Modus” different throwing position are predetermined. While the focus is set to pressure accuracy in “Classic Modus” (comp. Roth, 1993, p. 88) the performance in the “Action Modus” is defined by time pressure: The player can throw as many basketballs as possible within a timeframe of 20 s. The aim in “Action Mode” is to reach the highest score in summation of all hits in the six zones.

The Object of the study is the exploration of transferability of sport- and motion based skills and its digital adaption. We decided to use a complex full body gesture as the object of exploration which is tagged by a highly situational constancy; the penalty shot in basketball. The distance to the basket, the size (radius), the height of the basket,[2] as well as color, texture and size of the basketball[3] is predetermined (comp. FIBA 2012).

Oriented to the conjunction and situational conditions of a real world penalty shot, we decided to use the “Training Mode” in the digital adaption of the game “AR Basketball” and modified the time variable by the amount of ten (10) possible attempts for shots. The horizontal distance from proband to marker was 90 cm and the height over the ground level was 105 cm (in analogy to the predefined parameters of penalty shots in the real world but with other dimensions). The named specifications represent and guarantee a stable and functional setting for marker recognition and interpretation and to ensure the most a flat angle to the basketball basket.

The application offers two modes of “throwing motions”: Either the wipe mode, where motion of the finger determines velocity, direction and distance of the shot affecting the impulse and angle of the basketball. The second option was the use of

[2] The horizontal distance from the penalty line to the center of the basket measures 4,225 m. The basket itself is a diameter of 45 cm and is mounted to a height of 3,05 m over ground level.

[3] The texture of the basketball is divided into 8 panels giving the ball its characteristics layout. While the International Basketball Association (FIBA) doesn’t demand a standard for the color, the worldwide largest association, the National Basketball Association (NBA), predetermines the “typical” color of the ball in orange with black lines. Women are playing according the guidelines of the international regulations with basketballs of the size 6 with a range of 724-737 mm and a weight of 510–567 g while men play with a basketball in size of 7, a range of 749–780 mm and a weight of 567–650 g.

a slider on the right side of the screen, also controlled by using a finger to define the impulse of the basketball. If the slider is used, then the device is used to set the direction of the flying line corresponding to the localization of the marker. By choosing the wipe mode more variance is possible (e.g. influence on the direction the basketball should fly to). Another reason for choosing the wipe mode was to avoid the memorization of a certain state of the slider and an expected transformation of the throwing scheme by the probands. This is why we decided performing for this study should happen via the wipe mode.

Despite the very mere symbolic adaption of the real-world-alike throwing motion we anticipated an instrumental-action oriented transfer in the context of the challenge to be solved (Fritz, 2011, p. 130) by expecting the probands to be able to transfer the moments of similarity of virtual and real world schemes, here the flying behavior of the basketball; but also habituated experiences made with (basket) balls made in a virtual or real world context. The specific realization of the augmented reality application also pays into this thesis because it allows the convergence and softening of both worlds which for us is seen as key-element for making processes of transfer possible: "Events of similarity are described as transfer beneficial, which appear to be obvious and traceable as intersubjective. Those usually stay in context of simulation games or refer to aspects of virtual worlds which are strongly oriented to the real world" (Witting, 2010, p.16).

The characteristic of a flying ball in the penalty shot of basketball is the motion of a parabola (comp. Wick, 2005, p. 36) where the ball hits the target in a sinking and forward going movement. The parabola is deviated from the position of the player and the location of the target which is allocated in a horizontal line and a in a higher position as the player. The variables determining the flying line are the height, angle and velocity by the moment of dropping (ibid). In best case, the player is able to hit the target without touching the ring of the basketball basket.

By the size of ring and ball and in perspective of bio-mechanics calculations, the ball needs to enter an angle of at least 31° to hit the target without touching an border of the basket (comp. Zumerchi, 1997, p. 70). The larger the entrance angle is, the higher the effect on fault tolerance can be expected regarding the deviance of the ball reaching the center of the basket. Deductive reason therefore is: to reach the closeness to an entrance angle of 90°, which physically never can be achieved in this experiment.

Between the real world "original" and the digital adaption of the game "AR Basketball" exists one substantial difference. While in the real world, the dropping point of the ball is located beneath the target, the dropping point in the augmented reality application is located above the target. This depicted dropping-height basically doesn't have an impact on the flying line which in both cases is a parabola caused by a lopsided throw. However, an influence on the perception of a situation similarity, and therefore on a central variable for the occurrence of a transfer process, cannot be excluded. The visualization of the cue ball, the game objective and the game task (goal throw) are establishing a relationship to the real world. However, a significant difference between the real world and the virtual world result from the perspective, the view to respectively down to the basket: In the real world, the player looks up to the basket from beneath. In the digital adaptation in the game "AR Basketball" the player looks from above to the basket.

According to Fritz's model of transfer (2011), a throwing scheme from the real world to the virtual world like this should be able to integrate such change of parameters when identified by the probands as situationally "appropriate". Under biomechanical consideration of the different initial positions of a penalty shot in the real world and the augmented reality adaption in the game "AR Basketball" it can be shown that the dropping point of the ball above the target is easier in comparison to the dropping point of the real world setting which potentially offers the possibility of reaching a higher mathematical entrance angle of 90° which as mentioned before increases the fault tolerance of deviating the ball from the center of the basket and therefore for a successful hit on target.

15.6.1 Experimental Setup

At the beginning of the study, the probands were briefed about the task: they should try out to reach the highest score within a certain amount of penalty shots in the real world as well as in the digital adaption. The probands got 1 min to get familiar with the use of the "AR Basketball" application without recording the score. After a short break of one more minute, the probands were asked to perform ten (10) penalty shots in rotation into the real world basketball basket and the digital adaption on the iPad. All in all, the ball had been thrown in 3 rounds with 10 attempts in the digital adaption and 2 rounds with 10 attempts under "real" penalty shot conditions (comp. Table 15.1). No countdown had been set. Nevertheless the time had been recorded next to the amount of hits.

The basis of this methodical setting is the assumption that probands show awareness for transferability in moments of alikeness between the real and digital world. Apart from the adaptions of real world basketball game which we have already described in the digital application "AR Basketball" such as the principles of aiming and taking over external design elements like color of the ball, the shape and positioning of the target

Table 15.1 Experimental phases

Sequence	Phase	Content/task
1	Briefing	Explanation of examination procedure and task
2	Familiarization	Try out the application "AR Basketball" on the iPad for the duration of 1 min without results recording
3	AR Basketball 1	Ten "throws" within the application "AR Basketball" on the iPad without time limit
4	Real Basketball 1	Ten "real" Penalty shots without time limit
5	AR Basketball 2	Ten "throws" within the application "AR Basketball" on the iPad without time limit
6	Real Basketball 2	Ten "real" Penalty shots without time limit
7	AR Basketball 3	Ten "throws" within the application "AR Basketball" on the iPad without time limit

(basketball basket). It is also the setting of the game in a real sports hall which generates a moment of similarity and in which the experiment takes place.

Besides the multiple changes between the performance in the real and virtual world and the record of success, we also wanted to rate the stability of the throwing action; intramondial via several attempts in the same (real) world as well as intermondial a) in context of sensitivity to the real performance for interferences via virtualized action with comparable throw scheme but other parameters and b) in context of possible customization (learning effect) in the virtual world along several attempts in the real world and the transferred throwing scheme.

The aim of our study is the exploration of transferability of schemes from the real world into a virtual world. The forming of schemes is based on many extensive situational and task specific experiences, so the "strength of a scheme [is described] as a positive function of the amount of experience within the same category of motion" (comp. Wulf, 1994, p. 23). Accordingly we operationalized the probands due general qualification in terms of the question and the period of activities in basketball.

In this way, we were able to recruit 52 probands of both genders (f = 14; m = 38) aged between 15 and 34 years who at the time of the exploration were all active players in clubs with a playing experience of at least 3 years with a minimum of 2 training units a week. All through we didn't make any differentiation in terms of how intensive they played (popular and professional sports) nor an affiliation to any league or class. Rather, we saw the action guidance in the success rate, result consistency of the performance (basketball penalty shot) in phase 4 and 6, the stability and the task specific characteristic as relevant to deduce from (throw-) schemes in the real world.

For settling we conducted a hit ratio for both penalty shots with a hit ration of at least 50 % (aspect of success) in the real world and a deviation in the amount of max. 1 hit (aspect of stability). The group of probands who were successful and identified with a stable throwing scheme were compared in the analysis with the group of probands, who in the real world performed less in accuracy and stability (less than 50 % hit ratio in one or both attempts).

15.6.2 Results

In view of the penalty shot success ratio in the real world 32 of 52 probands (62 %) were able to reach five or more hits. 25 of the 32 probands showed a deviation in the amount of hits by ≤1, which corresponded to percentage of 48 % of all probands.

This result is congruent to our expectations that experienced basketball players showed in context of our study and the identified factors of range, length, actuality of sport specific experiences an quasi automated performance of motion (comp. Hebbel-Seeger & Lippens, 1995) which resulted in a comparatively large hit ratio and performance constancy. This is compliant to current results in sciences of motor-activity (comp. e.g. Wiemeyer, 2005).

Table 15.2 Proband classification into groups based on the free-throw performance in the real world

Group	Description	Amount probands	Average amount of successful hit per round	Percentage to the main unit (%)
1	At least 5 successful hits in both rounds	32	6,97	62
1b	At least 5 successful hits in both rounds by a deviation in amount of hits ≤1	25	6,92	48
2	At least once 5 or more successful hits in both rounds	11	4,73	21
3	In both rounds less than 5 successful hits	9	2,94	17

Only 9 of 52 probands (17 %) were not able to perform in both rounds with five or more hits. The average hit ratio of those 9 probands was at 2,94, hits per rounds compared to 4,64 successful hits of the probands (n = 11), who at least could make in one of two rounds in the real world a score of four or more.

The success ratio of the probands who performed in both rounds in each case five or more successful hits (n = 32) was comparatively at 6,97. No important differences could be made to the part group (n = 25), which not only performed five or even more hits but also showed a high result consistency in terms of the amount of hits (difference ≤1 compared to both rounds) (comp. Table 15.2).

As a start we interpret this result as proof for the heuristic scheme theory assumptions for action guidance where successful schemes of motion in a high performance (in sports) are depicted as in a high result constancy (comp. e.g. Reiser, Müller, & Daugs, 1997): The performance constancy of the probands during the penalty shots in the real world (above a certain performance range) correlates with the performance level.

If an intermondial transfer between real and virtual worlds is successful, this means that the probands are able to transform their (throwing) scheme from the real to the virtual world, thus the probands who are also more successful should be better compared to the other ones. In a first observation we noticed that hardly one proband was able to act as successfully in the virtual world as he was in the real world. Only 5 of 52 probands (10 %) were able to reach a slight higher hit ratio in the virtual world on the iPad (average, 0,2, 0,3, 0,8, 1,7 and 2,3 more successful hits per round) compared to the penalty shots on the "real" basket.

Those were probands whose performance under "real" conditions was settled at the lower range with correspondingly low hit ratios (3 probands from group 3, 2 probands from group 2). All other probands were not able to reach a similar performance from the real setting to the virtual world: The differences in the performance between the hit ratio in the real world and the virtual world in group 1, including the part group 1b, and group 2 is significant; not tough in group 3 (we used the Q-Q test for group 1 and the part group 1b but the non-parametric Wilcoxon Signed Ranks

Table 15.3 Explorative observation of penalty shooting performance in the real world by groups

Group sorting by penalty shooting performance	Amount of probands	Average hit ratio per round	Group internal variance of absolute hits over all three rounds	Average execution time per round (s)	Group internal variance of absolute execution time over all three rounds (s)
1	32	6,97	10–18	78,23	50–140
1b	25	6,92	10–19	77,36	50–110
2	11	4,73	7–12	77,18	53–122
3	9	2,94	3–8	74,72	45–116

Table 15.4 Explorative observation of penalty shooting performance on iPad by groups

Group sorting by penalty shooting performance	Amount of probands	Average hit ratio per round	Group internal variance of absolute hits over all three rounds	Average execution time per round (s)	Group internal variance of absolute execution time over all three rounds (s)
1	32	2,09	1–16	34,39	81–170
1b	25	2,12	1–16	34,32	81–170
2	11	2,12	0–20	34,27	72–130
3	9	2,19	0–13	34,81	73–128

Test for groups 2 and 3, because the data wasn't distributed normally and the sample size was rather small[4]).

Accordingly, nothing points to a positive transfer. On the contrary, at first it seemed to result in a negative transfer (interference) by scheme transfer of external similarities which doesn't adapt to the virtual world and therefore doesn't show such a good performances (comp. Hebbel-Seeger et al., 2003).

An explorative data analysis can't back up this thesis. In fact the differences of the penalty shooting observed in the real world and on the iPad between the groups even out the hit ratio and the time needed for the attempts (comp. Tables 15.3 and 15.4.). While the differences concerning the hit ratio of the penalty shots are significant in the real world between groups 1 and 2 and 1 and 3 and also between the groups 2 and 3, no differences can be observed in the virtual world

[4]Group 1: The p-value associated with this test is 0.00 and since this is smaller than alpha (0,05.), we can confidently reject the null hypothesis (there is no difference between the means) and say that there is a significant difference between the average number of baskets made in the real world and the virtual world (.635).

Group 1b: There is also a significant difference in the mean number of real world and virtual world baskets made. The associated p-value for this test is 0.00 which is less than alpha, therefore the null hypothesis can be rejected with confidence (.761).

Group 2: We still got a low p-value (.010), which makes us confident that the means are in fact different.Group 3: We got a p-value of 0.235, which is larger than alpha. Therefore we can not reject the null hypothesis: There is not enough evidence to support the claim that the means are different.

Table 15.5 Explorative observation of execution times per round in the virtual and real world by groups

Group sorting by penalty shooting performance	Amount of probands	Average execution time iPad 1 (s)	Average execution time iPad 2 (s)	Average execution time iPad 3 (s)	Average execution time "Real 1" (s)	Average execution time "Real 2"(s)
1	32	34,56	34,78	33,18	81,44	75,03
1b	25	34,12	34,96	33,88	79.8	74,92
2	11	37,73	32,64	32,45	83,82	70,55
3	9	35,89	35,22	33,33	81,33	68,11

Table 15.6 Explorative observation hit ratio per round in the virtual and the real world by groups

Group sorting by penalty shooting performance	Amount of probands	Average hit ratio iPad 1	Average hit ratio iPad 2	Average hit ratio iPad 3	Average hit ratio "Real" 1	Average hit ratio "Real" 2
1	32	1,56	2,16	2,52	7	6,94
1b	25	1,64	2,2	2,52	6,92	6,92
2	11	1,64	2,72	2,45	4,64	4,82
3	9	2,33	1,78	2,44	2,67	3,22

(we used the non-parametric Mann–Whitney Test[5]). Same is true for the execution time which has been observed in between the groups 1 and 3 and shows a difference (but below a statistic significance) which is missing in the virtual world.

Focussing on the change of the execution times and hit ratios between the singular rounds, the probands showed following comparable development: The execution time shortened across all groups from the first to the second penalty round in the real world without showing a connection to the average reached hit ratio. In contrast, the execution time on the iPad showed only small variances (even if across all groups a shortened execution time is visible), while the performance in group 1 und 2 was increasing on low level. No improvement could be seen in group 3 (comp. Tables 15.5 and 15.6).

The observation of the development or rather change of the hit ratio on the iPad along the three rounds indicates group specific characteristics which can be interpreted as the processes of transfer: While the probands of the 3rd group, in face of the low performance in the real world, no elaborated (throwing) scheme is assumed, no improvements within the three rounds is shown in context of the hit ratio—in all other groups (1 and 2) an improvement of successful attempts is recorded. According to Fritz's model of transfers, we can read this as a sign for processes of transfer and an improved adaption of the acquired (throwing) scheme from the real world to the new context of the virtual world.

[5] The p-values are in all cases 0.00, which means there is a significant difference (reject the null hypothesis: there is no difference between the means) in the performance between the groups.

The situation is different in terms of “body height”. In paragraph 5 the dropping height of the basketball on the iPad is listed as abstractional simplification. This simplification didn’t result at all in better scores during the experiment. In a more differentiated view we can notice that probands with a height of ≥185 cm (n=25) performed across all three rounds on the iPad with higher hit ratios compared to probands with a height of <185 cm (n=27). The differences increase in all three rounds and are even significant (0,001) in the third round. Yet all predefined groups (comp. Table 15.2) were equally distributed with view on the variable of body height.

Since body height in basketball plays a decisive role and provides an advantage, one could use the argument that those taller probands were the “better” players within the study whose advantage is also mapped into the virtual world. Other than in the virtual world no statistic relevant differences could be seen in context of performance and the dependency on the variable of body height.

The dependency on anthropometric attribute (body height) and hit ratio during the penalty shooting on the iPad challenges the reliability of the experiment-setup by assuming that the comparatively short distances (comp. paragraph 5) between the defined “throwing line”, the marker and the iPad, as well as the height of the marker—could create an advantage for taller probands: The potentially simple abstraction in the game “AR Basketball” and the higher dropping height within the game could be exploited by taller probands by leaning over. The distance between player and basket crucially could be reduced by still keeping an adequate dropping height; compared to the distance of the basket in the real world.

15.7 Summary and Outlook

Virtual worlds have in different contexts at least a potential in context of transferring emotional, affective, cognitive and even motoric schemes to the real world. The assumption of such an—intermondial—transfer implicates that a transfer in contra-direction from the real into the virtual world must be possible. Sure enough, hints of a transfer are found when players of digital games for example adapt and project known rules of games from the real world into the virtual world.

Nevertheless, most studies in context of motion and sports have set the focus on the transferability from direction virtual world to real world. There is apparently a demand for systematic exploration, scientific interest and evaluation of the matter in the scientific landscape and this specific domain.

Actually possible hints to processes of transfer from the virtual to the real world are found in the studies. Cause by the variety of methodically approaches and different qualities of the studies a transfer is subjected to (motivation, cognition, affect, treatment etc.), valid generalizations can be deviated.

This study only aimed so far to see if and how an expertise acquired in the real world finds equivalence in the virtual world. The foundation of reasoning for potential processes of transfer is based on Fritz’s model of transfer (1997, 2011), which besides the differentiation of forms of transfer, layer of transfers and the process of transfer itself works as scheme for transformation.

In difference to Wiemeyer and Schneider (2012), who also conducted a study using basketball and came to the result that "the real training seems to transfer to the virtual test" (Wiemeyer & Schneider, 2012, p. 69), our results revealed major differences in the performance of experienced basketball players during penalty shooting in a real and virtual setting which in first view seems to controvert a transfer. Nevertheless changes in performance across time on processes of transformation in the meaning of Fritz can be noticed and negotiated with a possible transfer between the real and the virtual world.

Since those results are of explorative character and our study is missing a control group, generalizations are interdicted. Our setting shows in addition sensitivity to the disruptive factor of body height, shown by the identified correlation between linear growth and success rate of the task on the iPad. With this study, we think that we can contribute an initial point of analysis towards further research of transfer-effects between virtual and real worlds and vice versa.

References

Araújo, D., Davids, K., & Serpa, S. (2005). An ecological approach to expertise effects in decision-making in a simulated sailing regatta. *Psychology of Sport and Exercise, 6*, 671–692.

Azuma, R. (1997). A survey of augmented reality. *Teleoperators and Virtual Environments, 6*(4), 355–385.

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Juliet, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE Computer Graphics and Applications, 21*(6), 34–47.

Breuer, J. (2010). *Spielend lernen eine bestandsaufnahme zum (digital) game-based learning*. Düsseldorf, Germany: LfM.

Cassavaugh, N. D., & Kramer, A. F. (2009). Transfer of computer-based training to simulated driving in older adults. *Applied Ergonomics, 40*(5), 943–952.

Deterding, S., Dixon, D., Khaled, R. & Nacke, L. Year. From game design elements to gamefulness: Defining "gamification". Retrieved June 13, 2014, from http://85.214.46.140/niklas/bach/MindTrek_Gamification_PrinterReady_110806_SDE_accepted_LEN_changes_1.pdf

Dörrfuß, U., Bader, F., Wegener, R., Siemon, A., Schwake, J.-U., Hofman, F., Hieber, T. & Schmid, U. (2008). *Video games can improve performance in sports: An empirical study with wii sports bowling.* Retrieved October 14, 2012, from http://www.cogsys.wiai.uni-bamberg.de/teaching/ws0708/hci/practice/BowlingWii08.pdf

Edery, D., & Mollick, E. (2008). *Changing the game. How videogames are transforming the future of business*. Upper Saddle River, NJ: FT Press.

Fery, Y. A., & Ponserre, S. (2001). Enhancing the control of force in putting by videogame training. *Ergonomics, 44*(12), 1025–1037.

FIBA (Hrsg.) 2012. *Official Basketball Rules 2012*. Retrieved October 14, 2012, from http://www.fiba.com/downloads/Rules/2012/OfficialBasketballRules2012.pdf

Fritz, J. (1997). Zwischen transfer und transformation. In J. Fritz & W. Fehr (Eds.), *Handbuch medien: Computerspiele* (pp. 229–246). Bonn, Germany: Bundeszentrale für politische Bildung.

Fritz, J. (2004). *Das spiel verstehen. Eine einführung in theorie und bedeutung*. Weinheim, Germany: Juventa.

Fritz, J. (2010): Virtuelle Spielwelten mit Kompetenz rahmen. In: Ganguin, Sonja und Hoffmann, Bernward (Hg.): Digitale Spielkultur. München: Kopaed Verlag. P. 105–114

Fritz, J. (2011). *Wie computerspieler ins spiel kommen. Theorien und modell zur nutzung und wirkung virtueller spielwelten*. Berlin, Germany: Vistas.

Fritz, J. & Fehr, W. (1997). *Wie sich Spielwelten und Lebenswelten verschränken. Präferenzen als Ausdruck struktureller Kopplungen*. Retrieved October 14, 2012, from http://snp.bpb.de/neu/wp-content/uploads/2008/08/fritz_fehr_strukturelle_kopplung.pdf

Gamberini, L., Barresi, G., Majer, A., & Scarpetta, F. (2008). A game a day keeps the doctor away: A short review of computer games in mental healthcare. *Journal of Cyber Therapy & Rehabilitation, 1*(2), 127–145.

Hebbel-Seeger, A. (2006). *E-törn: Segeln lernen interaktiv (CD-Rom)*. Bielefeld, Germany: Delius-Klasing.

Hebbel-Seeger, A. (2008). Videospiel und sportpraxis: (k)ein widerspruch. *Zeitschrift für e-learning, 3*(4), 9–20.

Hebbel-Seeger, A. (2011). Beyond the hype: Lehren und lernen in der virtuellen welt von "second life". In T. Mayer, R. Appelt, C. Schwalbe, & W.-H. Tan (Eds.), *Medien & bildung. Institutionelle kontexte und kultureller wandel* (pp. 330–339). Wiesbaden, Germany: VS-Verlag.

Hebbel-Seeger, A. (2012). Motiv: Motivation?!—warum lernen in virtuellen welten (trotzdem) funktionieren kann. *Zeitschrift für e-learning, 1*(8), 23–35.

Hebbel-Seeger, A., Torsten, R., & Dennis, S. (2013). *Synthetic worlds: Emerging technologies in education and economics*. Springer Publishing Company, Incorporated.

Hebbel-Seeger, A., Lietdke, G. & Lüssow, H. (2003.). Zwischen Transferenz und Interferenz—Sportartenübergreifendes Lernen in gleichgewichtsintensiven Sportarten. *Bewegung und Training (e-Journal)*, Suppl., 1-10. Retrieved October 14, 2012, from http://www.bewegung-und-training.de/

Hebbel-Seeger, A., & Lippens, V. (1995). Professionelles wissen: Überlegungen zu struktur und verbesserung. *Psychologie und Sport, 2*(3), 106–114.

Huber, F., Hamprecht, J., & Heise, M. (2012). *In-game advertising erfolgreich platzieren*. Lohmar, Germany: Eul.

Jantke, K.P. (2007). *Serious Games—eine kritische Analyse*. Retrieved October 14, 2012, from http://km.meme.hokudai.ac.jp/people/jantke/Publications/2007/11terWorkshopMultimedia_Jantke.pdf

Juul, J. (2005). Half-real: Video games between real rules and fictional worlds. Cambridge, MA:MIT Press.

Kempter, M. (2009). *Von der virtuellen Welt in die Alltagswelt der Kinder. Was Kinder beim Computerspielen lernen und wie sie dies in die Alltagswelt transferieren*. Retrieved October 14, 2012, from http://othes.univie.ac.at/4785/1/2009-05-11_0250774.pdf

Künzell, S. (2002). *Die Bedeutung der Efferenz Kopie für das motorische Lernen*. Retrieved October 14, 2012, from http://geb.uni-giessen.de/geb/volltexte/2003/1337/pdf/KuenzellStefan-2002-12-18.pdf

Landers, R. N., & Callan, R. C. (2011). Casual social games as serious games: The psychology of gamification in undergraduate education and employee training. In M. Ma, A. Oikonomou, & L. C. Jain (Eds.), *Serious games and edutainment applications* (pp. 399–424). Surrey, UK: Springer.

Leist, K.-H. (1993). Bewegungsautomatisierung: Ansätze ökologischer motorik forschung. In R. Daugs & K. Blischke (Eds.), *Aufmerksamkeit und automatisierung in der sportmotorik* (pp. 133–147). Sankt Augustin, Germany: Academia.

Limperos, A. M., Schmierbach, M. G., Kegerise, A. D., & Dardis, F. E. (2011). Gaming across different consoles: Exploring the influence of control scheme on games-player enjoyment. *Cyberpsychology, Behavior and Social Networking, 14*(6), 345–350.

Liu, Y., Alexandrova, T., & Nakajima, T. (2011). Gamifying intelligent environments. Proceedings of the 2011international ACM workshop on Ubiquitous meta user interfaces. Scottsdale, Arizona, USA: ACM.

Miller, R.M., Tsui, Y.H.W., Dearden, T., Wolthuis, S.L. & Stanley, T. (2010). *Learning and human computer interactions: Does Wii bowling transfer to real bowling?* Retrieved October 14, 2012, from http://www.iiis.org/CDs2010/CD2010SCI/EISTA_2010/PapersPdf/EA060IH.pdf

Munzert, J. (1992). Motorik-repräsentation, bewegungswissen und bewegungshandeln. *Sportwissenschaft, 22*, 344–356.

Nacke, L.E. & Lindley, C.A. (2009), WIIMote vs. controller: Electroencephalographic measurement of affective gameplay interaction. In L.E. Nacke, (eds.). *Affective Ludology. Scientific*

Measurement of User Experience in Interactive Entertainment (S. 231-257). Blekinge Institute of Technology, Doctoral Dissertation Series Nr. 2009:04. Retrieved October 14, 2012, from http://phd.acagamic.com/nacke-l-phd-thesis.pdf

Oja, M., & Riekki, J. (2012). Ubiquitous framework for creating and evaluating persuasive applications and games. In M. Rautiainen, T. Korhonen, E. Mutafungwa, E. Ovaska, A. Katasonov, A. Evesti, H. Ailisto, A. Quigley, J. Häkkilä, N. Milic-Frayling, & J. Riekki (Eds.), Grid and pervasive computing workshops. Berlin: Springer.

Piaget, J. (1976). *Psychologie der intelligenz (deutsche übersetzung der französisch sprachigen erstausgabe von 1947)*. München, Germany: Kindler.

Pietschmann, D. (2009). *Das erleben virtueller welten. Involvierung, immersion und engagement in computerspielen*. Boizenburg, Germany: Hülsbusch.

Reiser, M., Müller, H., & Daugs, R. (1997). Ausführungsvariabilität und ergebniskonstanz bei wurfbewegungen. In E. Loosch & M. Tamme (Eds.), *Motorik: Struktur und funktion* (pp. 92–96). Hamburg, Germany: Feldhaus.

Rosenberg, B. H., Landsittel, D., & Averch, T. D. (2005). Can video games be used to predict or improve laparoscopic skills? *Journal of Endourology, 19*(3), 372–376.

Rosser, J. C., Lynch, P. J., Cuddihy, L., Gentile, D. A., Klonsky, J., & Merrell, R. (2007). The impact of video games on training surgeons in the 21st century. *Archives of Surgery, 142*(2), 181–186.

Roth, K. (1993). Wie verbessert man die koordinativen fähigkeiten? In B. Sportpädagogen (Ed.), *Methoden im sportunterricht* (pp. 85–97). Schorndorf, Germany: Hofmann.

Roth, G. (2001). *Fühlen, denken, handeln*. Frankfurt, Germany: Suhrkamp.

Schenk, M. (2007). *Medienwirkungsforschung (3. Vollst. Überarbeitete Auflage)*. Tübingen, Germany: Mohr Siebeck.

Schmidt, R. A. (1975). A schema theory of discrete motor skill learning. *Psychological Review, 82*, 225–260.

Schmidt, R. A. (1994). *Eine schematheorie über das lernen diskreter motorischer fertigkeiten*. Kassel, Germany: Kassel University Press.

Schmitt, C. (2011). *Computerspiele. Fluch Oder segen? Die nutzer, die gefahren, die lernpotentiale, der umgang*. Hamburg, Germany: Dipomica.

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence Teleoperators and Virtual Environments, 6*(6), 603–616.

Sohnsmeyer, J. (2011). *Virtuelles spiel und realer sport—über transferpotentiale digitaler sportspiele am beispiel tischtennis*. Hamburg, Germany: Feldhaus.

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, J. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research, 34*(3), 229–243.

Walter, H. C., Vetter, S. C., Grothe, J., Wunderlich, A. P., Hahn, S., & Spitzer, M. (2001). The neural correlates of driving. *Neuroreport, 12*(8), 1763–1767.

Wesener, S. (2006). *Spielen in virtuellen Welten: Übertragung von Inhalten und Handlungsmustern aus Bildschirmspielen*. Retrieved October 14, 2012, from http://www.medienpaed.com/06-2/wesener1.pdf

Wick, D. (2005). *Biomechanische grundlagen sportlicher bewegungen*. Balingen, Germany: Spitta.

Wiemeyer, J. (2005). Prinzipien und merkmale gelungener bewegungen. In T. Rossmann & C. Tropea (Eds.), *Bionik. Aktuelle forschungsergebnisse in natur- ingenieur- und geisteswissenschaft.* (pp. 561–574). Berlin, Germany: Springer.

Wiemeyer, J. (2009). Digitale spiele: (k)ein thema für die sportwissenschaft?! *Sportwissenschaft, 39*(2), 120–128.

Wiemeyer, J. (2010). Gesundheit auf dem spiel?: Serious games in prävention und rehabilitation. *Deutsche Zeitschrift fur Sportmedizin, 61*(11), 252–257.

Wiemeyer, J., & Schneider, P. (2012). Applying serious games to motor learning in sport. *International Journal of Game-Based Learning, 2*(4), 61–73.

Witting, T. (2010). Wie computerspiele beeinflussen. *Ajs-Informationen, 46*(1), 10–16.

Wood, L. C., & Reiners, T. (2012). Gamification in logistics and supply chain education: Extending active learning. In P. Kommers, T. Issa, & P. Isaías (Eds.), *IADIS international conference on internet technologies & society 2012* (pp. 101–108). Perth, WA: IADIS Press.

Wright, M. J., & Jackson, R. C. (2007). Brain regions concerned with perceptual skills in tennis: an fMRI study. *International Journal of Psychophysiology, 63*(2), 214–220.

Wulf, G. (1994). *Zur Optimierung motorischer Lernprozesse. Untersuchungen zur Funktion von Kontext-Interferenz und Rückmeldungen beim Erwerb generalisierter motorischer Programme*. Schorndorf, Germany: Hofmann.

Zumerchi, J. (1997). *Encyclopedia of sport science*. New York: MacMiller.

Additional Reading Section

Alexiou, A. (2011). Serious Play: Using Digital Games for Training in Work Organisations. Retrieved October 14, 2012, from http://lubswww.leeds.ac.uk/uploads/media/Andreas_Alexiou_-_Proposal_V2.pdf

Backlund, P., Engström, H., Johannesson, M., & Lebram, M. (2007). Games and traffic safety: An experimental study in a game-based simulation environment. *Proceedings of the International Conference Information Visualization*, 11, 908–916. Washington, DC: IEEE Computer Society

Breuer, J. S., & Bente, G. (2010). Why so serious? On the relation of serious games and learning. *Eludamos. Journal for Computer Game Culture, 4*(1), 7–24.

Ehlenz, H., Grosser, M., & Zimmermann, E. (1987). *Krafttraining. Grundlagen, methoden, übungen, trainingsprogramme*. München, Germany: BLV.

Fischer, P., Kubitzki, J., Guter, S., & Frey, D. (2007). Virtual driving and risk taking: Do racing games increase risk-taking cognitions, affect, and behaviors? *Journal of Experimental Psychology. Applied, 13*, 22–31.

de Freitas, S., & Griffiths, M. (2009). Massively multiplayer online role-play games for learning. In R. E. Ferdig (Ed.), *Handbook of research on effective electronic gaming in education* (pp. 51–66). London: IGI Global.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Chichester, UK: Wiley.

Kliem, A., & Wiemeyer, J. (2010). Comparison of a traditional and a video game-based balance training program. *International Journal of Computer Science in Sport, 9*(Special Edition 2: Serious Games), 78–89.

Lee, J. (1999). Effectiveness of computer-based instructional simulation: A meta analysis. *International Journal of Instructional Media, 26*(1), 71–85.

Michael, D., & Chen, S. (2006). *Serious games: Games that educate, train, and inform*. Boston: Thomson Course Technology.

Nacke, L. E. (2009). *Affective ludology. Scientific measurement of user experience in interactive entertainment*. Blekinge Institute of Technology, Doctoral Dissertation Series Nr. 2009:04. Retrieved October 14, 2012, from http://phd.acagamic.com/nacke-l-phd-thesis.pdf

Olivier, N., & Rockmann, U. (2003). *Grundlagen der bewegungswissenschaft*. Schorndorf, Germany: Hofmann.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion, 30*, 347–363.

Schmidt, R. A., & Lee, T. D. (2005). *Motor control and learning: A behavioral emphasis* (4th ed.). Champaign, IL: Human Kinetics.

Virvou, M., Katsionis, G., & Manos, K. (2005). Combining software games with education: Evaluation of its educational effectiveness. *Educational Technology & Society, 8*(2), 64–65.

Weineck, J. (2004). *Optimales training* (14th ed.). Nürnberg, Germany: Spitta.

Wouters, P., van der Spek, E. & van Oostendorp, H. (2009). *Current practices in serious game research: A review from a learning outcomes perspective*. Retrieved October 14, 2012, from http://www.cs.uu.nl/docs/vakken/b3elg/literatuur_files/Wouters.pdf

Chapter 16
Storytelling to Immersive Learners in an Authentic Virtual Training Environment

Lincoln C. Wood and Torsten Reiners

16.1 Introduction

University education is in a constant change, trying to improve research, teaching, and administration; mainly to improve in rankings and attractiveness for students. Investments are done in all areas; marketing promotes the quality of infrastructure, research outcomes, and the excellence in teaching and learning. Classrooms undergo a continuous upgrade with the latest advancements in technology. And while the teachers are trained in using the technology for, e.g., a flipped classroom, higher participation, and collaboration among the students, one component is hardly considered in the upgrade: mediation of the teaching material. PowerPoint slides are transferred to Prezi, text is replaced with images, and textbooks are getting additional multimedia material. However, there is no significant change to make the material more engaging for students and to provide a sense of immersion. Indeed a very relevant and desirable idea to pursue as some projects demonstrate with their success of using games and virtual worlds in their teaching (Lee, Dalgarno, Gregory, Carlson, & Tynan, 2013; Pirker, Berger, Guetl, Belcher, & Bailey, 2012).

We provide an open space for learning; even though having boundaries to maintain the user within the scope of the learning objectives. Users can deviate in the open space. It is all about achieving the outcome; not necessarily how this is achieved. Note that verification of the state of objects or the environment is necessary to prevent certain critical states or actions to occur. Moving a box from the twentieth floor can be accomplished by dropping it from a window; yet, using a

L.C. Wood (✉)
Auckland University of Technology, Auckland, New Zealand
e-mail: Lincoln.Wood@aut.ac.nz

T. Reiners
Curtin University, Bentley, WA, Australia
e-mail: t.reiners@curtin.edu.au

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_16

pulley and rope would cause less damage and lowers the risk of hurting innocent people. Still, it is the learners' choice to pick from valid methods like pulley, lift, carrying, cranes, or helicopters as long as the aim of the scenario is fulfilled. On completion, the result is assessed by criteria such as time taken, cost, or damage; thus, while a helicopter ride may be fun it is not the most cost-efficient solution in a commuting problem and therefore maybe not preferable over others. Recorded variables like completion time are used to calculate a score; which the learner can improve on further runs. If a learner 'gets themselves killed' or makes a 'fatal mistake', just points are deducted instead of having an impact on the actual person or its virtual avatar. Virtual learning environments enhanced with gamification enables learners to repeat situations over and over to discover the correct solution to improve their score (McGonigal, 2011). When playing games, there is a very high percentage of failure rates on initial attempts of approximately 80 % (Fujimoto, 2012); yet, where the player is engaged to master the activity and complete the task, the overall fail rate drops precipitously. This type of repeated attempt is something highly discouraged by our educational systems. Educational institutions promote success and rather focus on a 'single-shot' assessment with extremely low fail rates but low grades than having learners repeat to improve and intensify the learning experience as well as learning outcome. The traditional classroom setups seem to be a fail-safe environment where failure and negative experience is disregarded.

Learners receive points, badges, or leader-board merits through gamification techniques, promoting a competitive atmosphere where users attempt to outdo others, while immersed in the learning scenario (Reiners, Wood, & Dron, 2014). Familiarisation with the learning environment in multiple repeated 'challenges' can motivate learners to contest more experienced learners; i.e., progressing up the leaderboard. In theory, it can promote a competitive atmosphere, full of rivalry, as users compete to outdo one another. In practice, such an approach can produce also stunningly negative dynamics, as unintended consequences spring forth from thoughtless applications. Consider what it would feel like if you were to join an Internet-based social media with some well-recognised users having astronomical points and a collection of badges that would make a boy scout green with envy. While this might inspire you, it will undoubtedly turn-off other users. Instructional designers must balance gamification components; for example, introducing handicaps as it is done in golf or by comparing learners only at the same level. A comprehensive overview extending beyond gamification elements of points, badges, and leader-boards is provided by Reiners et al. (2012); Wood and Reiners (2012) provide a model for including elements in a logistics and supply chain management class.

Throughout this chapter, we outline some of the challenges we have had with teaching units in Logistics and Supply Chain Management courses and address how we are actively solving these problems through the story: 'nDiVE: How to immerse the learner in an authentic n-dimensional environment'. In the following sections, we describe how we condense the multiple dimensions (the exact number depends on specific learning outcomes for the programme) into an authentic, immersive story (using a virtual environment for visualisation) to demonstrate, simulate, and control real-world situations in a format that allows students to grasp the highly complex and interwoven processes. We decided to encode the learning material as an interactive story similar to current open world video games (e.g., Grand Theft Auto [GTA]) or the classic 'Dungeons & Dragons' (Reiners et al., 2013, p. 735) as this supports the establishment of suitable scope and narratives while leaving the learner free to explore the space and create their own perspective on the established learning outcomes. In the next section, we outline the importance of deciding on the appropriate balance of realism and authenticity in presenting learning materials. We use different technologies depending on the learning objectives as well as the perspective the learner inhabits. The idea of fun, play and passion symbolises the gamification concept and addresses the problem that even the perfectly designed learning environment is not sufficient for a complete learning experience; learners have to be engaged and motivated as well. We integrate gamification mechanics to trigger each learner's motivation and engagement. Gamification is the use of game thinking and mechanics in a non-game context in order to engage users and solve problems (Wood & Reiners, 2014). We conclude the paper with an outlook on the future plans of nDiVE and opportunities to transfer the demonstrated concepts to other areas.

16.2 Realism and Authenticity

It has been well-recognized that authentic tasks, conducted in authentic situations, provide a stable foundation for adult-focused learning (Huang, 2002). Thus, while some argue that authentic learning should be primarily placed in real-world settings (Lombardi, 2007) (e.g., work-integrated learning or internships), others argue that the key characteristic is not the workplace but the authenticity of the tasks undertaken by the student (Herrington, Reeves, & Oliver, 2010). Authentic tasks become important in this way as they support a shift away from the traditional knowledge-transmission approach of learning towards a constructivist approach to learning (Jonassen & Rohrer-Murphy, 1999).

In contrast, it still feels as though most learning in universities still focuses on knowledge transmission and memorisation of facts as evidenced in examinations. Instead, we should be moving towards learning contexts that reflect how the knowledge (that the learner should be gaining) will be used in their future.

Thus, effective education in supply chain focused classes will be reliant on "a dual focus on both content and delivery is necessary" (Wood & Reefke, 2010, p. 78). The delivery can be enhanced through an authentic setting, such as using a study tour; however, while "the study tour helps to bridge the gap between business theory and practice" (Porth, 1997, pp. 198–199), they cannot be a foundation for a supply chain management qualification. It is unlikely (particularly, in this age of globalization) that a tour could focus on all relevant phases of value creation activities in a sequence of locations that students can easily visit (Hanna, 2000, p. 205). Indeed, even when this is accomplished, the data or information that may be useful to support learning may be hidden from the students (Reiners & Wood, 2013). This provides the opportunity for a structured learning environment, delivered virtually/online, where tasks are authentic and delivered in an immersive way to engender a sense of realism and connection with the learning process. In this way, the realism and authenticity of the tasks that are being undertaken should be more intensive than being done in a traditional classroom environment, making the outcomes and activities more valuable to students and their overall learning experience.

16.2.1 Realism Through Technology

Technology-supported approaches to classroom education can raise the level of realism. However, most adoptions of technologies in universities have focused on course management, monitoring data, or managing students; creating auditable outcomes. Thus, rather than being used as a support for improved learning, it is often incorporated simply as a platform for a teacher-centric method of information delivery to students. In this mode, the adoption supports a low-level of cognition, with a strong focus on remembering information and avoiding higher levels of cognition (Anderson & Krathwohl, 2001).

We assert that technology must be used to push beyond this, moving away from a technology leading to deterioration in learning (Brabazon, 2007), and towards learner-centric classroom environments.

There are a number of approaches to using technology. One that we find to be a natural match with the concept of nDiVE is of the consumer-focused Oculus Rift head-mounted display (HMD). The learner wears a headset with separate images for each eye to create a 3D surrounding. In addition, sensors track the head movement to align it with the virtual environment, allowing to simply moving their head or body to perceive the virtual world around them (feeling a 360 presence). Movement of the avatar that remains, unfortunately, still difficult to action in the virtual environment and is based on the use of keyboard, mouse, or gaming controller. While other options exist (e.g., a 'cradle' or 'harness' that enables the user to move on a 'walker platform') these platforms are currently not targeting the consumer market and are therefore relatively unlikely to be adopted in large-scale educational settings.

The sense of immersion can occur in one of several ways. At the most simple level, it is the "suspension of disbelief" (Dalgarno et al., forthcoming) in what is occurring. This provides a sense that the participant is 'inside the setting (Dede, 2009, p. 66). The sense of immersion can be connected to the perceptual immersion, or the depth of connection to the virtual environment (Biocca & Delaney, 1995). Yet, the feelings about the situation are also influenced by what the user is experiencing; a high degree of involvement by activities can lead to a sense of being completely engrossed or engaged with the situation, showing higher psychological immersion (Palmer, 1995).

16.2.2 Authentic Assessment in nDiVE

Gamification and the incorporation of game-based elements is particularly useful within authentic learning environments (Wood, Teräs, Reiners, & Gregory, 2013). Together, they can complement authentic assessments to help learners develop complex and valuable skills and encourage greater self-directed learning to take place. In this way, we believe that gamification within authentic assessment represent a leap ahead of traditional assessment mechanisms.

Complex assessment practices present a significant barrier to adoption of greater authenticity in assessment. While simple multiple-choice questions can be automatically assessed (and are easily supported), evaluating the capability of a learning to manage a disparate series of tasks in a virtual environment is not a simple undertaking (Fardinpour, Reiners, & Dreher, 2013).

The complexity of the assessment task returns to the establishment of the framework for the virtual environment. While educators agree that the deployment of 'artificially intelligent' bots would be useful, large-scale adoption remains some way off and is limited by technology, institutional resourcing for changes, and training in instructional design and implementation (Wood, Reiners, & Bastiaens, 2014). However, effective design of a range of bots can be guided by developed frameworks, minimizing the efforts required to develop support for particular learning activities (Wood & Reiners, 2013).

The primary challenge to incorporating gamification into assessment revolves around the feedback mechanisms. While it is not possible to create intelligent and automated feedback, methods can be used to supplement feedback with 'human intelligence'. There are two approaches. First, feedback can be provided by an instructor viewing and monitoring in-world activities. This has the benefit of expert instruction, but clearly requires significant time investments on the part of the instructor. Second, expert performances can be captured through evaluation of 'perfect' attempts at a task. This provides the learner with a framework of what they should be aiming to achieve, but not necessarily feedback on how they can improve parts of their performance to get there. Third, peer-assessment can take place, with other students tasked to provide guidance and feedback to the student.

Used in this way, the authenticity of a task can be significantly increased. Authenticity is raised by a good replication in a virtual environment. Learners can compare and contrast their success with feedback from others, or from agents/bots within the system itself. Gamification can form an adjunct to existing authentic environments, by helping to create a more motivating situation and encourage the desire for further self-directed learning by students outside of their regular educational boundaries.

16.3 Integration of Gamification Mechanics

We already can provide a series of well-defined tasks for learners. However, we wish to shift towards a paradigm with a greater level of openness allowing a more explorative and fun learning to take place. Therefore we are interested in using (admittedly, carefully-developed) scenarios rather than distinct tasks. This means that the environment and experiments have to provide incentives and objectives but without giving direct and complete instructions relating to what must be accomplished. Learners should be able to recognise important objectives and act accordingly by prioritising these.

Previous experiments have demonstrated significant engagement with the learning scenarios. Learners have expressed that they felt as though there are really present in the situation. It is possible to create an open space that combines play and self-directed learning, with minimal instructions to challenge learners to perform a sequence of activities.

We examine the implications of using of less obvious gamification tools, drawn from game-based principles including (Wood, Teräs, & Reiners, 2013):

- rewind;
- ghost image;
- save points and multiple lives; and,
- time- and space-control.

Together, these extend the ability for educators to create compelling educational environments. They allow behaviors to be influenced in a way that can enhance the desired learning outcomes. They can also be woven into a wider storyline and narrative. Coupled with the ability to assess narratives within a virtual environment, these approaches can support self-directed learning.

16.3.1 Ghost Images and Rewind

Self-directed learning requires something to learn against and some method for the learner to still strive. While leaderboards and badges give an abstract sense of achievement, direct or head-to-head competition support Performance-Based Instruction (Brethower & Smalley, 1992), allowing learners to evaluate precisely, and concretely, where their performance was lacking.

Ghost images can support two key learning activities. First, a learner can use a ghost image of their own effort, studying it retrospectively, enabling them to see how their performance may have been weak. This can lead to introspective self-evaluation of performance that can generate improvements. Second, expert performances can be captured and then evaluated using ghost images. This could be used as an overlay of an expert performance on a student performance, allowing the learner to understand how they deviated from an expert performance, enabling them to focus their improvements on specific and concrete areas in the next attempt. Additionally, it provides a sense of accomplishment and achievement when the student can match an 'expert' performance; such an accomplishment may be more tangible and meaningful than simply presenting 'summary statistics' such as found on a leaderboard.

16.3.2 Time and Space Controls

There are a range of different simulations available to help teach operations and supply chain management principles and most incorporate some control over time and space. Changing placement of items so that they are proximate in space, or changing the timing of events to ensure a fluid experience, can help keep users engaged in an experience.

Distortion over relationships in time and space are sometimes not warranted. Extremely realistic training scenarios may prefer to have exact replication of relationships as the learner would experience in the real world. Examples may include simulation of docking a ship, or a space shuttle docking with the international space station. Here, distorting relationships in time and space would be unwelcome.

In other situations, such as examining a global supply chain, an undistorted depiction of the passage of a vessel from a port in China to a port in the USA is unwelcome as it progresses over far too many days. By allowing the undistorted situation, no learner will remain engaged.

Therefore, nDiVE judiciously allows some distortion, with a strong focus on the learning activities that must be undertaken. These are designed into scenarios so that they are proximate. This is similar to the approach taken in other supply chain focused simulations. Examples include Involvation's "The Fresh Connection" simulation, used by universities in Australasia, North America, and Europe (Cotter, Forster, & Sweeney, 2009). Each turn of the game compresses a 26-week period of time into an instant. This enables the participants to view the outcomes of their decisions and gain instant feedback on what happened. This feedback allows reflection on which decisions impacted these outcomes and what they can do better in the next round. Similarly, other simulations (e.g., Supply Chain Risk Management Game (Kuijpers, 2009) and the Supply Chain Game by Responsive.net (Feng & Ma, 2008) make use of adjustments to time and space to aid the intention of the simulation.

16.3.3 Save Points and Multiple Lives

Drawing on these past elements, the use of save points, in particularly, draws on a particular use of time control to 'wind back the clock' in the simulation and re-arrange the items and actors as they were in an earlier configuration, enabling a learner to re-attempt a particular scenario. This is closely coupled with the use of a 'new life'. Thus, dying most emphatically need NOT to be the end of the learning experience (Reiners et al., 2014); indeed, learners can often dissect and examine a particular failure to understand the underlying causes. Armed with this information, they are then well-positioned to tackling the next attempt at the problem.

16.4 An Interactive Story

16.4.1 Nonlinear Narratives in Unrestricted Learning Spaces

Stories are one of the oldest means of passing on information and experiences by others. Storytellers combine words with gestures and expressions, creating illusions, using intonation to build up suspense to finally reach full immersion in the narration. Storytelling is art; the canvas being the mind and the words the crayons to draw the picture. Storytelling is connective; it requires an audience with whom we can share. Storytelling is creative; we hear words and sounds, see gestures and expressions, but we also combine these shared impressions with our personal experience, understanding, and knowledge to our very individual story. Storytelling is an effective mean to convey "information in a compelling and memorable way" (Neal, 2001) and can even be considered as the "original form of teaching" (Pedersen, 1995).

Here, we examine the use of mood and storytelling tools inherited from film and theatre (Björke, 2003) but applied to educational environments. The narrative has to be sculpted and designed to express a path through the story; yet allow for exploration and individual alterations.

Lecturers and other teachers need to focus on the provision of skills and knowledge. However, the creation of learning environments and narratives requires not only domain knowledge but also significant design capability. We develop a learner-centric bounded learning space, allowing the creation of an iterative and layered series of narratives within a story. Narratives are not linear, but embed defined points in the story to include decisions by the learner or to nudge the learner in a certain direction. While the tools are forthcoming to achieve this in a simplified manner, we are presenting here an overview of how environments have to be designed to motivate through developing openness in a way that encourages curiosity and, through gamification, rewards attempts, efforts, and success in achieving the learning objectives. This contributes to literature in the 'authentic learning' as it allows suitably complex scenarios to be developed, and it contributes to literature in the 'motivational learning' space as the provision of a bounded space enables experimentation and flexibility in activities undertaken towards attaining outcomes.

16.4.2 The Gamified Nudge

No matter what event they are involved in, participants often enjoy the freedom and delight of influencing the activities and the event as a whole. For example, Chess has strict rules regarding the use of pieces and how they interact, yet the players have a high degree of freedom as each move branches into one of the almost unlimited narratives; where one decision can be countered by the opponent in many ways. An even higher degree of freedom for the participants is achieved in various role-games with co-creative elements where the game master establishes the outline of events that constitute each 'quest' that the participants are involved in. Nonetheless, it is the participants that largely control what happens, how it happens, and why it happens. Note, however, that there is also a 'random' element, introduced by a multitude of die-rolls to discover whether 'something' occurs or how strong an effect is; often, these rolls can be seen by the players as they anxiously hold their breath.

The quests in games like Dungeon&Dragons are established by objectives, goals, and loosely structured stories that the game master (Dungeon Master, DM) controls. The performance of the participants is monitored and their interaction with the environment is manipulated, with the DM able to slow down or speed up the progress of the party through a given scenario, often with 'previously established' tricks or traps that have been prepared in advance of need.

What happens if the players become ‘sidetracked’ by something that is less relevant? The DM merely convinces them to focus on their main objective. There are a number of ways of achieving this, but gentle persuasion is usually adequate. Similarly, in professional games like GTA, the players are ‘gently encouraged’ to return to the storyline by increasingly strong ‘hints’ that are dropped in the guise of being part of the game and environment.

The result is that players have a sense of freedom. They are able to explore, examine, learn, and interact with the world around them. They can follow their hearts content. Up to a point—we still have a story to tell them! The use of the ‘nudge’ enables the native interest, curiosity, and enthusiasm of a player to be encouraged and incorporated into the situation.

The tension remains, however, of encouraging an ‘open’ exploration of spaces while being conscious of the fact we need a ‘closed’ focus on a particular outcome or result. Like when we pull a rubber band between two hands, the further we pull, the greater the force that attempts to correct the situation. Similarly, an open space can have mechanisms built in to ‘pull’ a player back to the path.

The implementation of a ‘pull’ or ‘nudge’ can be difficult to implement; while a DM can use observation and human intelligence, it can be difficult to ‘codify’ and thus use technology to automatically see what must happen, when, where, and by whom, in a way that all actions can be monitored and the scenarios adapted automatically.

Careful design of the learning spaces can result in a gentle set of guides to assist a learner in navigating through a scenario. Tracking and analyzing the data of the learner in the environment allows the design of a space so that learners’ time is primarily spent in areas (location) or narratives (objective) that they need to be in to complete the learning activities. Figure 16.1 shows examples from a container terminal scenario where the learner is:

1. directed by static information integrated into the environment (e.g., signage);
2. controlled by dynamic signals that fit within the context (e.g., traffic lights);
3. forced to respond to triggered scripts that cause events to change in the immediate vicinity (e.g., a reversing truck blocking a passage);
4. working in a constantly changing environment that adapts to the learner (e.g., container transports on a container terminal);
5. artificial intelligence (AI) support using ChatBots knowledgeable about the scenario (e.g., as outlined in Wood and Reiners (2013));
6. responding to external incentives (e.g., monetary bonus from the employer); and,
7. responding to intrinsic motivation induced by their sense of fun and passion to solve the task and achieve the goal.

Furthermore, such a ‘gentle’ guide requires little in the way of narrative or instructions. Preliminary work indicates that a simple set of instructions provided during an ‘orientation to the technology’ session can also encompass a basic idea of what to do within the environment. That, coupled with the ‘natural attractors’, gives the participant the basic outline of what to accomplish. Thereafter, the design and setup of the virtual environment should occur in such a way as to keep them on track while also encouraging the desired behaviours Fig. 16.2.

Experiments indicate that the design of interactive spaces can occur in such a way that prominent features act as ‘magnets’ for user attention (Reiners, Teräs,

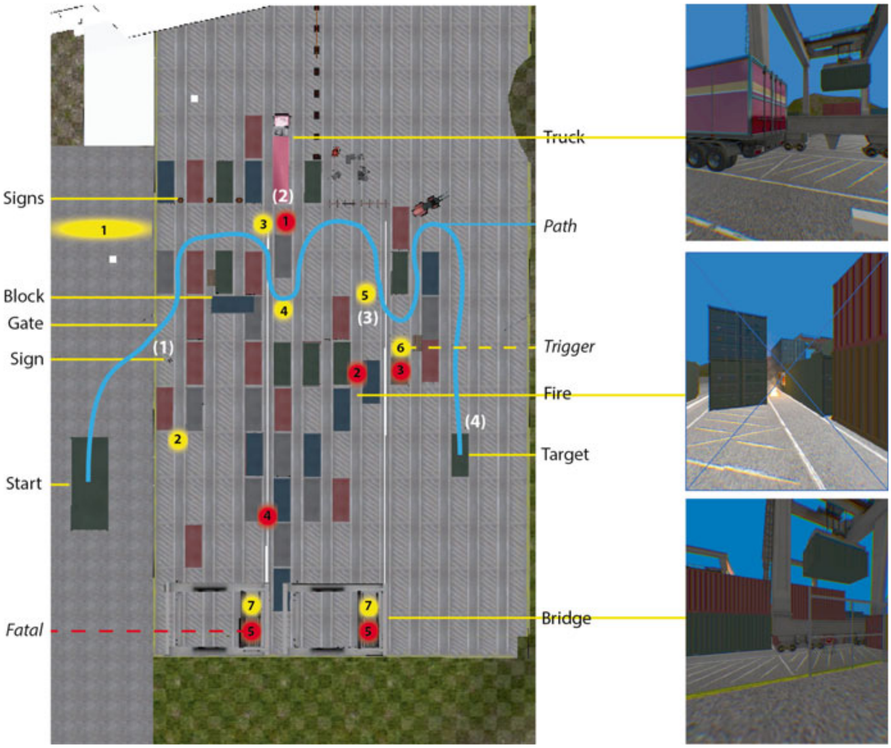


Fig. 16.1 Overview of the container terminal scenario. *Yellow* marker are trigger (1–7), *re* indicates an are where the learner can die (1–5), *white* numbers are milestones that e learner should reach (1–4), the *blue line* shows the path an expert walked while solving the task

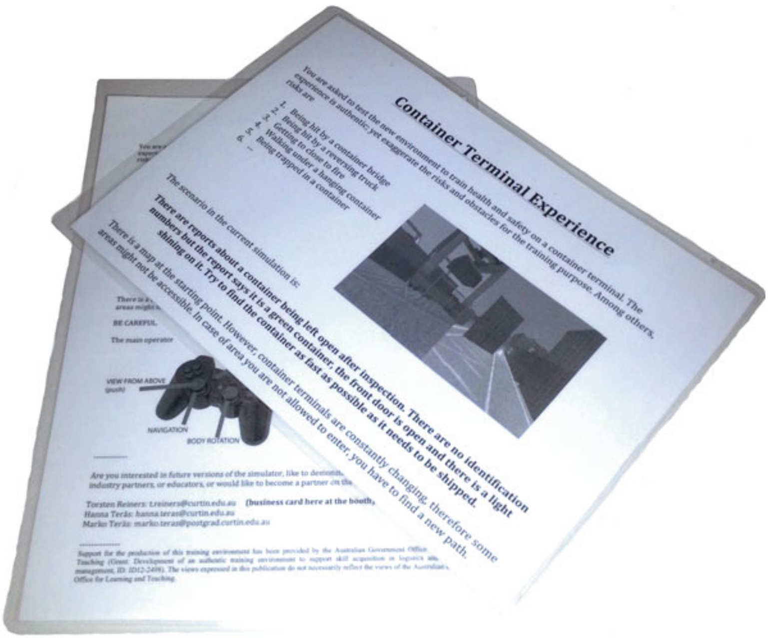


Fig. 16.2 Cards shown to the participants to introduce them to the objectives as well as control

Chang et al., 2014; Reiners, Wood, Gregory, & Bastiaens, 2014). People are by nature curious and inquisitive and do take the time to examine the spaces they find themselves within. Therefore, something, which appears different or unusual, tends to attract their attention and hold it. In this experiment, a short but reasonable scenario was developed to be readily understood by someone generally not familiar with the context of a container terminal; therefore, users need no prior exposure to the particular business or operating environment. With respect to the container terminal, the participants received two information cards; one describing the story, the other with a map and a possible route to reach a specific location. The story was presented as follows:

> *There are reports of a container left open after an inspection by government Customs officers. There are no identification numbers, however, we know that it is a green container, the front door is open, and there is a light shining on it. As this container must be shipped as soon as possible, you must find the container as fast as possible and close the door.*

We observed a high affinity of the participants to sticking to the story line, where other areas that could be of interest and were accessible, did not sidetrack them. Even in the case where they failed to enter the container terminal area (the entrance was immediately to the right after leaving the starting area), participants asked for support as they realized they were lost but still wanted to return to the narrative or story that they are participating in. Another group of participants, who did not receive the information cards at the start, were feeling engaged but not motivated in pursuing a specific (self-made) objective. Furthermore, the experiment showed that the warnings about dangerous elements in the virtual environment (e.g., those situations that kill the avatar and stops the experiment) increased the participants' awareness of their surrounding; e.g., signage such as notices telling them "do not enter" the area and heavy traffic nearby.

The experiment confirmed that stories and storytellers (here, manifested indirectly through signage or direct by scripted events) are valid tools to engage learners with the learning task, but also to keep them interested in exploring the space to find an answer. Deterding (2014) shows that the incentives (or challenges) must change over time to prevent frustration (e.g., where the task is too challenging) and boredom (e.g., where the task is too simple given the skill set of the learner). The story can, as described below, include gamification elements to adapt the environment to the skill set; these include semi-intelligent bots, changing environments, or challenges involving other learners.

16.5 Future Developments in nDiVE

The nDiVE project uses a virtual environment to enhance education relating to the movement and management of physical goods; specifically, logistics and supply chain education, although this can be extended to engineering management or construction. The approach is to adapt a scenario for presentation in a virtual environment whereby the situations that the learner must face are highly authentic and the activities or actions that they must undertake to resolve problems are authentic. This should ensure high levels of transference of skills developed in the virtual environment into their working life.

The high levels of engagement that are designed into the scenarios result from the inclusion of technology to raise immersion, the use of gamification techniques to hold and raise interest, and the soft technologies of an open environment to raise curiosity. First, HMDs, fluid and easily controlled interfaces, and a high degree of realism in the representation of the virtual environment combine to create a synthetic world that is both beautiful and compelling. Second, gamification techniques are used to influence the behaviour of the user in a way that they keep trying and working towards the solutions. These approaches include a range of integrated mechanics and elements ranging in complexity from points and leaderboards, to quests and challenges, through to save-points, multiple lives, and re-wind abilities. Third, the open environment provides learners the ability to explore, adjust, and examine the world around them. They are not 'stuck' in a classroom but instead have freedom of movement and intent within the environment. Yes, there are structures and guides throughout the environment that should be undertaken to complete educational objectives; however, there is also the ability to 'go off topic' for a while and try something new within the environment. This can raise the natural curiosity of the learner increasing their intrinsic motivation; meanwhile, careful design can create a situation where they fulfil educational requirements while still having fun.

Engagement with firms will enable us to create a compelling story based on a real setting, increasing the ability of learners to carry over skills from the virtual environment into real world activities. This will enable the creation of a series of modules that are stand-alone and may be completed individually, yet are linked together with a consistent flow in the elements of an integrated narrative (Reiners & Wood, 2013). Separate modules enable small changes to be incorporated between the storyline over the various modules. This model enables discrete scenarios to be developed without maintaining a perfectly connected story between scenarios.

Our next steps involve the addition of crucial gamification mechanisms designed to further encourage the learners to complete tasks. Following from these developments, the next set of experiments will involve testing the approaches used and verifying that the relationships hold. These will be used to determine the relative impact of different gamification mechanisms and how these are related to the development of intrinsic motivation in the learners. We are interested in encouraging and maintaining intrinsic motivation over time; thus, merely including points and leaderboards is perceived as being inappropriate and they therefore only constitute a portion of the overall environment.

The involvement of gamification mechanisms will be linked to the overall achievements of the learners. We hope to be able to connect various gamification elements to the development of intrinsic motivation and demonstrate an improved outcome consisting of improved performance.

16.6 Conclusions

The creation of a virtual environment can support authentic learning and assessment activities. Coupling the use of contemporary technology, such as HMDs, can enhance learner engagement in the scenario. It is not enough, however, to simply 'dump' things into the environment and tell students what must occur. Careful instructional design and thought is required to set up the environment to support learner engagement and awaken their sense of curiosity to draw them to particular situations. Thereafter, detailed design can be undertaken so that the activities of the learner are engaged towards the designer's objectives.

One of the key areas for future research is to determine whether or not such environments and programmes create long-term change in the learners. While existing studies show that skills and talents developed in virtual environments can be transferred to the real setting (e.g., Hebbel-Seeger (2014), chap. 15) there is little to indicate that the changes will 'stick' or be sustainable with the learner any longer than skills or talents developed in other ways.

The use of this approach within the business community has also been investigated. It is of interest particularly as it can be used to provide a fast and quick overview of a situation or an emerging hazardous area where dangerous situations may occur. While the approach outlined here can quickly and vividly re-create the situation for a worker in the virtual environment, it is not clear whether this would be any more effective than simply verbally cautioning them before they enter the specific area, or using a simple pen-and-paper based checklist or learning package. The costs associated with employing a virtual environment in this way are considerable and would therefore need to demonstrate (appropriate) value or benefit for the organisation before it could be successfully introduced.

The issue of cost vs benefit is an important one, even within the educational environment. Additional work is required to more clearly identify the economic trade-offs of this type of virtual environment. While using existing components can significantly reduce set-up times and costs, there is still (at this point in the project) a relatively high investment of time and expertise required, careful work could reduce this significantly. However, it is not known whether this can be accomplished in a way that engenders wider support in the community which would be necessary to lead to wide-spread adoption.

References

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives* (1st ed.). New York: Longman.

Biocca, F., & Delaney, B. (1995). Immersive virtual reality technology. In F. Biocca & M. Levy (Eds.), *Communication in the age of virtual reality* (pp. 57–124). Hillsdale, NJ: Erlbaum.

Björke, K. (2003). Seizing power: Shaders and storytellers. In *ICVS 2003* (vol. 2897, pp. 3–11). Berlin, Germany: Springer.

Brabazon, T. (2007). *The University of Google: Education in the post-information Age*. Hampshire, England: Ashgate.

Brethower, D. M., & Smalley, K. A. (1992). Performance-based instruction part 1: Definition and examples. *Performance + Instruction, 31*(3), 36–40. doi:10.1002/pfi.4170310311.

Cotter, J., Forster, J., & Sweeney, E. (2009). Supply chain learning: The role of games. *Supply Chain Perspectives, the Journal of the National Institute for Transport and Logistics, 10*. Retrieved from http://arrow.dit.ie/cgi/viewcontent.cgi?article=1002&context=jouacmiss&sei-redir=1&referer=http%3A%2F%2Fscholar.google.com.au%2Fscholar%3Fas_ylo%3D2008%26q%3D%2522The%2Bfresh%2Bconnection%2522%26hl%3Den%26as_sdt%3D0%2C5#search=%22fresh%20connection%22.

Dalgarno, B., Gregory, S., Knox, V., & Reiners, T. (forthcoming). Practising teaching using virtual classroom role plays. *Technology, Pedagogy and Education*.

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science, 323*(5910), 66–69. doi:10.1126/science.1167311.

Deterding, S. (2014, June 27). The lens of intrinsic skill atoms: A method for gameful design. Human–computer interaction. Special Issue "HCI and Digital Games," Forthcoming. Retrieved from SSRN: http://ssrn.com/abstract=2466871.

Fardinpour, A., Reiners, T., & Dreher, H. (2013). Action-based Learning Assessment Method (ALAM) in Virtual Training Environments. In H. Carter, M. Gosper, & J. Hedberg (Eds.), *Electric Dreams. Proceedings ascilite 2013* (pp. 267–277). Sydney, NSW, Australia.

Feng, K., & Ma, G. (2008). Learning supply chain management with fun: An online simulation game approach. *California Journal of Operations Management, 6*(1), 41–48.

Fujimoto, R. (2012). *Games and failure*. Retrieved from http://shoyulearning.wordpress.com/2012/05/20/games-and-failure/

Hanna, M. D. (2000). Touring a supply chain with students: Pedagogical and practical considerations. *Production and Operations Management, 9*, 203–211. doi:10.1111/j.1937-5956.2000.tb00334.x.

Hebbel-Seeger, A. (2014). Physical skills and digital gaming: The relationship between basketball and an augmented reality adaption. In T. Reiners & L. C. Wood (Eds.), *Gamification in education and business*. New York: Springer.

Herrington, J., Reeves, T. C., & Oliver, R. (2010). *A guide to authentic e-learning*. New York: Routledge.

Huang, H.-M. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 33*(1), 27–37. doi:10.1111/1467-8535.00236.

Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development, 47*(1), 61–79. doi:10.1007/BF02299477.

Kuijpers, R. P. (2009). *Supply chain risk management game: The design, construction, testing and evaluation of a serious game that facilitates learning about Supply Chain Risk Management* (Master of Science). Delft University of Technology, Delft, The Netherlands. Retrieved from https://www.google.co.nz/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB0QFjAA&url=http%3A%2F%2Frepository.tudelft.nl%2Fassets%2Fuuid%3A5d678557-669f-4c34-bac5-2a861454bc0e%2FKuijpers%2520R.pdf&ei=kV6mU56OMsfNkwXWmoHwCQ&usg=AFQjCNG9plpWKt6gHiDmNrZ9FMKGbVpEnA&sig2=U8chT30IpoSAxG7YzczeEA&bvm=bv.69411363,d.dGI

Lee, M. J., Dalgarno, B., Gregory, S., Carlson, L., & Tynan, B. (2013). How are Australian and New Zealand higher educators using 3D immersive virtual worlds in their teaching?.

Lombardi, M. M. (2007). *Authentic learning for the 21st century: An overview*. ELI Report No. 1. Boulder, CO: EDUCAUSE Learning Initiative. Retrieved from http://www.educause.edu/ir/library/pdf/ELI3009.pdf

McGonigal, J. (2011). *Reality is broken, why games make us better and How they can change the world*. London: Random House.

Neal, L. (2001). Storytelling at a distance. *Elearn Magazine*, *May*. Retrieved from http://elearnmag.acm.org/featured.cfm?aid=566979

Palmer, F. (1995). Interpersonal communication and virtual reality: Mediating interpersonal relationships. In F. Biocca & M. Levy (Eds.), *Communication in the age of virtual reality* (pp. 277–302). Hillsdale, NJ: Erlbaum.

Pedersen, E. M. (1995). Storytelling and the art of teaching. *English Teaching Forum, 33*(1), 2–5.
Pirker, J., Berger, S., Guetl, C., Belcher, J., & Bailey, P. H. (2012). Understanding physical concepts using an immersive virtual learning environment. *Proceedings of the 2nd European Immersive Education Summit, Paris*, pp 183–191.
Porth, S. J. (1997). Management education goes international: A model for designing and teaching a study tour course. *Journal of Management Education, 21*, 190–199. doi:10.1177/105256299702100204.
Reiners, T., Teräs, H., Chang, V., Wood, L., Gregory, S., Gibson, D., et al. (2014). Authentic, immersive, and emotional experience in virtual learning environments: The fear of dying as an important learning experience in a simulation. In *Transformative, innovative and engaging. Proceedings of the 23rd Annual Teaching Learning Forum, 30–31 January 2014. Perth: The University of Western Australia.* Retrieved from http://ctl.curtin.edu.au/professional_development/conferences/tlf/tlf2014/refereed/reiners.html
Reiners, T., & Wood, L. C. (2013). Immersive virtual environments to facilitate authentic education in logistics and supply chain management. In Y. Kats (Ed.), *Learning management systems and instructional design: Metrics, standards, and applications* (pp. 323–343). Hershey, PA: IGI Global.
Reiners, T., Wood, L. C., Chang, V., Guetl, C., Herrington, J., Teräs, H., et al. (2012). Operationalising gamification in an educational authentic environment. In P. Kommers, T. Issa, & P. Isaías (Eds.), *IADIS international conference on internet technologies & society 2012* (pp. 93–100). Perth, WA: IADIS.
Reiners, T., Wood, L. C., Gregory, S., Petter, N., Teräs, H., Gütl, C., … Herrington, J. (2013). nDiVE: The story of how Logistics and Supply Chain Management should be taught. In M. Gosper, J. Hedberg, & H. Carter (Eds.), *Electric Dreams. Proceedings ascilite 2013* (pp. 734-744). Sydney, NSW: HERDSA.
Reiners, T., Wood, L. C., Gregory, S., & Bastiaens, T. J. (2014). Experimental study on technology-induced authentic immersion in virtual worlds for education and vocational training. *Curtin University of Technology*. Retrieved from http://espace.library.curtin.edu.au:80/R?func=dbin-jump-full&local_base=gen01-era02&object_id=199350
Reiners, T., Wood, L. C., & Dron, J. (2014). From chaos towards sense: A learner-centric narrative virtual learning space. In J. Bishop (Ed.), *Gamification for human factors integration: Social, educational, and psychological issues*. Hershey, PA: IGI Global.
Wood, L. C., & Reefke, H. (2010). Working with a diverse class: Reflections on the role of team teaching, teaching tools and technological support. In H. Huai, P. Kommers, & P. Isaías (Eds.), *IADIS international conference on international higher education (IHE 2010)* (pp. 72–79). Perth, WA: IADIS Press.
Wood, L. C., & Reiners, T. (2012). Gamification in logistics and supply chain education: Extending active learning. In P. Kommers, T. Issa, & P. Isaías (Eds.), *IADIS international conference on internet technologies & society 2012* (pp. 101–108). Perth, WA: IADIS Press.
Wood, L. C., & Reiners, T. (2013). Game-based elements to upgrade bots to non-player characters in support of educators. In A. Hebbel-Seeger, T. Reiners, & D. Schäfer (Eds.), *Synthetic worlds: Emerging technologies in education and economics* (pp. 257–277). Berlin, Germany: Springer.
Wood, L. C., & Reiners, T. (2014). Gamification. In M. Khosrow-Pour (Ed.), *Encyclopedia of information science and technology* (pp. 706–714). Hershey, PA: Information Science Reference (an imprint of IGI Global).
Wood, L. C., Reiners, T., & Bastiaens, T. J. (2014). Design perspective on the role of advanced bots for self-guided learning. *The International Journal of Technology, Knowledge and Society, 9*(4), 187–199.
Wood, L. C., Teräs, H., Reiners, T., & Gregory, S. (2013). The role of gamification and game-based learning in authentic assessment within virtual environments. In S. Frielick, N. Buissink-Smith, P. Wyse, J. Billot, J. Hallas, & E. Whitehead (Eds.), *Research and development in higher education: The place of learning and teaching, 1–4 July 2013* (Vol. 36, pp. 514–523). Auckland, New Zealand: HERDSA.
Wood, L. C., Teräs, H., & Reiners, T. (2013). The role of gamification and game-based learning in authentic assessment within virtual environments. In *The Proceedings of HERDSA 2013*. Auckland, New Zealand: HERDSA.

Chapter 17
Shaping Behaviours Through *Space* and *Place* in Gamified Virtual Learning Environments

Da Zhang and Tony Clear

17.1 Introduction

Gamified designs and virtual environments add new opportunities and considerations to the nature of learning. In these settings the notion of 'game' has been expressly separated from the notion of 'play' (Caillois, 1961), and been incorporated into the learning and teaching activities, with varying degrees of seriousness. Aiming to demonstrate how behaviours may be shaped in gamified virtual learning environments, a critical incident (namely of avatar harassment) in an early 3D collaborative virtual environment (CVE) setting is revisited here based on the notions of 'space' and 'place'. The case studies presented here, arising from a long term action research programme into globally distributed teams and collaborative technologies (Clear & Kassabova, 2008), demonstrated our lack of understanding of people's natural behaviours in VEs, which we believe resulted in an 'unsafe' VE and unintentional game designs. In this chapter, an exploration of the notions of 'space' and 'place' provides a platform upon which we examine our previous efforts, reveal the missing element of policy and produce a framework for incorporating gamified designs into VEs. The findings of the research include a coherent set of policies to govern the VEs, and a model explaining how meaningfully gamified designs can help shape productive behaviours and avoid the dark side of gamification in a virtual learning environment.

D. Zhang (✉) • T. Clear
School of Computer and Mathematical Sciences, Auckland University of Technology, AUT Tower, WT 704 SERL 2-14 Wakefield Street, Auckland 1010, New Zealand
e-mail: dazhang@aut.ac.nz; tclear@aut.ac.nz

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_17

17.2 Literature Review

17.2.1 Gamification

Deterding, Dixon, Khaled, and Nacke (2011) define gamification as "the use of game design elements in non-game contexts". This definition is based on the concept that games and play denote two different behaviours or meanings, and gamification relates to games, not play. In Caillois's (1961) analogy, paidia and ludus are two poles of play activities. Paidia (or playing) represent a more free-form, expressive notion, in contrast, ludus (or gaming) emphasizes playing rules, and competitive challenges. Deterding et al. (2011) argue that a more comprehensive comparison between gaming and playing will be conducive to clarifying the definition of gamification. For example, the concept of gamefulness versus playfulness could imbue gamification with the notion of the qualities of gaming experience. Deterding's definition provides a theoretical guideline for applying gamification design. However, as Huotari and Hamari's (2012) studies suggest, this definition may become questionable, since the description of elements that are characteristic to games remains equivocal. Viewed from the perspective of service marketing, Huotari and Hamari believe the affordance of gamification derives from gamefulness which is a unique experiential condition to games, rather than a set of undetermined "game elements". Accordingly, the benefits of using gamification derive from the gameful experiences. With an emphasis on users' subjective experience, Huotari and Hamari's (2012) gamification definition refers to "a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation". McGonigal (2011) in discussing the positive contribution of games explicitly illustrates a series of comparisons between gameful experiences and reality. In the light of gamification, the discussion implies dual meanings. First, it reveals the positive emotions emanating from gameful experiences. In her TED presentation (McGonigal, 2010), she further summarized them as urgent optimism, social fabric, blissful productivity, and epic meaning. They consist of the motivation affordances of gamification. Second, the fourteen gameful experiences mentioned may indicate fourteen game designs that could be exploited in reality. Deterding et al. (2011) categorise game design elements into five levels, ordered from concrete to abstract, including: Interface design patterns; game design patterns or game mechanics; design principles, heuristics or 'lenses'; conceptual models of game design units; game design methods and design processes. Most of the elements are coincident with gameful experiences introduced in McGonigal's book, thus the motivational affordances of these elements appear consistent with the psychological factors identified by McGonigal. However, without a systematic understanding of the effect of particular elements, how best to apply game design elements in non-game contexts is still under exploration.

17.2.2 Structure of Collaborative Virtual Space

Here, the notion of *space* is discussed with two goals. The first is to build a comprehensive policy framework for governing VEs. The second is to explore how to incorporate game designs into VEs. Harrison and Dourish (1996) conceive space as "the structure of the world; it is the three-dimensional environment in which objects and events occur, and in which they have relative position and direction" (p.68). In the physical world, human action and behaviours have been shaped by features of space, including relational orientation and reciprocity, proximity and action, partitioning, presence and awareness. However, they contend that "in every-day action, this appropriate behavioural framing comes not from a sense of space, but from a sense of place" (ibid.). This concept provides a ground for designing and governing space, by separating the notion of '*place*' from '*space*'. Clarifying the relationship between the two reveals how a *space* could become a *place*. Harrison and Dourish's (1996) well cited principle states that "space is the opportunity; place is the understood reality". Stoner's (1991) observation in a small town nicely explained this principle in reality, where she recorded residents' daily lives within a narrow street, and found the same street (*space*) could be used for different activities (*place*). In the phenomenon of VEs, space manifests itself as spatial metaphors in a text based virtual space (for instance, the sections of an on-line forum), through a simulated spatial sense in 2.5D (isometric projection) and in a 3D virtual space. Yet this virtual *space* becomes transformed into a *place* when carrying certain socially relevant meanings. From the perspective of building virtual teams, Hamrin and Persson (2010) proposed the concept of "team place" which is (1) a space where people have shared purpose including a shared understanding on workflows, on how to establish connection appropriately, and finally a shared practice, (2) a place moderated by policies and time (also presented in their figure 15 below). This definition introduces the policy dimension for a virtual space. Dourish's (2006) further clarification on the distinction between 'space' and 'place', reveals the affordances of 'space', which we believe, combined with these understandings of 'place' help produce a comprehensive picture of a VE. To further develop these ideas a Behaviour Mapping Model is proposed in this chapter. Building on the model, we then discuss the policy and gamification dimensions within a VE.

17.2.3 Policy

Shea (1994) defines netiquette as the etiquette of cyberspace; rules of netiquette should be built on common courtesies and should adapt computer culture. She introduces ten core rules for netiquette, among which "Rule 1: Remember the human" (Shea, 1994, p. 35) and "Rule 2: Adhere to the same standards of behaviour online that you follow in real life" (ibid. p. 37) are considered as the basic manners of cyberspace. Rules 3–10 are based on the computer culture of that time when the interpersonal communication in cyberspace primarily relied on written messages. These eight rules are still applicable to current VEs, but inadequate. Second Life (SL) extends the ten core rules and establishes a set of social interaction norms called SLetiquette (SLetiquette 2014), in which the appropriate appearance and physical behaviour of avatars are defined.

In a virtual world, people are expected to comply with netiquette rules. However, when violations (including avatar harassment, invasion of privacy, deception, etc.) occur, policies should be laid down to address these unacceptable behaviours. Preece (2004) has noted two well-known approaches for online etiquette, namely 'setting rules' and 'moderating discussions', which "can be effective but often prove inadequate". Therefore, in addition to prescribed codes of conduct and moderating roles it will be useful to define further mediating roles (moderators, role models, mentors, etc.) and adopt more technology reliant approaches (filters, community tools, technically oriented processes, etc.).

Moreover, in reality, policy rules are always supported and complemented by laws, but in the virtual world, policies can suffer from a legal vacuum in some areas. For example, harassment has been explicitly defined in Auckland University of Technology's policy (AUT Harassment prevention and support, 2013), covering verbal (written or oral) or physical harassment. Harassment behaviour may lead to breaching University policies or committing crimes. However, its alternative in virtual space called "Cyberbullying" only refers to verbal harassment, since the definition for 'physical' harassment remains obscure in an online setting. For example, Shariff (2005) describes cyberbullying as a covert form of verbal and written bullying. At AUT, "we perform our teaching, research and other duties as defined under the Education Act (1989)" (AUT University's background, 2014), which stipulates that, institutions must provide a safe physical and emotional environment for students. Though the provision is not explicitly extended to virtual space, it is argued that an institution is allowed to intervene if cyberbullying has implications for student's well being while at school. The situation is similar in America and Canada where a school has an obligation to prevent student from cyberbullying if such expression disrupts learning (Shariff, 2005).

17.3 Case Study

This section draws heavily upon the early work reported in Clear (2004), recounting a collaboration cycle, one of a series within an ongoing action research programme (Clear & Daniels, 2003), which was designed with both learning and research related goals. Subsequent design and theoretical work (Clear, 2007) and that of Hamrin and Persson (2010), discussed later has developed upon these ideas. From a learning perspective the collaboration aimed to give students exposure to collaborative applications. Students co-operated in global virtual teams spanning cultural, geographical and temporal boundaries, since there was a 12-h time zone difference between New Zealand and Sweden. The research focus related to exploring the differences between 2D and 3D icebreaking techniques (online icebreaker games) in global virtual teams. Implicit in this activity were some gamified elements, although at that early time these were not developed in a manner fully conscious of gamified designs.

The 3D environment was provided by "Teamlink" (Clear & Foot, 2002), a JAVA 3D client server application developed as a research prototype at AUT. Students were required to configure personal avatars (in this instance Lego-type figures) through which to represent themselves, and collaborate with other group members (local and remote) within their own rooms of a virtual world resident on their local client machine. Movement, conversation and configuration data for groups and avatars in the virtual rooms was in turn accessed from a central server hosted at the Auckland location.

In the initial stage of the collaboration, students were required to become acquainted with their remote team members using one of two modes of cyber icebreaker (a 2D Lotus Notes™ forms based icebreaker game and the 3D avatar based icebreaker). The web forms based icebreaker was so designed that students worked through a linear process online involving a guessing game about their characteristics, which they had hidden but revealed obliquely through clues. Given the large time difference between sites, both icebreaker treatments had been designed to operate asynchronously—admittedly a somewhat counter-intuitive design for a 3D application.

Upon completion of their icebreaking phase, students were required to conduct an evaluation in which they indicated their preference for the 2D or 3D icebreaker mode. The Lotus Notes collaborative application then collated each team's decision for display and online review. To that extent the exercise incorporated an element of competition.

17.3.1 The Critical Incident

At the beginning of the trial students in allocated teams were instructed to log in and familiarize themselves with the 3D icebreaker application, configure their personal avatar profiles, and interact with other team members by creating a "sequence of steps" within their team's 3D "thread".

Perhaps the key aspect to consider here is that the students were instructed simply to "interact" with their fellow group members in the 3D space. While an internal trial iteration at AUT the previous semester had provided some confidence, we had doubts about our ability to get this experimental application working at all between the two remote sites. There was a requirement to install the clients on machines at each site, and uncertainty over how well the instructions would cover the required installation and configuration processes. We also had concerns over the stability of the new application, its ability to handle load, and how students should or would use this experimental space. Further we had not wanted to preordain how students should use this new space. Therefore we had consciously left the choice of activities open for the participants to enact themselves.

17.3.2 Data Sources

The available evidence to support the analysis conducted comes from a rich variety of sources, enabling a detailed picture of the critical event and surrounding perceptions to be reconstructed. A review of the instructions given the students, student evaluations given online and in group review sessions and a review with the class lecturer and co-researcher gave insight. Complementing these sources were several forms of empirical data from records stored in the database of the application. These included: 3D avatar configurations, user, groups & access data; 3D trial logs; 3D icebreaker threads, sequences and steps—stored in the MS-Access database and replayable as desired, enabling a session to be recreated "to support…aspects of the research process" (Benford, Fraser, Reynard, Koleva, & Drozd, 2002); 2D database weekly progress entries were also available in online logbooks.

17.3.3 The Drunken Avatar Encounter

In the second week of the trial an AUT female student reported a disturbing incident to her class lecturer. She had formed the impression that one of her collaborating colleagues from Sweden had been mischievously interfering with her avatar persona, in a manner that she considered inappropriate. The activities surrounding this incident are summarized below.

17.3.3.1 Timeline

The first week of the trial began in a relatively innocuous fashion, with team members familiarizing themselves with the 3D virtual space and the application. Avatars were configured successfully by AUT students and made some exploratory steps in the space. Towards the end of the week a Swedish student (YP) entered the virtual room, and ran about after introducing himself as "a drunken polar bear".

At the end of the sequence of steps he had contributed to the "3D thread", however, he walked up to stand very closely behind a female AUT avatar (VC) (cf. Fig. 17.1), smiled, then in a subsequent sequence walked right through her and waved. After an intervening weekend, VC on returning to the room confronted YP with the words "Hi, I hope you have a hangover from your drunken polar bear behaviour. I was unsure what you were doing to me before but for some reason I turned white". VC also mentioned the event to her class lecturer, implying that she thought YP had somehow gained access to her avatar persona, and 'stripped' her back to the bare white essentials.

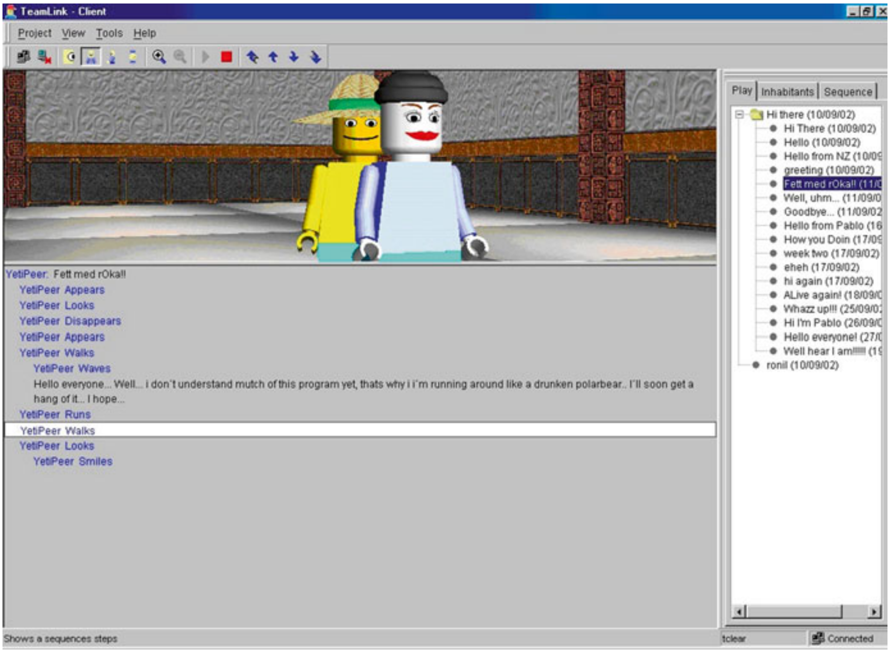


Fig. 17.1 Avatars misbehaving - the “Drunken Polar Bear”

17.3.4 Perceptions and Reality

Several sources of data were further analysed in an attempt to better comprehend both the perceptions and the reality underlying this incident. By carefully playing back the 3D sequences in the “Teamlink” application, it was apparent that the “drunken polar bear” avatar had shown a certain teenage male bravado, but it appeared that he had walked through not only VC’s avatar but another. By detailed analysis of the effects of this avatar merging, it appeared that the impacted avatar characters on the screen would often turn black, but not white as observed by VC. A further analysis of data items stored in the 3D database also verified that YP had not interfered with VC’s avatar persona. The avatar characteristics (face, shirt colour, hat etc.) used in each sequence had been stored on the database to enable their reproduction should owners change their characteristics mid-stream. VC’s avatar properties had remained constant throughout. The observed “whitening” of VC’s avatar must have been a screen effect as the two figures merged in avatar collisions.

In the following sections, we evaluate the game elements in operation in the collaboration and try to explain student behaviour within 3D CVEs from the perspectives of ‘space’ and ‘place’.

17.4 Gamification Elements in the 2D and 3D Collaborative Virtual Environments

The elements of gamification in the two different icebreaking modes applied in the study are tabulated in Table 17.1 against the model for game design elements proposed by Deterding et al. (2011).

It is apparent from Table 17.1 that the game design elements are more consciously designed into the 2D icebreaker, which was translated from a proven face to face version of an icebreaker game kindly donated by a colleague Dr Elyssebeth Leigh. There were obvious missing elements in the 3D version, which by merely providing a virtual 'room' in which students could mix and mingle without a more defined set of goals or challenges left more scope for errant behaviours to result. Perhaps the ill-defined nature of this virtual 'space' led to these unwanted outcomes.

17.4.1 Reflections on the Incident

In the case study, we had set up a CVE in both a 2D (a web-based groupware application) and 3D (a 3D virtual environment) Model. Student evaluation of the contrast between them shows that both the 2D and 3D icebreaker activities were capable of building trust and developing shared purpose for the virtual learning teams (Clear & Daniels, 2003). However, from the perspective of organizing activity and using game elements in virtual space, we consider the 2D model was more effective than the 3D one, for the reasons below:

- The 2D model structured a 'no confusion' environment where students acted with a clear purpose of making acquaintance with teammates through playing a guessing game. During the process, a clear social etiquette was followed. No abusive language was reported and observed in the text and graphic based communication. And there was no complaint of annoying behaviour.
- The goal of game elements aligned with the collaborative purpose. As shown in Table 17.1, a series of game elements, including time constraint, playing in pairs and in turn, challenge and reward, appeared in the icebreaker activities, which propelled students through a sequence of steps. Though we don't know how much fun or motivation was contributed by any specific element, the linear icebreaking process of the guessing game allowed students to perform icebreaker tasks smoothly without confusing or distracting them.

In the 3D model, one more dimension was introduced into the virtual space to afford a more multidimensional means of representing the self in cyberspace. A 3D empty room was set up where students could encounter each other and the 3D avatar allowed students to communicate with their teammates and surroundings by creating a sequence of simple movements (for instance, smile, wave). Unfortunately,

Table 17.1 Mapping of game design elements to 2D and 3D icebreaker applications

Level	Description	Example	2D icebreaker	3D icebreaker
Game interface design patterns	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leaderboard, level	Not extensively gamified sequential web forms	Not extensively gamified 3D room, avatars and multiple views (1st, 2nd, 3rd person & helicopter) 3D version of a discussion thread
Game design patterns and mechanics	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns	Time constraint (12 h time zone distance), asynchronous, turns	Time constraint (12 h time zone distance), asynchronous, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Game models Conceptual models of the components of games or game experience MDA; challenge, fantasy, curiosity; game design atoms; CEGE	Challenge—paired players guess content of an envelope based on clues posted by other player single game style. Inter global virtual team competition and scoring	Left undefined, players to meet in room and converse and 'socialise' game style unclear
	Enduring play, clear goals, variety of game styles			
Game models	Conceptual models of the components of games or game experience	MDA; challenge, fantasy, curiosity; game design atoms; CEGE	Face to face icebreaker game model adapted to web forms played in pairs and in turn with team scores	Sequences of replayable primitive actions for avatars—walk, run, smile, turn, icebreaker ill defined curiosity of encountering strange team members inherent
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design	Curiosity inherent not incorporated prototyping, field testing	Not incorporated game informed custom developed software, unit and system testing, field testing

such settings also resulted in confusion within the virtual space. Although the students had a clear goal of meeting teammates when logging into the 3D virtual space, students' negative comments suggested that they were uncertain about what to do when arriving there. Apparently, aimlessly wandering in an empty room confused them in the virtual space. Consequently, it's no surprise that the students VC and YP held different personal understandings on the 3D environment, which we believe in turn led to the incident. In contrast to the 2D icebreaker game, the 3D model provided more self-representation but less instructional guidance, which meant that the expected purpose of the exercise was not well addressed in the 3D environment. Further examination reveals multiple understandings afforded by the virtual space, including the individual understandings, the degree of shared purpose among students, and the 3D icebreaker activities we expected to see, based on which a variety of different behaviours appeared in the virtual space.

At the early stage of 3D icebreaker activities, some game elements were unconsciously imported into the environment. While there was no specific game design or no playable 'activity', students felt that the 3D environment and self-representation with avatars injected more elements of fun and excitement into the virtual space than the 2D model (Clear & Daniels, 2003). Later evaluation shows that the more enjoyable experience led to a better completion rate. Apparently, the game elements partially met our expectations for the 3D model, and subsequently improved students' motivation in playing with the avatars. Still, the game elements lacked clear instructional information and failed to reduce the confusions caused by the empty room. The 3D avatar-based conversation did not include any specific process for helping students blend into the new environment, which resulted in the unintentional game elements which failed to align with the underlying context of 3D learning environments, and then failed to prevent "Drunken Polar Bear" from behaving in an annoying fashion.

In a later version of the software we revised the design in order to offer more structured 'activities' and spaces to support collaboration and make fuller use of the "3Dness" of the application. Fig. 17.2 presents an "activity" captured through a 'helicopter' camera view, in which students had to position their avatars in one of four quadrants illustrating their food preferences. From the students perspective the "activity" was more fun than a normal group activity as they were motivated to join by their curiosity about others' choices, which could be conceived as a game element based on Table 17.1. Compared to the earlier design of an empty 3D room, the gamified group activity made the 3D environment more like a social place by providing an occasion for students to socialise within their surroundings. As designers, we consider it was a beneficial game design since it was able to motivate the students to join an activity designed to achieve the expected purpose of introducing team members to the collaboration. The observations made from evaluating the 2D and 3D models indicate that the various understandings afforded by a VE provide an interface for moderating people's behaviours and for incorporating game elements into virtual space.

The key distinction between 'space' and 'place' pointed out by Harrison and Dourish (1996) provides an approach for capturing the various understandings

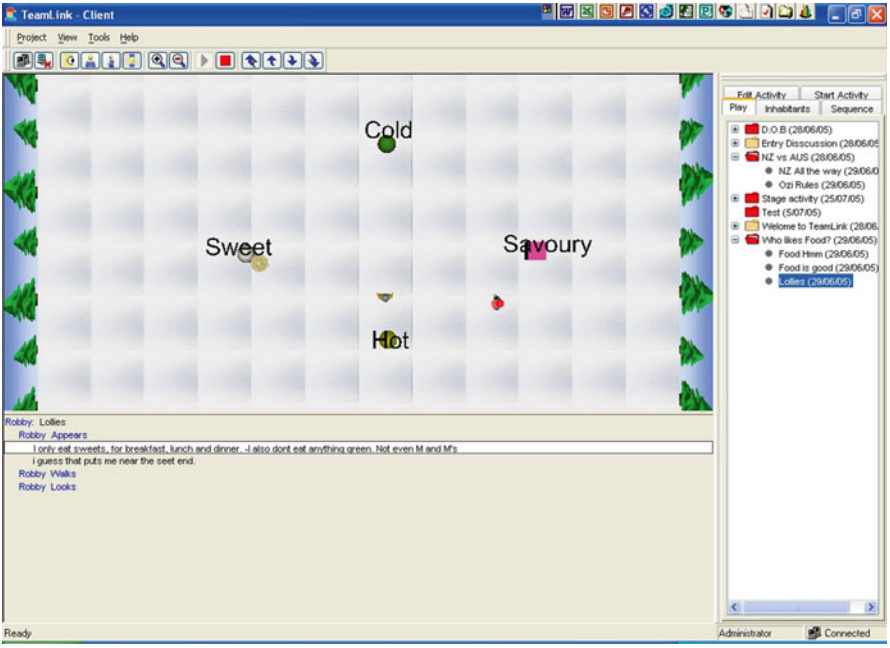


Fig. 17.2 Activity based icebreaking in the 3D CVE

which relate to virtual space. While the 3D virtual world provided a room, this bland room really only constituted a 'space', in which students might locate themselves but there were no accompanying social structures or rules of behaviour. This virtual world needed to be transformed into a 'place' "invested with understandings of behavioural appropriateness, cultural expectations and so forth" (Harrison & Dourish, 1996). Therefore the application needed to take the leap from "space… the opportunity" to "place…the understood reality" (ibid.).

The challenge as project sponsor was how to envisage a design for moderating or controlling users' behaviours within the 'space' and ultimately lead them into the designer's preconceived 'places'. The final solution as demonstrated in Fig. 17.2 involved the notion of an "activity" taking place within a scene, as a context within which icebreaking could be conducted. An activity would have a duration, enable named objects to be placed in the space, and have a focusing instruction, which would require avatars to locate themselves in the physical space in relation to one another and/or the placed objects. Thus a form of "sociometric readout where group members physically display their connections with each other" (Carter, 2002) could be supported within the application, and avatars would be able to orient themselves relative to one another based upon an icebreaking activity. These elements moved the "Teamlink" design closer to creating a 'safe' VE, within which actors could act more predictably.

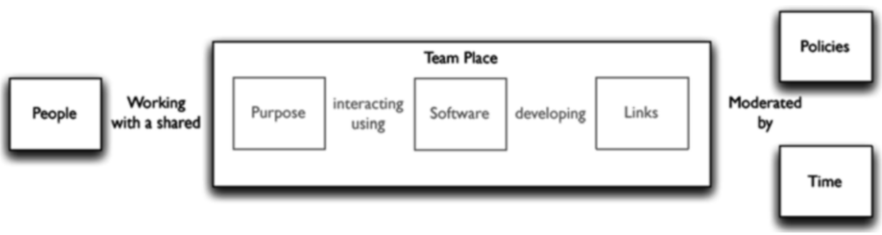
17.5 Reconceptualising Virtual Environments

To better inform such 'space' and 'place' designs, understanding the functioning of VEs at a conceptual level is challenging. For instance conceptualising the phenomena of 'space' and 'place' in CVEs raises several complex and subtle questions, canvassed well by Harrison and Dourish (1996) and again in Dourish (2006), and further addressed in a global setting by Hamrin and Persson (2010) and with a focus on mobility in globally distributed teams by Clear, Hussain, and MacDonell (2012).

17.5.1 *Creating a Team Place*

Harrison and Dourish (1996) believe the critical distinction between 'space' and 'place' provides an approach for structuring virtual space. According to them, "Physically, a place is a space which is invested with understandings of behavioural appropriateness, cultural expectations, and so forth", thus the creation of a place could be conceived as a process of understandings emerging and evolving within space. Hamrin and Persson (2010) following up on these notions, pointed out that "The creation of place requires the ability for users to appropriate the space, be it virtual or physical, to make it their own. The place must also have purpose, otherwise it will be either short lived or not likely gain much interest" (p.23). Their explanation elaborates the creation process by incorporating the elements of individual understandings and perceptions and the purpose of a place. They further developed a model for representing a "Team Place" based upon their work evaluating the 3D CVE application profiled in this chapter, and expressed it thus:

> This view consists of People, Purpose, Software, Links, Policies and Time and it is derived from Lipnack and Stamps (2000) definition of Virtual Teams as people working with a purpose across links over time. It has been expanded to include elements of Preece's (2000) definition of an online community, comprising of People, Policies, Purpose and Software (see chapter 3.9). While examining place in relation to Virtual Teams and communities, it is striking how many similarities there are on a conceptual layer, considering place as a setting for action and correct behavior. As a concept on its own, place does not say anything about communication amongst its inhabitants it but when applied in this setting, the place that is created set the stage for mutual understanding, These understandings have brought us to form this view of a virtual team (figure 15).



As can be seen from their figure 15, the model comprises multidimensional elements. Applying it to our 3D CVE, the people element represents the individual student possessing personal understandings about the space, the purpose element corresponds to the shared understandings, and the policies reflect the will of the *space* designer. During the icebreaker activities, a shared purpose of making acquaintances emerged in the space; the students who adopted this idea of purpose thus entered into the "Team Place" and became able to perform collaborative activities. The "Drunken Polar Bear's" behaviours indicate that he only captured parts of the shared purpose, and thus is perceived as wandering outside the "Team Place". Because of the different personal understandings, the "Drunken Polar Bear's" form of engagement with the collaboration suffers from conflict or ambiguity, resulting in, for example, the reported incident. The policies element provides an opportunity to inject additional designer understandings, which could be preferred social norms or some pre-established purpose, into the virtual space. Apparently, these understandings were missing in our 3D CVE. While Hamrin and Persson's model did not explicitly address the presence of 'space', both "Team Place" and each element are hosted by 'space'. The ability of interacting with the people elements as well as the ability to embody various understandings, suggests that space is not just able to provide infrastructure settings, but is also capable of affording social meanings. Dourish's (2006) further clarification on the distinction of 'space' and 'place' reveals the affordances of space. He argues that "the predominant relationship between place and space has looked at space as pre-given and place as a social product… However, I have argued for a different perspective, one that recognizes the ways that both space and place are products of embodied social practice" (p. 301).

The affordances of 'space' and 'place' here may constitute a 'room' which is full of opportunity for a variety of different behaviours to emerge and evolve. As for the CVEs, a pre-established shared understanding, which reflects the expectations of the activity designer, has been injected into the virtual space during construction. When a participant steps into the space and starts to interact with surroundings, an 'individual/personal place' emerges, which embodies the individual's understandings about the space. Besides the pre-established purpose, other forms of shared understanding might be produced during the collaboration. Gradually, a range of different behaviours appear in a CVE. As for a single user VE where users interact with a system separately, shared understanding does not exist. Only two types of individual behaviours, the expected and unexpected exist. In these circumstances, the policies, which provide an opportunity for moderating participants' behaviours, become necessities of the space. Applying game elements into the space offers another opportunity for facilitating or motivating certain behaviours.

The above discussion has illustrated the emergence and the evolution process of people's behaviours within virtual space, and also revealed the roles of policies and game elements in virtual space. We argue that such understanding provides a grounding upon which a full-fledged policy framework could be built, and from which game elements could be coherently incorporated into virtual space. In the following section, we further propose a model for visualizing the notions of 'space' and 'place' as well as various behaviours existing in virtual space.

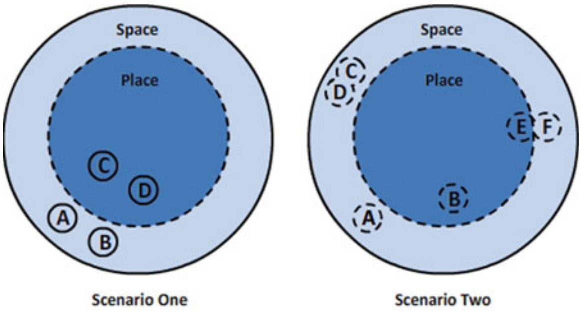


Fig. 17.3 Behaviour mapping model

17.5.2 Behaviour-Mapping Model for Space and Place Incorporating Aspects of Policies and Gamification

We borrow the design of Clear et al.'s (2012) Mobility Mapping Model which separated three distinct spheres of a globally distributed team including a virtual space (somewhere), an accessible and determinate space (known where), and an inaccessible and indeterminate space (elsewhere). Actors within these spheres could traverse through permeable boundaries to enable new forms of connection. Then we cast Hamrin and Persson's (2010) "Team Place" Model into the Behaviour Mapping Model.

As illustrated in Fig. 17.3, the model manifested the virtual space in a concentric structure of two spheres. From outside to inside, are the spheres of Space and, Place. Individuals could wander and act within the spheres, which are determined by the introduced and emerging understandings of the user, namely an 'Individual Place' in this model.

17.5.2.1 The Individual Place

The notion of 'Individual Place' is proposed here to illustrate personal behaviours within a virtual space. The creation of 'Individual Place' is the product of interactions of the individual and surroundings. It represents personal understandings on the space which in turn shaped individual's behaviours. Scenario One of Fig. 17.3 depicts a single user VE and the 'Individual Place' is represented by a solid circle which indicates that users "cannot see each other". The individual has ongoing awareness of activities, but does not have the sense of other users' presence. In such a scenario, people's behaviour either meets or does not meet the expected practices of the designer. Accordingly they either move into the place sphere or remain in the space sphere. Scenario Two illustrates a CVE, the 'Individual Place' here with a dotted circle indicates that users are able to interact with each other. Subsequently, collaboration may occur among participants. It is worth noting that a shared understanding is necessary for the creation of "Team Place" rather than being a prerequisite of collaboration. But the type or degree of shared understanding could affect the output of collaboration. Thus collaboration may occur among any individuals within the CVE, and the output varies depending on the shared understanding. For example, the collaboration between participants C, D might offer a good experience for them but may result in damage for the space, due to their unexpected behaviours. Collaboration among participants A, B, C may similarly end in conflicts or an unintended and unexpected “Team Place”. However, in both environments, the individual, staying in the Space sphere (A, B in Scenario One and A, C, D, F in Scenario Two), always has the opportunity to step into the Place sphere. For a space designer or creator, this opportunity could be afforded by explicit policies and supportive game designs.

17.5.2.2 The Sphere of Space

In these modelled scenarios, the Space Layer (the whole area within the outermost solid boundary) represents a ‘space’, which provides the fundamental infrastructure and associated social meanings (a text-based virtual space, a simulated 3D environment, etc.) for affording various understandings. In our case study, when students log into the 3D environment, the virtual space could mimic for them the spatial sense that people possess in reality, for example the sense of up, down, left, right, distance, and personal space. During such interactions, the personal understandings of ‘individual place’ can expand and be formed gradually. However, students still cannot perform any tasks until stepping into the Sphere of Place.

17.5.2.3 The Sphere of Place

In this model, ‘place’ is presented as the Sphere of Place which lies in and is surrounded by the Sphere of Space. This structure echoes Harrison and Dourish’s (1996) opinion that “Place is in Space”. And we use the Sphere of Place to represent the pre-established understandings, or “spirit” (DeSanctis & Poole, 1994) of the collaborative technology, injected by the activity designer. In a single user VE, the understandings are expected behaviours for individuals. When in CVEs, the understandings are expected shared practices. In the 3D environment, if students fail to capture either the shared purpose or shared social practices or both, they are viewed as staying in the Space sphere, for example the “Drunken Polar Bear”, whereas in the more delineated 2D icebreaker activity, students could easily enter into the sphere of Place and become ready to collaborate with other students. In this model, a bigger sphere for Place and a relatively smaller sphere for Space indicate the ‘place’ is well constructed and people could easily blend into it. As discussed above, the Place sphere is not the only form of shared understanding in the space; other forms may exist at the same time. In the Scenario Two of Fig. 17.3, different forms of shared understandings emerge among participant C, D, and E, F. Both could be conceived as a “Team Place”, according to Hamrin and Persson’s (2010) model.

17.5.2.4 The Policy Dimension

According to the proposed model, from the designer's perspective the space is threatened by unexpected forms of use. Whereas from the perspective of the participant, the experience might be disrupted by unexpected harassment. In this section, we apply the policy dimension to the model with an aim to moderate those unexpected behaviours.

Orientation Policy

Based on the notion of 'space', we identified two kinds of people who are more likely to stay in the Space sphere, the newcomer who is unfamiliar with the practice of new environments and the bungler who lacks the ability to enter into a place. They are prone to make errors and break rules, due to their lack of common sense or skills in the setting. Accordingly, an orientation/tutorial programme is needed. According to the proposed model, these programmes should provide the participants with opportunities to learn and practice in an environment without affecting the underlying setting as well as other users. A typical example could be new born babies who have zero idea of the culture and social norms. They will be taught and trained for years to understand social norms and blend into society. Another example is an online forum which employs a linear set of simple tutorial-oriented tasks; new registered users are required to finish those tasks to get full access to activities. In the policy dimension, we deem the orientation/tutorial programme as a necessity for the virtual space and name it as an orientation policy. As illustrated in Fig. 17.4, the whole Space sphere is controlled by the orientation policy.

Location Specific Policy

Real world social norms define widely acceptable behaviour standards not only in day to day physical, but also in virtual spaces. For instance, netiquette rules are built on common courtesies (Shea, 1994); also physical behaviours within virtual space

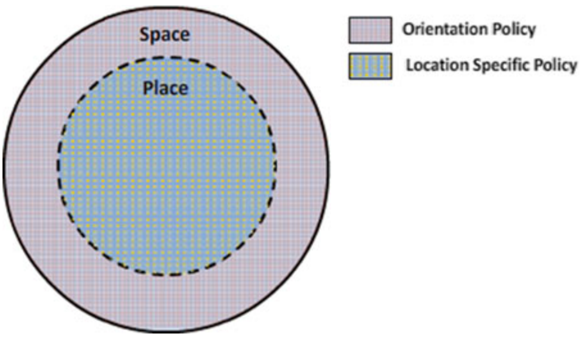


Fig. 17.4 The policy dimension

are mirrored from the real world (Crowe & Bradford, 2006; Jeffrey & Mark, 1998). Our case study of the 3D CVEs, to some extent, coincides with these phenomena. Although we did not define any code of conduct during the trial, it was expected that the students would copy their real life social manners in the virtual place. Also, the reported behaviour of passing through an avatar was unconsciously interpreted by applying real world social norms, and then subsequently led to uncomfortable feelings. From the perspective of 'space' and 'place', the phenomenon could be explained as the result of a real world place and a virtual place possessing similar or the same shared understandings and practices. Such an explanation reveals another implication of the phenomenon. If real world social norms are applicable to virtual space, compared to copying them as a whole, it is safer to check and apply the real world social norms into a virtual space place by place. The first benefit is to avoid dealing with any concept of universal laws in the real world, which are too general to be usefully applied in a VE. In addition, the second benefit provides operability, since the specific place has clear responsibility and specific rules. For example, when walking on a street, people are following the rules made by the city council, and when stepping into a classroom, people should obey the school regulations. According to the proposed model, location based polices are used to execute the pre-established understandings within the Place sphere. Accordingly, we define the policy for the Place sphere, as shown in Fig. 17.4, as location specific policy to indicate it is a local/partial policy, rather than a global/universal policy.

Here, we further discuss the location specific policy for 3D CVEs to continue our previous exploration of defining protocols for virtual space (Clear, 2004), in which we have explicitly adopted a part of AUT University policy to address the incident of avatar harassment. Based on the conclusion of that study, we recommended incorporating the whole AUT University policy, introducing guidelines, responsibilities, complaints procedure and discipline statute, etc., into the 3D CVEs. We reviewed those policies by categorizing them into responsibilities and the accompanying system of conduct and penalties.

Conduct and Penalties System The system is based on AUT complaints procedure and discipline statute (2014) which explicitly defines prohibited behaviours at AUT. Most rules are applicable for 3D virtual education environments, however, the definition of university property and harassment needs to be further clarified to be applied to virtual space. Because of a policy vacuum, the simulated educational facilities may not be deemed as university property. Thus vandalism in a virtual campus may not breach the law, but still could lead to misconduct, as it disrupts others' learning opportunities. Corresponding policies should be laid down to address such behaviours. At AUT, the definition of verbal harassment has been extended to virtual space (AUT Harassment prevention and support, 2013) but physical harassment in virtual space remains undefined. Defining 'physical' harassment in a VE is a complicated and convoluted project. However, the violation of personal space should be explicitly prohibited in rules.

Responsibility The expected behaviour of being a university student and the expected behaviour at a lecture have been included in AUT academic policy (AUT

Academic Information, 2013). Staff as well as student responsibilities for using ICT has been defined in AUT Internet, Intranet and E-Mail Policy procedures (2013), however, most clauses are limited to the responsibilities for the legal use of copyright material and protecting privacy. A broader responsible use agreement has been proposed at NETSAFE (2013), we consider that provides an ideal model to define staff and student responsibilities in virtual space.

More Considerations Supporting Adherence to Policy

Preece's (2004) study and the success of 3D virtual playgrounds suggest that further mediating roles and more technical supporting features are needed to augment and compensate for deficiencies in any policy dimension.

Further Mediating Roles

In the previous study (Clear, 2004), we have identified a range of mediating roles for CVEs, including coordinator, IT administrators, moderator, peacekeeper, mentor, etc. These roles are important in providing the social cues to establish and reinforce notions of 'place' and patterns of acceptable behaviour, and are even needed in single user VEs. In Multiple User Virtual Environments World of Warcraft® (WoW) (http://us.battle.net/wow/en/) for example, the Game Masters (GMs) present as avatars which could be easily recognized by gamers and are able to provide a range of services in an efficient manner.

Technical Support for Compensating Policy Dimension

Compared to real world spaces, virtual space is more vulnerable to malicious use or attack, for example, spam and hacking. Policies become insufficient to restrain such unexpected behaviours, which however could be inhibited by a technical approach. Various filtering systems have shown their potential for preventing people from unwanted harassments, for instance the spam blocker, communication backlist, mature languages filter, etc. In WoW, the quickest way of dealing with offences is to use filter tools to block harassment. In SL, if gamers feel uncomfortable in the surroundings, they can simply teleport away to a safe location. All these features are applicable and necessary for 3D CVEs. In complementing the filter system which offers an efficient but temporary solution for users to avoid harassment, a reporting system is needed for eliminating this problem entirely. Moreover smart and handy report tools are always demanded by users. SL enables gamers to collect evidence (taking screenshots) and file reports in a few steps (Second Life, 2013). In WoW, a gamer could report abuse by simply right selecting a name, then clicking report (World of Warcraft Harassment Policy, 2013). Moreover, a well-designed avatar could help a user avoid harm more easily. In SL, sitting down is a self-protection movement. When facing physical harassment or assault, the avatar could sit down to avoid being affected. In a virtual campus, an educator could adopt these or similar technical designs to create 'gamified places' that support a positive learning environment.

17.5.2.5 The Gamification Dimension

Hamrin and Persson's (2010) "Team Place" Model depicts what a virtual team should look like. The model proposed here in Fig. 17.3 describes the appearance of virtual space, in which we could see a range of different "Team Place" and 'Individual Places' evolving. Some are expected, some are not. The requirement of promoting desired behaviours provides opportunities to exploit the engaging nature of the game dimension within VEs. Yet at the same time, applying game elements could also be harmful. Inappropriate design may bring more unexpected behaviours into virtual space, for example, the "Point Hunter" (discussed below in the dark side of gamification section). In the next section, we interpret the gamification research below, based on the applicability of the proposed Behaviour Mapping Model, in order to demonstrate ways of using the model in gamification design.

A Meaningful Gamification Design

Nicholson (2012) proposed a user-centered theoretical framework for creating a meaningful gamification design. According to his definition, a meaningful game design should improve users' internal motivations by focusing on users' needs or goals. Such design will result in longer-term and deeper engagement between users, non-game activities, and supporting organizations. In contrast, a meaningless gamification is organization-centered design, in which users are motivated by external rewards that are not related to the underlying activity. Designers using meaningless gamification will first ask: "How does this benefit the organization?" instead of how the gamification benefits the user. Based on the Behaviour Mapping Model, we could conceive Nicholson's effort as to build a long-term connection between users and non-game activities by using game design. The emphasis on users' need or goals indicates that a meaningful game design must meet individual understandings or align with their 'Individual Place' in order to improve users' internal motivation. However, the user-centered theoretical framework ignores the affordance of non-game activities, which is a 'place' reflecting the expectations of the designer. Whether they are internal or external motivations, the goal of game design should always align with the designer's understandings, ensuring that the gamification arrow is shot directly at the target. Rather than a short-term or temporary engagement, game designs that are not related to the underlying activity will lead to harmful forms of gamification, as discussed in the section below. Thus, we argue that the success of game design depends on its matching with the designer's 'place'; and the effect of game design depends on satisfying 'Individual Place'. The organization-centered design therefore is a prerequisite, rather than the opposite of user-centered design. In Nicholson's words, meaningful gamification should first align with the goal of non-game activities, then meet users' needs, and ultimately build a long-term engagement between users and underlying activities. These concepts are employed to analyze the cases below.

In Singer and Schneider's (2012) study demonstrating social software's potential for promoting the adoption of best practices among developers, they built the "Teamfeed" web application (a discussion platform) based on the Subversion® repository in order to encourage computer science students to make commits to the version control system more frequently. Game elements were used in the application where students could represent themselves as an uploaded image icon, and a leaderboard listed the team members and the counts of their commits. During the study, they received a balance of positive and negative comments. A few students improved their commit frequency. But the rest insisted on their own practices. Interpreted applying our proposed model, the researchers tried to setup a 'place' for adopting a best practice of making more and smaller commits, and they used game designs as a bootstrapping strategy to incentivise more students into that 'place'. However, the game design was focusing on the specific behaviour of making a commit rather than the initial goal of promoting best practice, which led to confusion and criticisms. Students who had changed their behaviour were still unaware of the benefit of making small commits and complained that the application had encouraged them to make superfluous commits, indicating they still wandered outside the designer's Place. Also, since the game design failed to meet most users' understanding, the promoted activity was resisted by a majority of students. At least half of them raised concerns over their commit quality and doubted the metric used in the leaderboard feeling that some commits were too simplistic and useless. Had the leaderboard incorporated the metric of commit quality it would then have become understandable for most students so they could match their behaviour with the designer's expectation, and therefore subsequently would reduce concerns and motivate more students.

A series of experiments conducted on an IBM® Enterprise Social Network Service (SNS) depict what a successful but external motivation driven case of gamification looks like. The SNS is an online social site which features lists, photos and comments. Text and graphic based social activity under a shared organization culture leave no room for confusions and misbehaviour. With an aim to incentivise repeat usage, increase contributions, and establish user reputations, a points-based incentive system was adopted to reward expected social behaviours including contributing lists, photos, and posting comments. In a log analysis based on the first three weeks of the experiment (Farzan et al., 2008b), the overall content contribution was dramatically increased by the incentive scheme, which was however followed by a "decayed impact" (Thom, Millen, & DiMicco, 2012). A further evaluation on user interviews and the results of a controlled experiment conducted during the following six months (Farzan et al., 2008a), confirmed that successful gamification controls the behaviours of users to generate a predictable result without confusing or distracting them. However, the points-based external motivation was destined to be a short-term effect. Users' comments suggest that the level-focused users stopped contributing immediately after researching the desired level. And the short-term effect was more clearly revealed in an experiment conducted ten months later (Thom et al., 2012), in which the removal of the gamification feature led to a significant decrease on content contributions.

The Dark Side of Gamification

The above discussion of meaningful gamification reveals the existence of harmful gamification whose goal fails to relate to the underlying non-game context. It is worth noting that harmful gamification and the side effects of gaming are two different conceptions. In a metaphor of driving cars, the former is dangerous driving, which is an outcome of inappropriate usage and could be corrected. The latter is car emission, which is the output of the car itself, and can only be mitigated. We notice that the side effect of gaming has been mentioned in a few research studies, for example the behavioural addiction encouraged by gaming (Long, 2013) and comparison pains caused by a leaderboard (Barata, Gama, Jorge, & Gonçalves, 2013), which all stem from the nature of the game. In contrast, the dark side of gamification is the consequence of design mistakes that accidentally build game places that are separated from the designer's place. The user motivated by game elements may ignore the designer's intended place and step into a separate game place. A typical example is the point hunters who create multiple accounts to answer their own questions to fulfil the desire of gaining points. We believe that clarification on the distinctions between the side effects of gaming and the dark side of gamification is necessary for designers to correctly understand gamification and apply it in an appropriate way. For example, based on the interpretation above, we could argue that 'kills intrinsic motivation' is the side effect of gaming, rather than the dark side of gamification, which has been perceived as a painful output from gamification in current studies.

17.6 Conclusion

Virtual environments open a new arena for socialisation, and in our case study, designable 'places' for learning. These new learning places are becoming increasingly attractive to educators with the development of 3D technologies and the emerging gamification designs. However, they are still reliant upon promising, but to some extent unfamiliar and unproven technology and theory is still developing within the virtual setting. Since, 2001 we have been conducting a series of studies within CVEs (Clear & Kassabova, 2008), to exploit their potentials for global virtual teams. This chapter adds to the ongoing studies and has applied the notions of 'space' and 'place' to progress towards (1) developing a coherent set of policies to govern the VEs; (2) finding an appropriate approach to incorporate game designs into VEs.

Compared to the real world of 'physical' space which has been evolving with human society for thousands of years, the virtual context remains yet to be harnessed. The unanticipated behavioural changes observed within virtual space (i.e. the avatar harassment incident observed in our case study) have led to the need for rules to avoid anti-social behaviours. In this chapter, we do not aim to define a universal policy for virtual space. However, our discussions on the notion of 'space' and 'place' provide a universal approach to interpret human behaviours within the real world, and virtual worlds as well as those spaces of imagination. Consequently, we argue that the research provides an opportunity to build common courtesies, policies, policing mechanisms and roles in virtual spaces. To achieve the first aim of devising suitable policies, we further visualized the relationship between 'space' and 'place', and explicitly applied it to our case study to examine human behaviours emerging within 3D CVEs. Subsequently we incorporated real world University policy into the virtual place and built a policy framework including the need for both orientation policy and location specific policy to govern such virtual spaces. In addition to the policy, we also extend the previous discussions (Clear, 2004) towards improving policy execution efficiency by including the additional approach of augmenting technical feature design.

In this chapter, the discussion on gamification frames our exploration of its application in VEs. As discussed above, although existing research has defined an abstract approach to applying game design elements (Deterding et al., 2011) and offered theoretical understandings on the motivational affordances of gamification design (McGonigal, 2011), the ideal approach to identifying game design elements and their effects remains undefined. Thus, we could use the 'levels of game design elements' defined by Deterding et al. (2011) to evaluate our previous attempts, but not to address the policy demands needed to achieve our first goal above. However, regardless of what could be a game design element and no matter how one could implement the motivational affordances of games, our research has revealed a way of embracing these aspects into VEs. Based on the proposed model, we interpret what a meaningful gamification should be, and conversely introduce the dark side of gamification. Though the concepts diverge from existing research, they provide a road map for our further studies.

We acknowledge that this work is far from complete, and elements of the model elaborated here will need exercising in a context of virtual courses (or other applications) applying gamified designs. The respective role and importance of the contribution of each of the elements of: space, individual place, team place, technology, roles and policy will need unpacking in future studies. From this theoretically informed work we hope that the models proposed and the insights into the 'spatial' dimensions of VEs can help educators realize the motivational benefits of gamification design, and benefit from exploiting the learning affordances of virtual spaces informed by gamified designs. Thus may the potential for significant contributions to collaborative learning presented by VEs be realised.

References

AUT Academic Information. (2013). Retrieved August 23, 2013, from http://www.aut.ac.nz/being-a-student/starting-out/undergraduates/academic-information

AUT Complaints Procedure and Discipline Statute. (2014). Retrieved September 9, 2014, from http://www.aut.ac.nz/being-a-student/current-undergraduates/academic-information/academic-policies-and-regulations

AUT Harassment prevention and support. (2013). Retrieved August 23, 2013, from http://www.aut.ac.nz/being-a-student/current-undergraduates/your-health-and-wellbeing/harassment-prevention-and-support

AUT University's background. (2014). Retrieved September 9, 2014, from http://www.aut.ac.nz/about-aut

AUT Internet, Intranet and E-Mail Policy (2013). Retrieved August 23, 2013, from http://www.aut.ac.nz/privacy/Internet,-Intranet-and-E-Mail-Policy

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013) So fun it hurts—Gamifying an engineering course. In: *Foundations of augmented cognition*. Springer, pp 639-648.

Benford, S., Fraser, M., Reynard, G., Koleva, B., & Drozd, A. (2002). Staging and evaluating public performances as an approach to CVE research. In: *Proceedings of the 4th international conference on Collaborative virtual environments,* ACM, pp 80-87

Caillois, R. (1961). *Man, play, and games*. Champaign, IL: University of Illinois Press.

Carter, P. D. (2002). Building purposeful action: Action methods and action research. *Educational Action Research, 10*(2), 207–232.

Clear, T. (2004). Global virtual teams: Moderating behaviour in 3D collaborative virtual environments. In: *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2004*, pp 2321-2326.

Clear, T. (2007). Global virtual teams and 3D collaborative virtual environments. In: J. Hosking (Ed.), *Proceedings SIENZ'07—Software Innovation and Engineering New Zealand Workshop, 2007*. University of Auckland Software Engineering Research Group.

Clear, T., & Daniels, M., (2003). 2D and 3D introductory processes in virtual groups. In: Frontiers in education. FIE 2003 33rd Annual, 2003. IEEE, pp S1F-1-6 vol. 3.

Clear, T., & Foot, G. (2002). Avatars in cyberspace-A Java 3D application to support performance of virtual groups. Innovation and technology in computer science education, Aarhus, Denmark.

Clear, T., Hussain, W., & MacDonell, S. G. (2012). The many facets of distance and space: the mobility of actors in globally distributed project teams. In: *Global Software Engineering (ICGSE), 2012 IEEE Seventh International Conference on, 2012. IEEE*, pp 144-148.

Clear, T., & Kassabova, D. A. (2008). A course in collaborative computing: Collaborative learning and research with a global perspective. In: *ACM SIGCSE Bulletin, 2008*. ACM, pp 63-67.

Crowe, N., & Bradford, S. (2006). 'Hanging out in Runescape': Identity, work and leisure in the virtual playground. *Children's Geographies, 4*(3), 331–346. doi:10.1080/14733280601005740.

DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science, 5*(2), 121–147.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification". In, 2011. ACM, pp 9-15. 10.1145/2181037.2181040

Dourish, P.(2006). Re-space-ing place: Place and space ten years on. In: *Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work, 2006.* ACM, pp 299-308.

Farzan, R., DiMicco, J. M., Millen, D. R., Brownholtz, B., Geyer, W., & Dugan, C., (2008a). When the experiment is over: Deploying an incentive system to all the users. In: *Proceedings of the Symposium on Persuasive Technology, In conjunction with the AISB*.

Farzan, R., DiMicco, J. M., Millen, D. R., Dugan, C., Geyer, W., Brownholtz, E. A. (2008b). Results from deploying a participation incentive mechanism within the enterprise. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* ACM, pp 563-572.

Hamrin, P., & Persson, M. (2010) Exploring the notion of space in virtual collaborations: Finding prerequisites for success in virtual teams. Uppsala University.

Harrison, S., & Dourish, P. (1996). Re-place-ing space: The roles of place and space in collaborative systems. In: *Proceedings of the 1996 ACM Conference on Computer Supported Cooperative Work, 1996.* ACM, pp 67-76.

Huotari, K., & Hamari, .J., (2012). Defining gamification: a service marketing perspective. In: *Proceeding of the 16th International Academic MindTrek Conference.* ACM, pp 17-22.

Jeffrey, P., & Mark, G., (1998). Constructing social spaces in virtual environments: A study of navigation and interaction. In: *Workshop on personalised and social navigation in information space, 1998.* Swedish Institute of Computer Science Stockholm, pp 24-38.
Lipnack, J., & Stamps, J. (2000). Virtual Teams: Reaching Across Space, Time and Organizations with Technology (2 ed.). New York: John Wiley and Sons. Inc.
Long, D. (2013). Think differently: The game brain. *Independent Education, 2*, 28.
McGonigal, J. (2010). *Gaming can make a better world*. Retrieved August 15, 2013, from http://janemcgonigal.com/videos/
McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin Press.
NETSAFE. (2013). *The netsafe kit for schools—policy and use agreements* [Online]. Auckland. Retrieved August 21, 2013, from http://www.netsafe.org.nz/the-kit/policy-and-use-agreements
Nicholson, S., (2012). A user-centered theoretical framework for meaningful gamification. Proceedings GLS 8
Preece, J. (2000). Online Communities: Designing Usability, Supporting Sociability. Chichester: Wiley.
Preece, J. (2004). Etiquette online: From nice to necessary. *Communications of the ACM, 47*(4), 56–61. doi:10.1145/975817.975845.
Second Life Community (2013). Retrieved August 21, 2013, from http://community.secondlife.com/t5/English-Knowledge-Base/How-to-deal-with-abuse-and-harassment/ta-p/1339983
Shariff, S. (2005). Cyber-dilemmas in the new millennium: School obligations to provide student safety in a virtual school environment. *McGill Journal of Education/Revue des sciences de l'éducation de McGill, 40*(3).
Shea, V., (1994). Netiquette. Albion Books, San Francisco
Singer, L., & Schneider, K., (2012). It was a bit of a race: Gamification of version control. In: *Games and Software Engineering (GAS), 2012 2nd International Workshop on, 2012*. IEEE, pp 5-8.
SLetiquette (2014). Retrieved September 9, 2014, from http://wiki.secondlife.com/wiki/Sletiquette
Stoner, J. (1991). The house of montisi [speaking of places]. *Places, 7*(2).
Thom, J., Millen, D., DiMicco, J., (2012). Removing gamification from an enterprise SNS. In: *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work, 2012*. ACM, pp 1067-1070
World of Warcraft Harassment Policy (2013). Retrieved August 23, 2013, from https://us.battle.net/support/en/article/harassment-policy

Chapter 18
The Development and Assessment of a Team-Based Management Game

John Denholm, Ian Dunwell, and Sara de Freitas

18.1 Introduction

This chapter is concerned with the design and measurement of serious games which simulate the operations of a company for the purpose of training potential business managers, while doing so in the safe environment of a Higher Education setting. It uses gamification to construct a scenario-based representation of an on-going business. Mayer and de Jong (2004) says that, "Simulation-games are a simplification and condensation of a real system, allowing participants to experiment safely with (future) decisions and institutional designs and reflect on the outcome…. In a number of rounds, the participants make decisions, form coalitions and make compromises based on their given and/or self-constructed goals and interests" (Mayer & de Jong, 2004, p. 226). The emphasis is less on breaking new ground with the technology employed but rather on drawing on the concepts of decision support systems (operational and financial models that employ 'what-if' scenarios) to optimise a future operation. Mayer and de Jong (2004, p. 223) also states that "Both gaming and group (decision) support system (GDSS) are frequently used to support decision-making and policymaking in multi-actor settings" but that, "No systematic overview or framework exists in which GDSS are related to the functions of gaming or vice versa".

The design of the game which is the subject of this article incorporates the features of a group decision support system (GDSS), in this case to model the future of an entire business operation, and harness the concept to train students of management working in teams to maximise the success of the business. In doing so it imparts practical knowledge of marketing, finance and production techniques while adding the spice of collaboration and competition to enhance the motivation to succeed.

J. Denholm (✉) • I. Dunwell • S. de Freitas
Serious Game Institute, Coventry, West Midlands CV1 2TL, UK
e-mail: jadenholm@yahoo.com; idunwell@cad.coventry.ac.uk; sfreitas@cad.coventry.ac.uk

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_18

The content of some taught subjects does not change much over time. Examples are French or Mathematics. However in other areas, for example business studies or logistics, the content and treatment are constantly changing as a result of new techniques being applied in the real world. In fact globalisation and increased competition have led to significant changes in business practice. Under such pressure to learn new business techniques it is essential that new and better methods of training are adopted. To keep up with the global changes in the real world, there has to be a major shift in the way in which business is taught, towards a more practical approach and in a way which (a) makes the subject more motivational and engaging to students and (b) places more emphasis on practical rather than theoretical issues, many of which no longer apply.

For these reasons there is increasing justification for employing the concepts of Problem Based Learning (PBL) or Experiential Learning (EL) as described by Kolb (1984) and Thompson (2008), an approach which can be effective in dealing with the management of an operation, requiring soft skills e.g. people and leadership skills as much as technical ones. This raises secondary questions. To what extent are games in general designed according to recognised research-driven recommendations? What guidance exists for proper assessment of the value of games? To what degree does advanced technology e.g. the use of video, animation and avatars contribute to the effectiveness of games? Further questions relate to attitudes within the teaching profession. Are teaching staff generally aware of the potential value of games in education? How are their attitudes influenced by their knowledge or perception of video and other related games designed for entertainment? Would teaching staff benefit from more awareness of the purpose of games and how they are designed and administered?

Findings by de Freitas, Hainey, and Connolly (2006) have concluded that there is a need for more empirical-based research into how learning is taking place and how games could be specifically developed to target groups and their personalised learning needs. Management games are gaining currency in HE Faculties where courses relate to industry, for example in project management or manufacturing operations. Simulation-based training (SBT) allows for the development of management skills at a much faster pace than usual, making it an ideal technique to use in management education programs (Salas, Wildman, & Piccolo, 2009). For example, the Warwick Manufacturing Group (WMG) at Warwick University, U.K. makes extensive use of four different simulations covering the topics of finance, engineering design, project management and the management of change, in its classes for its Programme and Project Management Masters courses (Denholm, Protopsaltis, & de Freitas, 2013).

Games of this type have certain features in common e.g. they simulate a project or business operation over set time periods; they are team-based and require collaborative decisions. Tutor assistance and frequent feedback are an integral part of the process. The term Team Based Mixed Reality (TBMR) is used here to denote this genre of game, ‘mixed reality’ implying neither virtual nor real. An example of ‘mixed reality’ would be students discussing issues around a table to reach a consensus on decisions. Games of this type are not necessarily massively multiple online role-playing games (MMORPGs) i.e. involving networked interaction with multiple computer screens, avatars or video. But they do demand a degree of imagination on the part of the participants, possibly more than that of one-to-one immersion games, as these are constantly prompting the player with visual images. In a study in the 1970s by Johns Hopkins University (Boocock, 1994) involving a number of gamed simulations, experiential learning was seen as a way to improve on the more traditional ways of teaching the curriculum; games could extend the process of receiving information into the realms of *acting* on it. However there was doubt as to whether this ability to act on the information necessarily extended beyond the boundaries of the lesson, i.e. into the process of finding solutions to real life problems later on.

This chapter recounts a study to design and develop a generic business management game at minimal cost and resources and test its value with cohorts of students in HE courses (post-graduates and undergraduates). In all a number of objectives were identified, i.e. to:

I. Review the literature on serious games in education, learning theory and game design, in order to apply good practice to both game design and assessment.
II. Investigate and survey a number of business games currently in use in HE.
III. Develop a new game concept along generic lines which simulates the strategic planning and management of a complete business operation.
IV. Investigate and develop techniques to enable game construction in a cost and resource efficient way and according to good game design practice.
V. Develop and test a game against specific criteria, defined to maximize its success.
VI. Assess the game with a large sample of students, in terms of both the subjects' perception and actual measured improvement in knowledge and decision-making skills.
VII. Make recommendations for alternative and future game developments.

The Serious Games Institute Business Simulation (SGIBS) game was designed and developed over a period of 2 years from 2010 to 2012. The developed game was then the subject of a series of assessment trials conducted during January and February 2013, the conclusions from which are covered here.

18.2 Learning Theory and Experiential Learning Models

The overall research study divides naturally into three phases: firstly preliminary studies focussing on students' perceptions of games; secondly the design and development of the SGIBS game to embody good practice; and thirdly a series of trials using the game to measure the *actual* improvement in knowledge and soft skills. This chapter focuses mainly on the second and third of these, leading to the research questions: "How critical is game design to the educational value of TBMR games?" and "Are games of this type effective in improving participant's abilities".

Benjamin Bloom (1956) headed a group of educational psychologists who developed a classification of levels of intellectual behaviour important to learning. Bloom's taxonomy classifies learning outcomes into three dimensions: (1) cognitive or *knowing* (2) affective or *feeling* and (3) psychomotor or *doing*. There are six levels in Bloom's cognitive dimension: basic knowledge, comprehension, application, analysis, synthesis and evaluation (Butler, Markulis, & Strang, 1988). During the 1990's a new group of cognitive psychologists, lead by Lorin Anderson (a former student of Bloom), updated the taxonomy to reflect relevance to 21st century work, redefining the six categories as Remembering, Understanding, Applying, Analysing, Evaluating and Creating.

Bloom's taxonomy is widely used as the basis for the evaluation of effectiveness of management or business simulations (Anderson & Lawton, 2009). TBMR games participants are required to engage with the three lower levels of the taxonomy: remembering, understanding and more specifically in relation to experiential learning, applying. Overall, simulation seems to be effective for cognitive learning, particularly the lower levels of Bloom's cognitive dimension.

Designers need to synthesise the elements that lead to success, in particular the contribution of teamwork and competition, the importance of alignment to the module Learning Outcomes/Objective (LO), the levels of challenge and the feedback provided during and after the game sessions. Also important are factors such as entertainment and goal-setting which contribute to motivation, emotion and attitude. Gee (2003) suggested that in order to design a good educational game or simulation, the designer should possess relative professionalism in particular areas, and the learning and skills imparted to students should be chosen under proper and intelligent consideration. Also, the educational game should be built into an exhaustive value system that is relevant to the established topic of the game and should explicitly connect relevant instructions with particular circumstances. Gee continues, "The role of the game designer is not just to maximise imparting of information relevant to the topic in question, but to take the experience beyond that which traditional methods can do; to contribute some emotional experience, be it conflict, time-pressure or whatever in order to place the participant in as close to a real life situation as possible".

de Freitas, Rebolledo-Mendez, Liarokapis, Magoulas, and Poulovassilis (2009) have developed an evaluation methodology for immersive learning experiences in a virtual world. The study incorporates a four-dimensional framework (4-DF) developed earlier by de Freitas and Oliver (2006). Within each of these, three aspects are identified e.g.:

The Learner (Profile, Role, Competences)
Pedagogy (Associative, Cognitive, Social/Situative)
Representation (Fidelity, Interactivity, Immersion)
Context (Environment, Access to Learning, Supporting Resources)

Arnab et al. (2013) used the 4-DF to guide the design and development of a game, aimed at supporting the delivery of game-based learning within a formal setting, which has undergone a cluster randomized control trial that concluded positive learning outcomes, and the above elements (main and sub-headings) were considered for their relevance to the design of the SGIBS game. An earlier model by Keller (1984) proposed four steps for promoting and sustaining the learning process: **Attention**, **Relevance**, **Confidence**, and **Satisfaction** (ARCS). More recently Schwan (2006) differentiates between four types of participant:

Impassioned: Looks for a challenge. High motivation and tolerance to frustration.
Wanna-be-Player: Identifies with and wants to be liked. Low tolerance to frustration.
Fun Player: Treats playing as recreational.
Occasional Player: (largest group): Plays occasionally for amusement.

The SGIBS game is designed for a number of teams competing in the same seminar room, each in control of a 'company' and developing strategies in competition with other teams to achieve the highest score, according to certain pre-defined goals. This is conducted under time limits in order to generate conflict and raise levels of motivation to succeed, while promoting the message that team cooperation may provide a winning strategy. Meredith Belbin (1981, 1993) has become notable for his research which suggested that the most effective teams have members who between them can perform certain key roles. In his study of management teams in the early 1980's he proposed a number of principles for establishing and running an effective team:

- Members contribute to teams in two ways: professionally and technically. They will play a specific 'team role'.
- Teams with a good balance of team roles will contribute professional and technical skills to best effect.
- Effective teams comprise members who recognise and adjust to the relative strengths that exist within the teams in both professional and team role capacities.
- To be effective a team needs a balance of team roles.

Individuals are better suited to play some team roles than others, according to Belbin. His eight team role types, later revised to nine (Belbin, 1993) indicate the particular attributes associated with each and the strengths and possible weaknesses they can bring to each role.

The principles suggested by Belbin (1981) were considered as a basis for the allocation of teams prior to the game assessment trials which used as subjects eleven classes of students, taking a module entitled, "Management of Engineering and Technology Innovation" (METI) incorporated within a number of degree courses ranging from ICT to Engineering and Motorsport, and taught by four different tutors. The module required these students to work in small team and they had already, i.e. before the game intervention in January 2013, been required to take a Belbin personality type test as a means of identifying their most likely type of contribution to a team, e.g. creativity, leadership etc. Immediately following these

Belbin tests, the results had been used by the four tutors in question to provide a basis for small team allocation during workshop lessons and presentations throughout the delivery of the module. However, for game trial purposes it was considered that this process may not have been very reliable and that it was more appropriate to re-allocate all students on a (computer-generated) random basis. New teams would present opportunities for extended social interaction while ensuring no bias affected the assessment process. However, once teams were allocated the selection of specific management roles *within* each team, e.g. sales, finance, production, was offered as an option.

18.3 Preliminary Surveys of Games of the TBMR Genre

In order to gain an insight into the variety of business-related games actually in use, seven games were initially investigated in two Universities within the West Midlands region of the UK. The findings of four of these, conducted at Warwick University, were the subject of earlier surveys (Denholm et al., 2013). Three further games belonging to the genre and currently in use at a different University were identified and a survey of players' opinions carried out during 2010 and 2011.

18.3.1 Hypermarket Game

This game was surveyed in November 2010 and is based largely on the use of physical plastic parts, to help postgraduate students of Logistics to understand the problems encountered in supply chains. It is similar to the M.I.T. Beer game (Millard & Britton, 2007). It works on a role-play principle, with each student (or team) taking on one of five specific roles: Consumer, Distribution Centre, Manufacturer, Primary Supplier and Raw Material Supplier. Comments returned with the survey included: "*Such types of games really enhance our knowledge in practical terms*" and "*Good experience*".

18.3.2 Software Stores Control

The same survey was conducted at the end of the deployment of this game with students taking a 'Developing Financial Capabilities' module, in May 2011. The game was created and administered by two tutors over a number of weeks. Sample comments returned were: "*The game was very well planned & structured. It helped me understand & apply concepts to real companies*" and, "*Very good game in explaining financial and accounting techniques, helped to improve business skills, as cash matters*".

18.3.3 Xing Game

This is a commercially available game produced by The Working Knowledge Group Ltd - Management Consultant, Bristol, UK. It provides a generic approach to raising awareness of the fundamentals of planning a start-up business. It has limitations; in particular it does not simulate the actual *management* of a business, only the planning of it, starting from an initial business idea presented to each team. It does not involve the use of computers, is not cyclical and depends on constant tutor intervention. It is designed to be played by small teams but is not inter-team competitive although it encourages discussion. It was conducted and surveyed during Feb 2011 with seven classes of undergraduate students taking the METI module as a preliminary investigation prior to the SGIBS game assessment trials (which focussed on the same METI module but with a new cohort of students in the following academic year). Comments returned from this survey included: "*I think it's a brilliant idea, very different from practical learning, especially helping with the development of people skills*". "*Would be more interesting if teams were competitive and if there was a certificate given to all participants*".

Findings from all three of those games showed high levels of student satisfaction, in particular when asked if the game made them feel part of a team, if they felt they wanted to score well over other teams and if they would they like the opportunity to play the same game again.

18.4 The SGIBS Game Design and Development Process

Eseryel, Guo, and Law (2012, p. 282) says, "We do not know how to design educational games to support higher order thinking and problem-solving skill acquisition while maintaining high student motivation. To facilitate the design of educational games, validated assessment models are crucial. However there are very few game evaluation models available for the educational game designers." Schrader and McCreery (2012) state that, "Integrating games into the classroom takes considerable effort for teachers and students. Few game-based educational models provide transformative learning experiences".

With this in mind the design of the SGIBS game was conceived, based around the METI undergraduate module. In addition to the relevance of its content, there were advantages to this choice, since a large sample of students, over a hundred, in eleven classes, could be made available, in the event ($n = 101$) six classes for game intervention and five classes for a control group. Two of the six game classes consisted exclusively of Chinese students. These had recently arrived in September 2012 for the second year of their degree at the UK. University under an arrangement whereby they completed the degree with 2 years in China followed by 2 years in the UK. The inclusion of two Chinese classes in the intervention trials was not planned in advance, as might have been the case for an in-depth *cultural* study, but was seen in a pragmatic way as an opportunity to make comparisons between *game* responses from Chinese and Non-Chinese classes.

The game was developed using Excel version 2010 software, enabling relatively rapid development in comparison to the use of programming code. While not the preferred software choice for most advanced technology games, it provided access to built-in features such as mathematical and graphical functions, ideal for displaying results. It was completed in August 2012 and tested during two separate trial runs using volunteer staff at the Serious Games Institute (SGI), Coventry, UK. It is also worth noting that similar computer methods have been used for simulating investment strategy, i.e. in a group decision support system (GDSS) to simulate future business scenarios using projected cash flow models (Denholm, 2007). The projecting forward of a set of financial statements for a company (e.g. most recent set of accounts) on various assumptions is not dissimilar to the techniques employed as the scaffolding for the SGIBS game.

The game scenario was based on reviving an ailing company designing and selling coffee machines, the game running over *eight*, or optionally *twelve*, 3-month periods. Each of four teams in a class competes to manage 'similar' companies in the same market to implement the right strategies and take the best tactical opportunities available. The periodic nature of the game allows a cycle of debate, reflection, decision and action (i.e. trial strategy). According to Kolb (1984) and Kiili (2007) this cycle is the basis of effective learning. In addition, game participants receive intermediate feedback and hence are in a position to react immediately to the results. This cycle is repeated for each period, giving the possibility of correcting the effect of earlier decisions. For example, if players decide to invest in more manufacturing capacity but fail to raise the necessary funding, a large overdraft will result, something that can be corrected in the following period.

Although largely determined by the METI module Learning Outcomes/Objective (LO), the content and scope was limited by what could reasonably be covered in the allotted time for game play which, in view of time-tabling constraints, was one and a half hours.

Throughout the course of the game, the teams were required to take **strategic** decisions (pricing, funding and expansion). In addition, a further set of **tactical** decisions were offered at intervals, in the form of sixteen 'opportunities' printed on cards presented to all teams. On each of those cards, in the form of 'tips' was information on costs, benefits and other possible consequences of choosing the option in question, thus avoiding the need for participants to do calculations, but rather to focus on making judgements.

It was considered important from the outset to focus on the pedagogy, i.e. to keep the game mechanics simple but to try to achieve enhanced learning and promote the development of soft skills. Factors which introduced entertainment and raised motivation by providing challenge in the form of inter-team competition and the setting of winning target criteria were considered paramount. "Designing game-based learning is very different from designing entertainment games as it must take account of learning objectives, instructional activities etc. Assessments need to be *aligned* with the learning objectives". (Smith & Ragan, 1999). "The art of game design is creating situations, challenges, rules and affordances that keep players at the leading edge of what they can do. Research suggests that when students are more motivated, assessment results are a better reflection of their ability". (Schmit & Ryan, 1992; Sundre & Wise, 2003).

In the end it was largely a matter of judgement as to what the scope, content and level of difficulty should be. The game was designed to be conducted over twelve rounds or periods, each representing 3 months, but may be conducted for a lesser number e.g. eight periods. The only distinction between periods is that they either require **strategic** decisions (periods 1, 2, 5, 7, 9 and 11) or **tactica**l decisions (periods 3, 4, 6, 8, 10 and 12) The reason for two consecutive **strategy** periods at the outset is that in a forward planning situation the strategic plan should precede the detail. Two types of forward planning have been identified by the Association for Project Management (APM), namely 'strategic' and 'detailed' planning. The first involves a "top-down" approach used during the early stages, to answer the 'why', 'what' and 'how' questions of a project. "Detailed planning should commence when strategic planning has been rightly put in place to avoid starting the project on a wrong note." (Hopkinson, Close, Hillson, & Ward, 2008).

Simpler decisions were introduced first, followed by increasingly more complex ones. For example, in the first round of the game, denoted as Period 1, the only decision required is at what level to set the price of the product, the company's latest design in coffee machines. Thereafter decisions begin to involve funding, expansion, quality, advertising and cost reduction, becoming gradually more challenging, encouraging team discussion and conflict.

Many authors extol the virtues in games of competition, goal-setting, collaboration and game 'flow'. "In order to have meaningful social interactivity among the players, a game should incorporate collaborative tasks, which allow them to interact naturally". (Eseryel et al., 2012). Chen, Dun, Phuah, and Lam (2006) says that, "Social interactivity during game play, such as competition and collaboration with others who are also playing the game, plays an important role in contributing to learners' motivation". Sweetser and Weth (2005) found that "social interactions allowed players to compete, collaborate and connect, leading to game flow experiences". Bransford, Brown, and Cocking (2000) state that, "Goal-based scenarios have long been viewed as an active primer for situated learning. In a good game, a player is involved in an iterative cycle of goal-based interactive problem-solving. Setting a goal or target as a measure of team success would seem to enhance the competitive aspect of the game".

Dempsey, Haynes, Lucassen, and Casey (2002) found that, "Incorporating challenges, clear goals and sufficient feedback into narratives are important for players' gaming experiences. There needs to be a clearly defined end-point in the game and hence the criteria for winning. Otherwise there is no straightforward way to assess the learning that has taken place". In the SGIBS game, time constraints were imposed, 10 min for each cycle or period representing 3 months of real time. The targets set were to maximize the company's Return on investment (RoI), Stakeholders' equity and Reputation. No random elements were introduced, ensuring a level playing field for all participants.

18.4.1 Feedback

"Feedback which is used by the learner is considered the most important, distinctive attribute of formative assessment" (Taras, 2005). "It can be found at every level and unit of an efficient educational system and is an overarching concept that helps to explain and interpret the role of assessment in educational games". Tutor feedback was considered a key element in conducting the game, not just during the final debriefing at the end of the session but after every round. Periodic results, displayed to the entire class, can be discussed and lessons learned. Graphical displays are ideal for this, but statements on Company progress are also useful, when there is a need to focus on more detail, with automatic highlighting showing exceptional figures e.g. the highest and lowest across teams. (See Fig. 18.6 in Sect. 18.6.2 below). Feedback has more educational value if it is formative and *immediate*, rather than summative i.e. at the end of a module, by which time it is too late for students to benefit and improve their gradings. It can be argued that games give even *more* immediate feedback, as this occurs after each cycle. The SGIBS game was not used for summative i.e. for module gradings, but rather formative assessment, with both intermediate tutor feedback and final game debriefing. The chart below shows a simple example of immediate feedback during the game and illustrates the element of competition for sales in the same market (Fig. 18.1).

Feedback in this graphical form is easily assimilated, shows clear comparisons by team and provides motivation to initiate further strategies to overtake the competition e.g. expand capacity, promote the product and reduce defective or reject parts. This may be especially effective if the variations in team success are not too disparate, as in the example shown.

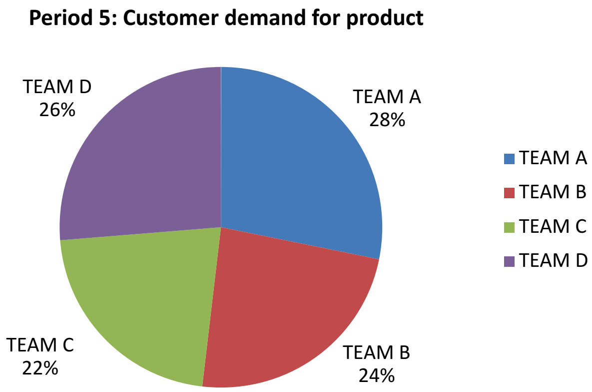


Fig. 18.1 Example of a graphical display from the game showing market share, by team

18.5 The SGIBS Game: Characteristics and Features

The points below summarise the main features of the developed game.

(a) It provides a platform for participants to improve both *knowledge* and *decision-taking skills* in relation to the problems encountered by the management of an ailing business, trying to innovate and become successful in a competitive market.

(b) In simulating a business operation, it deals with both physical quantities and financial parameters: units ordered, produced and sold, defects, sales income, labour and material costs, profit and asset values including loans and cash. Results are displayed, per team and per period, in the form of Profit & Loss, Cash Flow and Ratios (profit margin, return on assets, debt to asset ratio).

(c) It is designed to be conducted in a conventional seminar room, over a time-span of 1.5–3.0 h, with a single tutor-controlled computer for data input and a large screen for presenting periodic results.

(d) It caters for up to four teams playing in competition in the same room, the number of participants per team ranging from one (i.e. individual play) to eight (maximum). Colour coding is used for easier team identification.

(e) The same initial Game Brief Document is given to all participants prior to the game session, setting out the starting business scenario and stating the rules of play. Company financial statements are also provided in the brief for Period 0, the starting point.

(f) Each team is supplied with a control sheet and opportunity cards during the session, as described in Sect. 18.6, allowing teams to take either *strategic* or *tactical* decisions.

(g) Players within a team may, if they chose, elect to take on roles such as Director of Finance, Sales, Marketing, Production, but decisions taken should be agreed by *all* members.

(h) Teams are allowed a specific period of time e.g. 4 min, in which to take periodic decisions. This is the same for all teams, but the time may be varied at the discretion of the tutor e.g. for special reasons such as language difficulties.

(i) Strategic decisions are taken by each team on the practical aspects of producing and marketing a new product, setting its price, raising funds or expanding capacity.

(j) Tactical decisions may be taken by each team involving opportunities to hire professional managers to manage departments (design, sales, production, purchasing), promote the product, engage consultants, implement quality or automate procedures, change suppliers, update the IT facilities and outsource the operations. Eight such options (from a total of sixteen cards) may be selected by teams at certain fixed periods throughout the game.

(k) All teams will be competing in the same market with a similar product. As determined by algorithms embedded in the software, decisions by one team may affect the results of others, e.g. via the market reacting to product prices or capacity.

(l) Decision data for each team is entered into the computer, which will then display the key results, by team (Profit & Loss, Balance Sheet, ratios) in both tabular data and graphical form. An indicator of relative company status (reputation and image) is displayed, based on a combination of improved quality and appropriate advertising. (See Fig. 18.6).
(m) Embedded calculations produce a *predetermined* effect on the team's results, for one or more forward periods, according to the control sheet choices made and the opportunity cards selected.
(n) There are no *random* elements, thus ensuring a level playing field with winning goals equally achievable by all teams, and not subject to unforeseen events favouring one team. This is emphasised in the game brief given beforehand.
(o) A brief feedback session is given by the tutor at the end of each period, with reference to the displayed periodic results. Exceptions e.g. the best and worst figures across the four teams are highlighted by using cell colouring.
(p) Each team's overall performance is measured using real-life criteria for success (Return on Investment (RoI), Equity value, Image/Reputation and Cash Balance).
(q) Terminal feedback/debriefing is given by the tutor, with comments on each team's performance, highlighting good or poor decisions and their effect on the outcome. The game's tracking system may be used to assist this process.

18.6 The Game Development Process

Figure 18.2 below shows the 'Input–calculation–output' schematic on which the game design was based. The section shown in Fig. 18.2 for Period 1 is repeated for Period 0 to the left and Periods 3, 4, 5 etc. to the right, for as many as might be required.

18.6.1 The Decision Input Mechanism

At the end of the permitted time for **strategic** decisions, the tutor takes the control sheets from each team and keys in the choices ticked, in the appropriate column for each of the teams, A, B, C or D. These choices may be hidden from the other teams by switching off the display screen.

Figure 18.3 below shows part of the Control Sheet (for the first four periods).

For tactical decisions, a total of sixteen opportunity cards are given to each team at intervals during the progress of the game. The same cards are given to all teams at the same points in time. Any eight of the sixteen cards may be played by

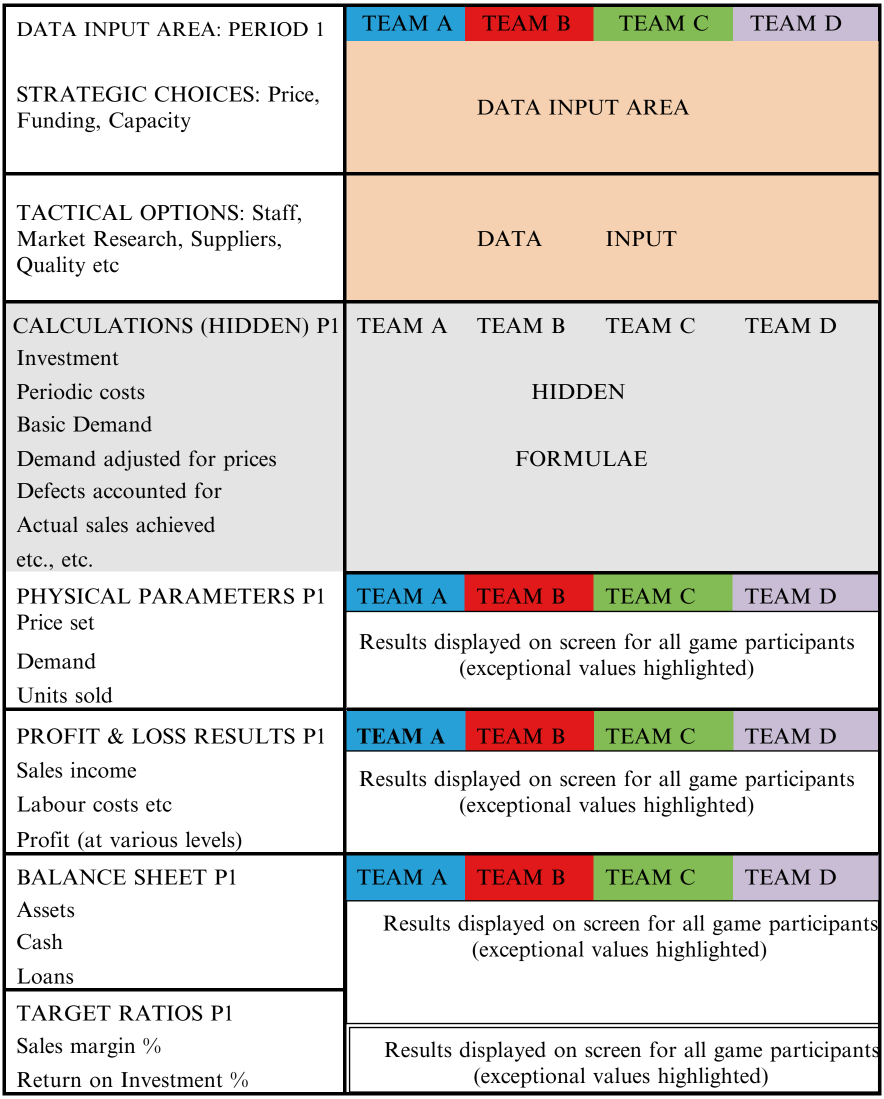


Fig. 18.2 Diagram showing the game structure for one period (Period 1)

a team throughout the game, so the team members must agree to select only the best options, as well as making their choices at the most appropriate time. Figure 18.4 below shows a sample of three of the opportunity cards (numbers 13, 14 and 15) that teams might play at any point, subject to limits on the number of decisions permitted at any one time. Each card contains a 'knowledge tip' or hint, denoted on the card as KT, with information as to the likely outcome of making

8P BUSINESS GAME: CONTROL SHEET PERIODS 1-4 TEAM:	**A**

PERIOD 1	According to your decision:	5% down	Unchanged	10% up
STRATEGIC	Tick one box. new price will remain			
DECISION	until you change it in later period.			

At this point each team is given **SEVEN** Opportunity Cards (Numbers 1-7)

Your team should discuss which of these options is most important at this stage.

PERIOD 2	Change price again?	5% down	Unchanged	10% up
STRATEGIC	Tick one box.			
DECISIONS	Increase / decrease your bank loan (interest rate is 8% but may change)			
	Enter a + 1, 2, or 3 to INCREASE Loan by £5000, £10,000, £15,000			
	Enter a -1, -2, -3 to DECREASE by £5, £10, £15K			

PERIOD 3	PLAY up to any 2 cards (only) that you have. The rest may be used later.		
TACTICAL	Record the numbers of the cards played here:		

Each team is now given Opportunity Cards 8-10.

PERIOD 4	PLAY any 2 cards (only) that you have. The rest may be used later.		
TACTICAL	Record the numbers of the cards played here:		

Fig. 18.3 Illustration of control sheet given to each team (for Periods 1–4)

that choice, in addition to some cost and benefit data where applicable. For example one card permits the purchase of a consultancy study which may provide better information on which to base decisions about choosing a supplier. In this case, a consultancy report containing relevant useful information is returned to the team in question, in the following period.

At the end of the permitted time for tactical decisions, the tutor takes the cards which each team has selected and keys in a ‘1’ against the corresponding card number (1–16) against each team A, B, C or D. This triggers a series of calculations

TEAM C	13	TEAM C	14	TEAM C	15
Action	**Benefits**	**Action**	**Benefits**	**Action**	**Benefits**
Promotion campaign at trade exhibitions and trade journals	Launch new versions of product, raise awareness for a time.	Switch to new Supplier C. Has quoted costs almost as low as Supplier B	benefits unknown but consultants might help, at a cost	Invest in advanced assembly automation	Large capital investment but may reduce labour costs
One-off cost	**Period costs**	**One-off cost**	**Period costs**	**One-off cost**	**Period costs**
£150			As for Supp B	£8,000	lab down 60%
KT: This method of promotion focuses on the trade rather than the general public. slow but steady way of getting exposure for new products as and when launched		KT: Much time and effort must be expended in finding and building a relationship with a new supplier. But it is usually worth the effort to find the right one, in the long term.		KT: Capital spend will not affect your profit (not a trading cost), but may mean incr in bank loan and interest. Can improve your P & L account by reduction in labour costs.	

Fig. 18.4 Illustration of three opportunity cards

which will alter future Company statements in terms of sales, costs, profits, assets etc. depending on the particular card option entered. The changes may affect the Company's position for one or several periods into the future.

18.6.2 Progression Through the Game Session: A Snapshot

Figure 18.5 below shows a number of graphs, each of which may be displayed. Period 6 is taken as an example. These can be shown in any sequence, or omitted, depending on their relevance at that particular point in the simulation. Teams have a few minutes to take note of their progress, problem areas and status in relation to the other teams. Tutor feedback assists the learning process, e.g. team C might like to review their parts supplier and team D could raise a bank loan to eliminate its overdraft.

Figure 18.6 below shows more detailed numerical results which may optionally be displayed to the teams. The figure shows just two teams only (for Period 6). The maximum and minimum values in some key rows are highlighted to assist the periodic feedback given by the tutor. An 'image/reputation' factor is displayed, which is derived on the basis of the implementation of quality improvement procedures plus product promotion, and while this is calculated on a fairly simplistic basis, it provides the right messages on the importance of quality and marketing, while adding to the competitive element.

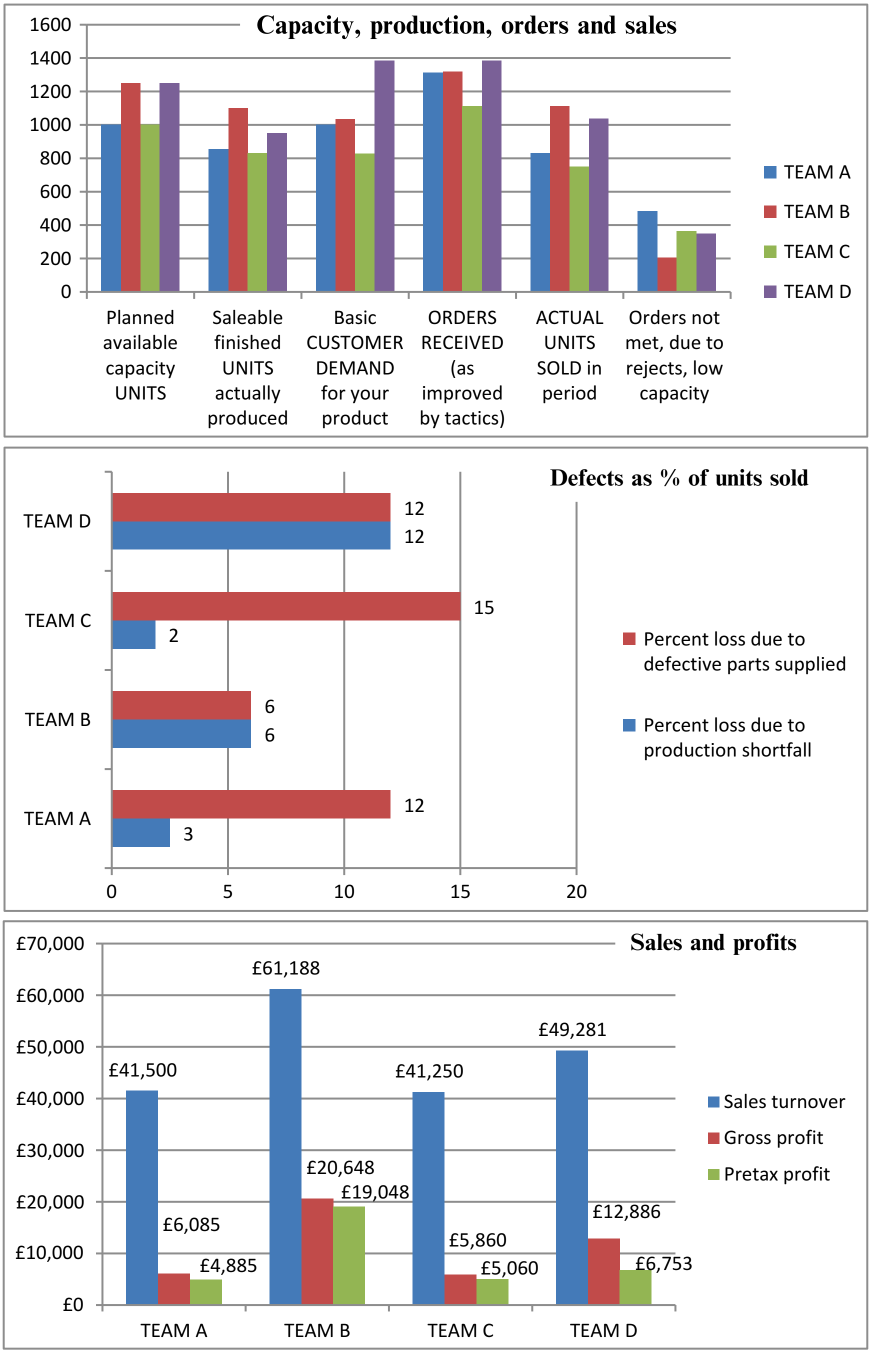


Fig. 18.5 Sample graphs of results from game shown for Period 6

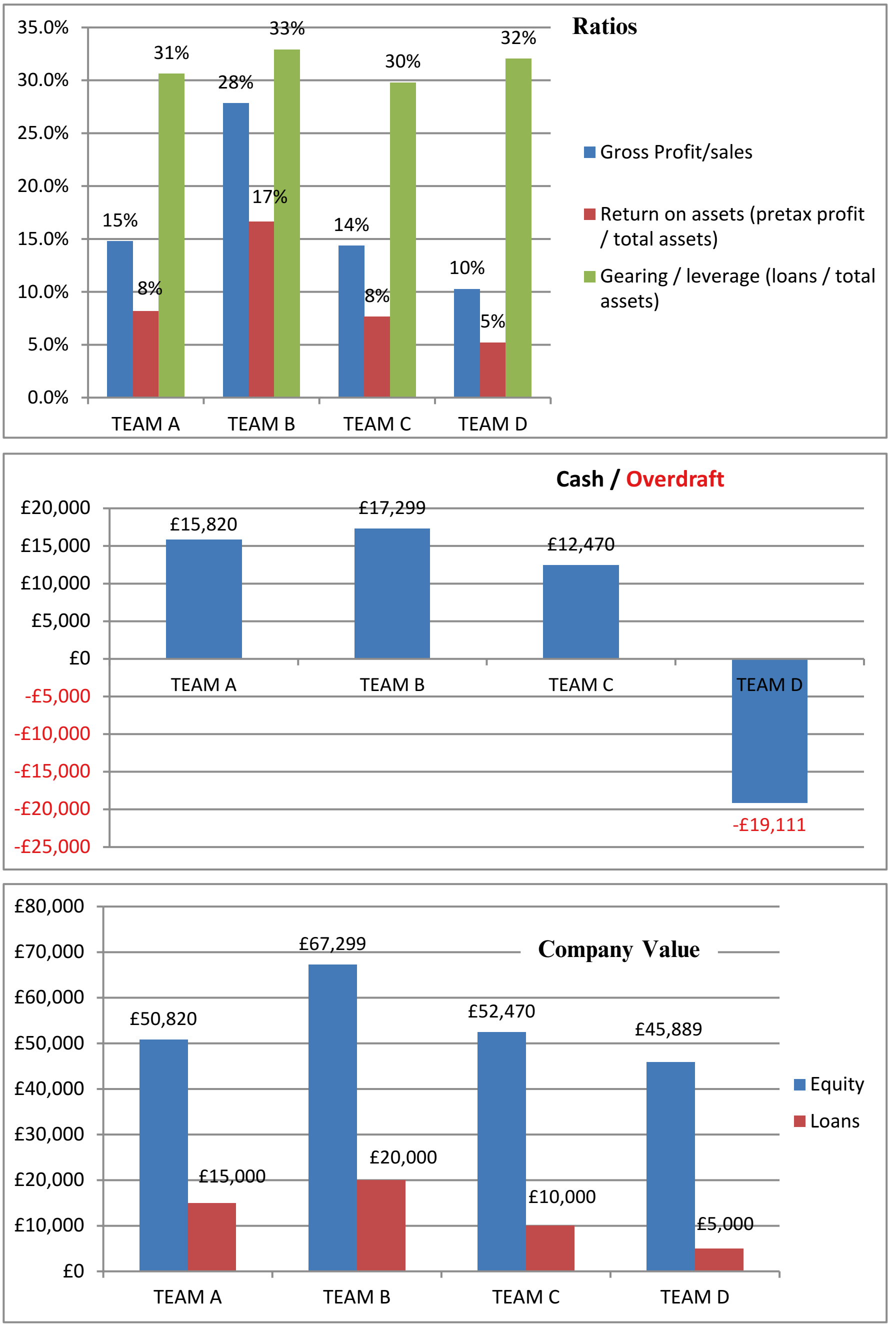


Fig. 18.5 (continued)

	TEAM A	TEAM B
Consultancy Report due? (prompt for tutor)	**no**	yes
Product Price set	£50	£55
Planned available capacity UNITS	1000	1250
Percent loss due to production shortfall	3	6
Percent loss due to defective parts supplied	12	6
Saleable finished UNITS actually produced	855	1100
Basic CUSTOMER DEMAND for your product	1000	1033
ORDERS RECEIVED (as improved by tactics)	1313	1319
ACTUAL UNITS SOLD in period	830	1113
Orders not met, due to rejects, low capacity	**483**	**207**
PROFIT % LOSS for the period (3 months)		
Sales turnover	**£41,500**	**£61,188**
Materials and direct labour	£20,000	£25,000
Overheads (salaries, advertising, rates, electricity, insurance)	£15,415	£15,540
Gross profit	**£6,085**	**£20,648**
Interest on arranged loans	£1,200	£1,600
Interest on overdraft (if needed)	0.00	0.00
Pre-tax profit	**£4,885**	**£19,048**
Retained profit (after tax and div, 50% of above)	£2,443	£9,524
Co. Image:	**HIGH REPUTATION**	**IMPROVING**
BALANCE SHEET		
Fixed assets and stock value	£50,000	£70,000
cash / Overdraft	£15,820	£17,299
TOTAL assets	**£65,820**	**£87,299**
Equity	£50,820	£67,299
Loans	£15,000	£20,000
TOTAL assets	**£65,820**	**£87,299**
RATIOS %		
Gross Profit/sales	14.7%	33.7%
Return on assets (pre-tax profit / total assets)	**7.4%**	**21.8%**
Gearing/leverage (loans / total assets)	22.8%	22.9%

Fig. 18.6 Screenshot of game for Period 6: shown for two teams (highs and lows highlighted)

18.6.3 Decision Tracking Features

Trend graphs can show the progress over several time periods and these can be displayed occasionally e.g. as in screenshots shown in Figs. 18.7 and 18.8 below (for Periods 1–6).

Figure 18.9 below may be displayed at the end of the game to assist debriefing.

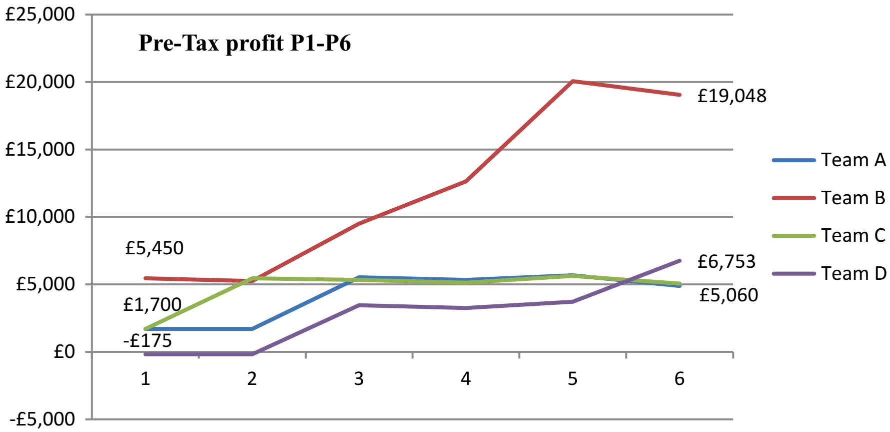


Fig. 18.7 Graphs from game showing progress of profits, by team (Periods 1–6)

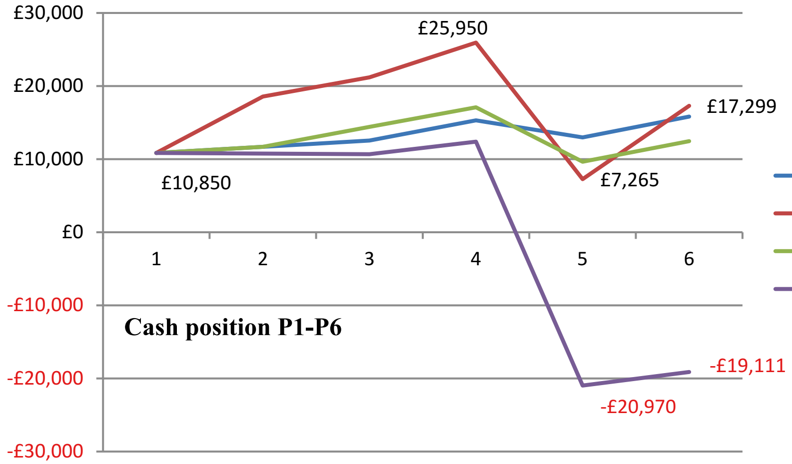


Fig. 18.8 Graph from game showing progress on cash flow, by team (Periods 1–6)

To assist debriefing tutors may display this chart for each team in turn. In Fig. 18.9 above it is shown for team B, the winning team in this example, enabling tutor feedback comment such as:

"Team B decided to raise their product price at the start. Although losing them market share, this was not a problem as they were unable to meet the demand in any case due to lack of capacity and a high percentage of defective items. They increased capacity in stages in Periods 5 and 7, having hired top managers for production, purchasing and also a market research team. Once a new top design person was acquired, they promoted their product in trade journals and at exhibitions (wisely, not on TV as they are not targeting the public), raised bank borrowing to fund the expansion but owing to high profits were able to reduce the loans, eventually to

	TEAM B	P1	P2	P3	P4	P5	P6	P7	P8
		TEAM B	TEAM B	TEAM B	TEAM B	TEAM B	TEAM B	TEAM B	TEAM B
Decision	**STRATEGIC ISSUES**								
A	Raise price by 10% (**1**) or lower by 5%(**-1**)	1						1	
B	Inc (dec) pres LOAN by units of £5000 (**+-1,2,3**)		1			-1		-3	
C	Increase prod'n CAPACITY by 250 UNITS (**1**)					1		1	
Choice	**TACTICAL ISSUES (select any 2 only per period)**								
1	**Hire a top production manager and team**			1					
2	**Hire a top sales manager and team**								
3	**Hire a top chief designer and team**				1				
4	**Update staff computers with intra/ internet**						1		
5	**Pay for supply chain consultant advice**								
6	**Hire market research team**			1					
7	**Hire top purchasing manager and team**				1				
8	**Advertise in consumer magazines**								
9	**Total Quality Prod'n Programme, 6 sigma etc**								1
10	**Change to supplier B (cheaper quotes)**								
11	**Adverts on TV channel over next period**								
12	**Co car and bonus scheme for managers**								
13	**Campaign in food trade exhibitions, journals**						1		
14	**Change to Supplier C**								
15	**Invest in automated assembly**								
16	**Outsource assembly to Asia**								1

Fig. 18.9 Illustration of post-game decision-tracking: Team B

below the level at which the company was first acquired. In Period 8 they implemented quality procedures, possibly a little late, and outsourced production to Asia giving them a big cost advantage. They look set for a bright future."

18.7 The SGIBS Game Assessment Trials

While dry runs had been conducted using volunteer researchers from the SGI, leading to minor adjustments, twelve-period pilot sessions were conducted on two postgraduate classes in November and December 2012. These were classes of Masters students taking a module in Project Management Methods ($n=11$) and Operations Management ($n=16$) respectively. While these preliminary results indicated both a positive response from the staff and students concerned, with requests to use the game again, the pilot game sessions did not have a control group and were used purely to assess the timing and other critical factors in a live situation with real students. Subsequently the number of game time-periods was reduced to eight for the main trials in view of the shorter lesson time available with the undergraduate classes and a decision was taken to collect student ID numbers in order to match pre- and post-test scores by individual student.

The SGIBS game was assessed in early 2013 with six undergraduate game classes, two comprising Chinese students, and five further classes for control purposes. Pre- and post-tests were conducted consisting of sixteen multiple choice questions, each offering three alternative answers. The same test was given before and after the game to fifty participating students and also to fifty-one non game-participating students (the control group). Of the sixteen questions set, eight were based on factual knowledge and eight on decision-taking e.g. "What would you do if…?"). These two sets of questions, referred to as PART A and PART B on the test sheet, were used to evaluate any increase in real knowledge and soft skills respectively, the results being adjusted with reference to the non-playing control classes.

Permission for the study was granted in October 2012 and full Ethics approval obtained from the University in which the trials were conducted in November 2012, following Ethics approval from the Serious Games Institute (SGI), Coventry, UK. where the research was conducted.

18.7.1 Results of Test Measurements and Perception Surveys

T-tests were carried out on improvements in scores for game participants versus improvements in scores for control participants ($n=101$) as follows:

PART A: Knowledge. There was a no significant difference between the improvements in game scores (M=2.35, VAR=294.5 SD=17.2) and control groups (M=−1.69, VAR=352.2, SD=18.2). Conditions (1 tailed) $t(99)=1.67$, $p=0.13$.

This shows an increase in game score improvement over control score improvement of 4.04 % which is not significant ($p > 0.05$).

PART B: Decision-taking. There was a significant difference in the improvements in scores for game (M = 3.00, VAR = 520.2, SD = 22.8) and control groups (M = −8.73, VAR = 485.3, SD = 21.9). Conditions (1 tailed) t(99) = 1.66, $p = 0.005$. This indicates a significant increase in net mean scores of 11.73 %.

BOTH PARTS A & PART B: There was a significant difference in the improvements in scores for game (M = 2.68, VAR = 203.6, SD = 14.3) and control groups (M = −5.2, VAR = 252.0, SD = 15.31). Conditions (2 tailed) t(99) = 1.66, $p = 0.005$. This indicates a significant increase in net mean scores of 7.86 %.

These results are supported by previous studies which have shown game-based learning to be more effective at teaching learners how to apply knowledge rather than acquire the knowledge itself.

Further T-tests were carried out on improvements in scores for Non-Chinese students versus Chinese students ($n = 50$). This was done using game scores only, as there were no Chinese students in the control group classes.

PART A: Knowledge. There was a significant difference in the improvements in scores for Chinese (M = −3.70, VAR = 303.3, SD = 17.4) and Non-Chinese (M = 7.50, VAR = 238.5, SD = 15.0). Conditions (1 tailed) t(48) = 1.68, $p = 0.010$. This indicates a significantly higher ($p < 0.05$) improvement in Non-Chinese mean scores of 11.20 %.

PART B: Decision-taking. There was a significant difference in the improvements in scores for Chinese (M = −2.82, VAR = 557.0, SD = 23.6) and Non-Chinese groups (M = 7.96, VAR = 483.4, SD = 21.0). Conditions (1 tailed) t(48) = 1.68, $p = 0.05$. This indicates a significantly higher ($p < 0.05$) improvement in Non-Chinese mean scores of 10.76 %.

BOTH PARTS A & PART B: There was a significant difference in the improvements in scores for Chinese (M = −3.26, VAR = 224.5, SD = 15.0) and Non-Chinese (M = 7.73, VAR = 136.1, SD = 12.0). Conditions (1 tailed) t(48) = 1.68, $p = 0.003$. This indicates a significantly higher ($p < 0.05$) improvement in Non-Chinese mean scores of 10.99 %.

18.7.2 Survey of Students' Perception of Game Value

A five-question survey of participants' perceptions of the value of the game also conducted as shown in Fig. 18.10 below, the questions chosen to represent five key evaluation criteria. Responses were obtained on a 7-point Likert scale 0–6 (6 being the most positive response), from all game-participating undergraduates ($n = 50$). Figure 18.10 below shows the Likert scale results in response to the five questions in the qualitative survey.

When the two of the six game classes comprising Chinese students were analysed separately, these were seen to rate the experience less highly, on all five counts. (See Fig. 18.11 below).

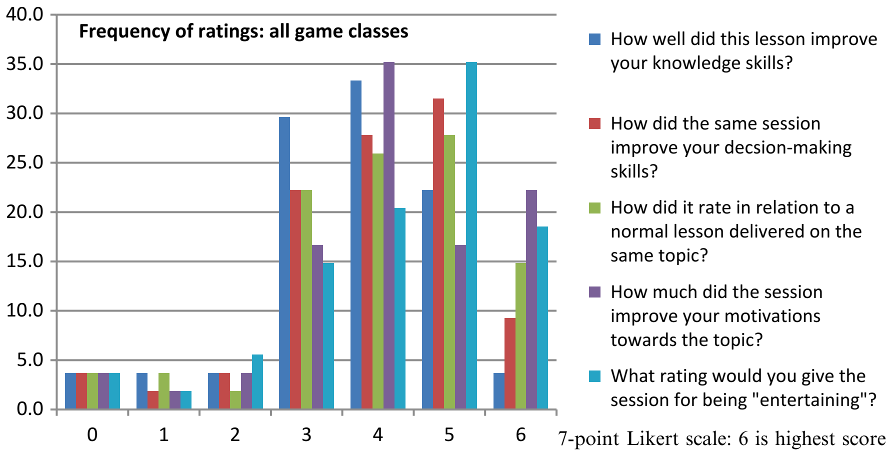


Fig. 18.10 SGIBS game: frequency of responses to five key questions

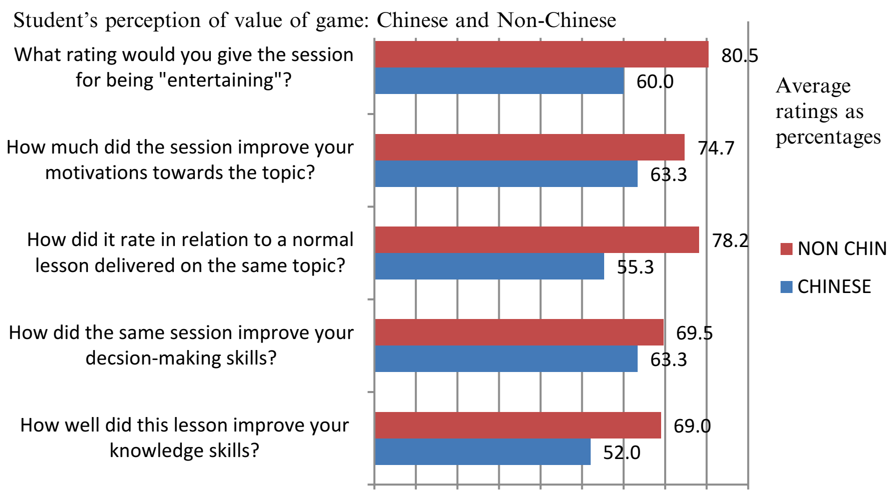


Fig. 18.11 SGIBS game responses: Chinese and non-Chinese classes

For the five ratings taken together, Anova between Chinese and Non-Chinese classes showed that there was a significant difference in Chinese (M = 61.25, VAR = 27.34, SD = 5.23) and Non-Chinese (M = 74.37, VAR = 26.03, SD = 5.10). Conditions (1 tailed) t(8) = 1.86, $p = 0.004$.

Figure 18.12 below shows the correlation between test scores before the game and after.

The line of perfect correlation and zero improvement has been added, indicating that most Non-Chinese students either improved or stayed the same. The coefficient of correlation was $r = 0.69$ and the average improvement in scores was 7.7 %, with

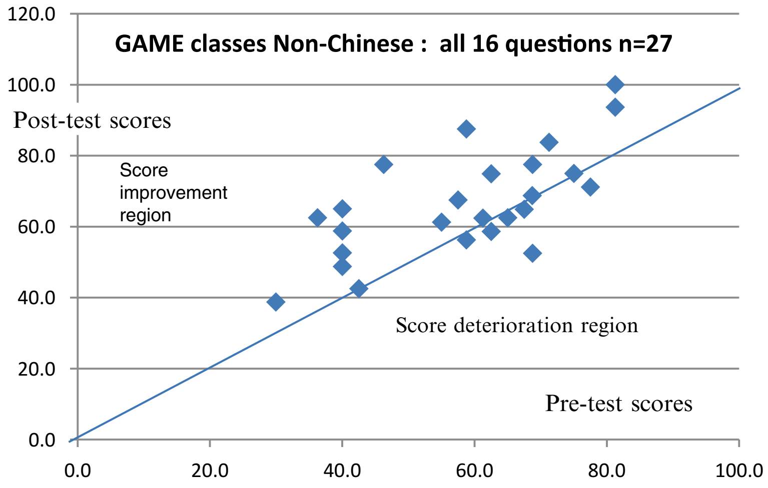


Fig. 18.12 Correlation between scores, before and after the game

marks ranging from 30 to 81 % before the test and from 38 to 100 % after. For Chinese students the correlation was $r = 0.42$ and the average improvement in scores was −3.3 %, i.e. their performance declined, with marks ranging from 21 to 78 % before and from 25 to 78 % after. This suggests that scores for Chinese students were more random and less reliable as a measure.

18.7.3 Synthesis of Game Design with Reference to Suggested Models and Frameworks

Section 18.2 above referred to earlier models and frameworks for game design. A synthesis of the new game in relation to these models is suggested below.

18.7.3.1 de Freitas et al. (2009) 4-D Framework

Category	Sub-category	Alignment to SGIBS game
The Learner	Profile, role, competences	Student profile is known and targeted, at least in terms of course, module studied and level in HE (with possible exceptions e.g. mature students)
Pedagogy	Associative, cognitive, social/situative	Designed to be embedded in METI modulwe, with content aligned to module LOs. Builds on and reinforces the theory lessons given. Promotes inter-team conflict and intra-team cooperation, as defined and practiced elsewhere throughout the METI module

Representation	Fidelity, Interactivity, Immersion	No visual representation with the business scenario, but use of video could be used to enhance sense of reality. Promotes team interactivity in a very real sense i.e. physical proximity, as in a boardroom situation
Context	Environment, access to learning, supporting resources	Environment is artificial (classroom). In longer elapsed time version e.g. over a whole term, access to library, Internet or given material is possible, with potential benefits

18.7.3.2 The Keller (1984) Four Step ARCS Model

Step	Keller's suggestions	Applications to SGIBS game
Step 1: Attention	Tactics employed are to provide surprise and gain interest, pose challenging questions and problems, using humour, variability and enquiry. Often difficult to sustain	Surprise and interest is generated by cards presented throughout game. Humour is down to the tutor but there are many opportunities during the initial briefing, debriefing and periodic feedback
Step 2: Relevance	Should relate to the topic of study but be seen to provide future practical skills e.g. to enhance career prospects	Wide ranging if lacking in depth, though this could be provided with longer sessions and customised versions. Aimed at being an introduction to many aspects of running a business e.g. marketing, finance, production. Not specialised but could be adapted as such. Is directly aimed at enhancing future careers in business management
Step 3: Confidence	Design game to permit rising steps of achievement	Starts with a simple decision on raising or lowering pwroduct price. Instant feedback and possibility of reversing decisions means that corrections can be made
Step 4: Satisfaction	The achiever must feel some reward, praise or intrinsic feeling that scoring well will be valuable in the future. Praise must not be overdone, or a feeling of being patronised may result	Tutor has opportunities after each period to give measured praise for progress against several criteria e.g. sales, profits, RoI, reputation. Final achievement can be defined by any one of those measures, i.e. no single team will normally 'win' outright

18.7.3.3 The Four Types of Participants Suggested by Schwan (2006)

Attribute	Characteristics	Evidence during SGIBS game
Impassioned	Looks for a challenge. High motivation and tolerance to frustration.	Attitude varied with class and degree type being studied. ICT students in general exhibited most passion, Motorsports students the least
Wanna-be-player	Identifies with and wants to be liked. Low tolerance to frustration	A small minority of students were unhappy about not achieving a satisfactory result
Fun player	Treats playing as recreational	Element of fun evidenced by banter and laughter in some classes, postgraduates in particular, in pilot classes
Occasional player	Plays occasionally for amusement	Single session did not allow this character trait to be observed

18.8 Conclusions

The pre-and post-test results showed that for all students, and after adjusting for the change on control results, the improvements in mean scores (out of 100) were:

All classes	Game improvement ($n=50$)	Control improvement ($n=51$)	Game—Control ($n=101$)
Knowledge	2.35	−1.69	4.04
Decision making	3.00	−8.73	11.73
Both	2.68	−5.21	7.89

Game classes only (no Chinese in control groups)	Chinese improvement ($n=23$)	Non-Chinese improvement ($n=27$)	All students improvement ($n=50$)
Knowledge	−3.69	7.50	2.35
Decision making	−2.83	7.96	3.00
Both	−3.26	7.73	2.68

The student satisfaction survey indicated positive ratings on all counts, slightly higher than for the three earlier game studies at the same University. Taking responses to all five questions together, the rating was 74.4 % for Non Chinese undergraduate students. For postgraduate students the rating was 76.6 % indicating that this type of game may be equally regarded by postgraduates as by undergraduates. Chinese undergraduate students had a less positive experience than others, returning a rating of 58.8 %, attention span dropping throughout the game and testing process being a possible factor; this may have arisen from language difficulties in interpreting the game brief, the test questions and other material under time pressure, for students exposed to a style of educational delivery at variance with their previous experience.

Excluding the two Chinese classes, results from the qualitative survey of undergraduate students taking part in the SGIBS game gave a high overall average for knowledge improvement (69.0 %), decision-making (69.5 %), comparison with a normal lesson (78.2 %) and motivation (74.7 %). Entertainment had the highest rating (80.5 %). The average for the SGIBS game qualitative responses to the satisfaction survey, albeit condensed to five questions at 74.4 % (again excluding Chinese) was higher than for the three games surveyed in the preliminary studies, which were based on an eleven question satisfaction survey: Hypermarket 65.1 %, Stores Control 66.6 %, Xing game 64.9 %.

The design of the SGIBS game was based largely on judgement as to the appropriate content, goals, levels of challenge and duration of play. Findings on students' perceptions were in line with previous literature, i.e. they confirm the importance of key factors such as challenge, teamwork, competition, alignment to learning outcomes, goal-setting and feedback. However results from test questions on factual knowledge showed no significant improvement, as measured by PART A of the test, which is in line with previous research, in particular with the earlier extensive study summarised below:

> Based on seven years of research involving 150 studies, Livingstone (1973) found that games can teach factual information although no better than traditional methods of instruction, but that those students preferred the method and there were short-term positive changes in attitudes towards education and careers (Boocock 1994) and Livingstone, Fennessey, Colman, Edwards, & Kidder, 1973). Livingstone et al. argued that, according to the evaluation of more than 150 studies in simulations, simulation games *cannot* provide more effective impacts than other methods of education in terms of teaching factual knowledge. However simulations and games are more easily accepted by students than other lecture activities, and they can help the student players to change their attitudes toward particular topics, though the effects cannot last for a long time.

However the present study does show a significant improvement in scores from test questions in PART B i.e. those measuring performance in soft skills. These results show a mean improvement of 11.7 % ($n = 101$, $p = 005$) and therefore suggest that present-day games of this SGIBS genre *can* provide a positive impact in terms of the teaching of soft skills. However findings for the present study can only relate to the developed game itself, and to the particular groups of students tested, studying the chosen modules and courses at the University in question.

18.9 Future Developments

The design and development process showed that low cost game construction is possible with the right tools. While it involved some 250 h of the researcher's time, freely available software meant that no additional resources or costs were incurred.

In particular where games involve numerical content or graphical displays, the method is proven to be effective, shortening the time needed to develop the software and also to make subsequent revisions and changes. It could be described as a generic method of software development for games of its type. The SGIBS game could also be the subject of a number of enhancements in future versions e.g.:

- More than four teams catered for, or adapted for students competing individually.
- More time-periods covered, and/or designed for longer sessions.
- Wider scope or greater depth of content e.g. specialized knowledge to raise challenge.
- Re-alignment to different Learning Objectives or customized for other modules.
- A greater number of decision-taking options, both strategic and tactical.
- Role playing elements introduced, i.e. specific management roles defined.
- Possible basis for the development of a MMORPG version permitting a wider participation; this would provide for massive data sampling if pre- and post-testing were included.
- A wider study focusing on cultural attitudes with variables such as ethnic origin, age and type and level of degree studied being differentiated.

Game design is an iterative process, with trial and error and re-design essential, analogous to Kolb's cyclical theory of reflection in the learning process itself (Kolb, 1984). But the design process described here may be a valuable input for expanding frameworks and a useful blueprint for future games of the Team Based Mixed Reality type and their use in game assessment.

References

Anderson, P. H., & Lawton, L. (2009). Business simulations and cognitive learning: Developments, desires, and future directions. *Simulation and Gaming, 40*(2), 193–216.

Arnab, S., Brown, K., Clarke, S., Dunwell, I., Lim, T., Suttie, N., et al. (2013). The development approach of a pedagogically-driven serious game to support relationship and sex education (RSE) within a classroom setting. *Computer and Education, 69*, 15–30.

Belbin, R. M. (1981). *Managing teams: Why they succeed or fail*. London: Butterworth-Heinemann.

Belbin, R. M. (1993). *Team roles at work*. Oxford: Butterworth-Heinemann.

Bloom, B. S. (1956). *Taxonomy of educational objectives, handbook I: The cognitive domain*. New York: David McKay.

Boocock, S. S. (1994). Johns Hopkins games program. *Simulation & Gaming, 25*(2), 172–178.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brian, mind, experience and school*. Washington, DC: National Academy Press.

Butler, R. J., Markulis, P. M., & Strang, D. R. (1988). Where are we? An analysis of the methods and focus of the research on simulation gaming. *Simulation and Gaming, 19*, 3–26.

Chen, H., Dun, H. B. L., Phuah, P. S. K., & Lam, D. Z. Y. (2006). Enjoyment or engagement? Role of social interaction in playing massively multiplayer online role-playing games (MMORPGS). In R. Harper, M. Rauterberg, & M. Combetto (Eds.), *Entertainment computing—ICEC 2006: 5th international conference* (pp. 262–267). Cambridge, UK.

de Freitas, S., Hainey, T., & Connolly, T. (2006). *Evaluating games-based learning*. Hershey PA: IGI-Global.

de Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers and Education, 46*, 249–264.

de Freitas, S., Rebolledo-Mendez, G., Liarokapis, F., Magoulas, G., & Poulovassilis, A. (2009). *Developing an evaluation model for immersive learning experiences in a virtual world.* 2009 Conference in games and virtual worlds for serious applications.

Dempsey, J. V., Haynes, L. L., Lucassen, B. A., & Casey, M. S. (2002). Forty simple computer games and what they could mean to educators. *Simulation and Gaming, 33*(2), 157–168.

Denholm, J. A. (2007). Investment by simulation. *Journal of Management Studies, 6*(2), 176–180.

Denholm, J. A., Protopsaltis, A., & de Freitas, S. (2013). Team-based mixed-reality (TMBR) games in higher education. *International Journal of Game-Based Learning, 3*(1), 18–33.

Eseryel, D., Guo, Y., & Law, V. (2012). *Assessment in game based learning, foundations, innovations, and perspectives* (p. 257). New York: Springer.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave/Macmillan.

Hopkinson, M., Close, P., Hillson, D., & Ward, S. (2008). *Prioritising project risks: A short guide to useful techniques*. Princes Risborough, England: Association of Project Management.

Keller, J. M. (1984). Use of the ARCS model of motivation in teacher training. In K. E. Shaw (Ed.), *Aspect of educational technology XVII: Staff development and career updating*. New York: Nichols.

Kiili, R. (2007). Foundation for problem-based gaming. *British Journal of Educational Technology, 38*(3), 394–404.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Livingstone, S., Fennessey, G., Colman, J., Edwards, K., & Kidder, S. (1973). *The Hopkins game program: Final report on seven years of research (Report No 155)*. Baltimore, MD: John Hopkins University, Centre for Social Organization of Schools.

Mayer, I., & de Jong, M. (2004). Combining GDSS and gaming for decision support. *Group Decision and Negotiation, 13*, 3. ABI/INFORM Global.

Millard, N., & Britton, R. (2007). Calling time: An effective and affective evaluation of two versions of the MIT beer game. *BCS, Vol 2 Proceedings of the 21st BCS Group Conference*.

Salas, E., Wildman, J. L., & Piccolo, R. (2009). Using simulation-based training to enhance management education. *Academy of Management Learning and Education, 8*(4), 559.

Schmit, M. J., & Ryan, A. (1992). Test-taking dispositions: A missing link? *Journal of Applied Psychology, 77*, 629–637.

Schrader, P. G., & McCreery, M. (2012). Are all games the same? *Assessment in game-based learning, ifenthaler et al.* In Dirk Ifenthaler, Deniz Eseryel & Xun Ge (Ed.), Springer, 11–25.

Schwan, S. (2006). *Game based learning*. Retrieved from www.e-teaching.org

Smith, P., & Ragan, T. (1999). *Instructional design*. Hoboken, NJ: Wiley.

Sundre, D. L., & Wise, S. L. (2003). *'Motivation filtering': An exploration of the impact of low examinee motivation on the psychometric quality of tests*. Paper presented at the annual meeting of the National Council on Measurement in Education, Chicago

Sweetser, P., & Weth, P. (2005). Gameflow: A model for evaluating player enjoyment in games. *ACM Computers in Entertainment, 3*(3), 1–24.

Taras, M. (2005). Assessment—Summative and formative—Some theoretical reflections. *British Journal of Educational Studies, 53*(4), 466–478.

Thompson, M. (2008). Concept and principles of experiential learning activities. *MTA International*, *13*.

Chapter 19
Gamification in Virtual Worlds for Learning: A Case Study of PIERSiM for Business Education

David Craven

19.1 Introduction

A class in business management for international students operates across a lunch break. The students are involved in the virtual business simulation: PierSim. The students are so engaged and motivated that teachers cannot get the students to take their lunch break. The teachers take their lunch break and the students continue "playing" and "learning" in the PierSim environment.

Twenty-four ESL junior high school Chinese students visit Australia for the first time. They are taught how to play PierSim. Within 1 h, the students are engaged and sharing insights into business strategy. The students use the 'language of business' and surprise their teachers travelling with them regarding their English expression. The engagement and involvement is so high that the students miss their bus back to their hotel.

Students playing PierSim develop strong ethical positions for their businesses and share them online with the public. Faced with increased competition and the requirement to deliver profits, the students breach their ethical obligations without a second thought. The management teams adopting the strongest ethical position are the first to breach their code of ethics. An in-depth discussion follows on ethics and corporations. Does competition and the quest for profits compromise the values of even the most ethical person?

Students operating businesses in PierSim are faced with the challenge of global warming. Unable to look beyond their pursuit of profit and cognisant of the potential for their actions to bring about the end of the 'known world', the students place self-interest and short-term profit ahead of sustainability and collaboration. The virtual world disappears beneath the ocean. A deep discussion follows on self-interest and global issues.

D. Craven, M.B.A., B.Bus., B.A., Dip.Teach. (✉)
Head PierSim Academic Programs, PO Box 203, Ferny Hills QLD 4055
e-mail: craven@fdn.uq.edu.au

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_19

Year 11 and 12 students, after having operated their businesses in a virtual environment, sit down with the real-world CEOs of companies and have meaningful discussion on the issues and challenges of operating a company. The students are able to share insights on business that surprise the CEOs.

These are five real world events that have occurred as a consequence of students using PierSim, a virtual world business simulation developed on the OpenSim platform. Prior to sharing the findings of 3 years of research involving PierSim, it is beneficial to explore the concept of gamification and its application to virtual worlds.

19.2 Gamification

There are a myriad of perspectives advanced on the nature of gamification. Much time, energy and discourse has been invested in the development of a definition of gamification. Deterding, Dixon, Khaled, and Nacke (2011) propose that gamification is ‘the use of game design elements in non-game contexts’ (p. 2). This definition requires an exploration of the nature of game design. Caillois (2006) describes six characteristics of games: non-obligatory; has clearly defined limits in space and time; uncertain in its course and outcomes; unproductive; governed by a set of rules and is a ‘second reality’ (Caillois, 2006, p. 128). Elements of this definition might be challenged in an educational setting where participation in the game is obligatory and may be accompanied with assessment tasks.

The traditional definition of games is that they are experiences governed by a set of rules and characterised by competition with a prescribed outcome (Juul, 2005; Salen & Zimmerman, 2004; Whitton, 2010). This narrow definition may not reflect the myriad of gaming environments that have evolved in imagined and virtual worlds where the gaming concept is a representation of an imagined or real world involving a challenge and a high level of interaction (Whitton, 2010). There may not be a prescribed end-point or a defined outcome in the virtual world. The element of fun and engagement of the user seems curiously absent from these definitions suggesting that there may be a need to develop a new definition of gamification for the classroom context. In this context, gamification might be better referred to as experiences that foster participation, are immersive and are enjoyable and engaging for the user.

Greater benefit is derived from viewing gamification as a process that requires an understanding of game design, game mechanics and game features. Game design requires the creation of a fun and rewarding experience governed by a set of rules that may be implicit or explicit. As a process it involves the user in providing feedback on their experience that fuels the process of continual improvement. It involves the adaptation of the game mechanics and features in order to improve the gaming experience. The experience of developing the virtual world of PierSim has revealed that this process is costly, continual, time consuming and requiring the use of a team of highly skilled people. When viewed as a process, the gamification of education should be seen as a significant investment. Gamification is much more than the issuing of badges and rewards in an educational context.

19.3 Gamification of Education

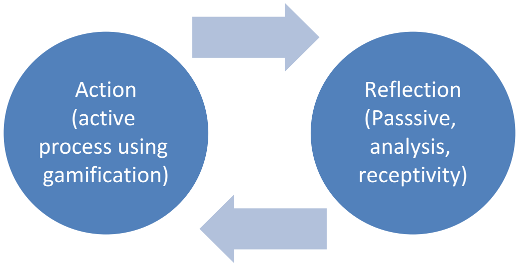
Traditionally, video games and virtual worlds have been viewed as the province of Generation X, Y & Z (the Alphabet Generation). However, current research by Brand, Lorentz and Mathew (2014) suggest that video gaming is becoming a mainstream activity. Eighty-one percent of mothers and 83 % of fathers play video games (p. 5). In the home environment, 71 % of households have two or more gamers (Brand, Lorentz, & Mathew, 2014) suggesting that gaming is becoming pervasive within the Australian home. The average age of gamers is now 32 (Brand et al., 2014, p. 11) and 47 % gamers are female (Brand et al., 2014, p. 13). This development suggests that gaming may be the new catalyst for social cohesion in the family (Dye, 2010). Gaming within the family context is becoming the new catalyst for cross-generational social interaction. Can gamification of subjects become the new catalyst for engagement and participation in the education sector?

There is nothing new in the gamification of education. In the 1970s, the SRA Reading Laboratory was used within the school sector to stimulate reading and comprehension. The programme involved performing a sequence of staged activities, receiving a reward on their successful completion and progressing to the next level. As an experience it satisfied the gamification definition. At the time, it was unlikely that the teachers and students considered that they were playing a game. Interestingly, students 'playing' PierSim have shared the same perspective suggesting that in the educational context it is possible to submerge the gaming elements into the learning experience. The immersion in the experience becomes so intense that the player loses sight that they are 'playing' a game.

While it is not a revelation that improving the educational outcomes for students is dependent upon engagement and participation (Department of Education & Early Childhood Development, 2009; Liberante, 2012; Richardson, 2011), given the pervasiveness of digital games and environments in the lives of the Alphabet Generation and their potential for bridging the generation divide, gamification offers opportunity to address issues of motivating and engaging the student (Fassett & Warren, 2004; Weber, 2004). Gamification has the potential to enhance the perceived value of the task to the learner which in turn increases the level of interest in the learner and their level of motivation (Garris, Ahlers, & Driskell, 2002; Gee, 2003; Weber & Patterson, 2000). Interest and immersion in the learning environment can result in learning osmosis where learning seeps into the mind of the learner through the experience in an unconscious manner. This unconscious learning needs to be made conscious through the process of critical reflection. The process results in a level of knowing that is enduring because it is memorable.

Currently, gamification appears to be transfixed on the gamification of processes and the use of badging (Johnson et al., 2013). This seems to be no different than the techniques used in the SRA Laboratory of the 1970s. Real learning and the gaining of insight and knowledge comes from the learning process generated by the gaming experience. Learning is a dual process of action and reflection (Fig. 19.1).

Fig. 19.1 The learning process. (Adapted from the model of experiential learning: Kolb, 1984, p. 42



For learning and insight to occur, the two elements must co-exist (Hansen, 2000; Kolb, 1984; Wood, Teras, Reiners, & Gregory, 2013). The insight that Newton gained from watching the apple fall from the tree or Watt's observation of the boiling kettle was dependent upon the active pursuit of understanding that occurred prior to the passive moment of inspiration. The gamification of education is the configuration of the experience in a manner that enables reflection, analysis and insight to occur. Unless this is overlayed across the gaming experience, then the value of gamification is limited. In the traditional classroom, the teacher might allow students to play games if they have finished their class work early. Although this use of gamification in the classroom might enhance productivity, it contributes little to increasing the learning and understanding of the subject. There has been ample criticism of the use of rewards to promote learning (Deci, 1971; Kohn, 1999; Lepper, Greene, & Nisbett, 1973). The same criticism may well be directed to the current infatuation with badging.

Gamification in the classroom, when combined with reflection, can create a significant learning experience leveraging the engagement and high energy of the learner (Fink, 2003). Not only can gamification facilitate higher order learning from Bloom's cognitive taxonomy such as comprehension and knowledge but also facilitate the development of ethical understanding, leadership and interpersonal skills, communication skills and the ability to adapt to change. The replacement of right and wrong answers with cause and effect relationships through gamification fosters involvement, discussion and reflection. It shifts the teacher from being the arbiter of the learning process to supporting, coaching and mentoring the learner in deriving knowledge from the experience through critical reflection.

Watching teachers using PierSim in the classroom, a paradigm shift in the role of the teacher occurs. The experience becomes the teacher and the teacher becomes an observer. Through the process of observation, the teacher guides the student using a critical reflective process to an understanding of what has occurred. At first, it is difficult for the teacher to stand back and allow the students to make mistakes. Yet faced with a gaming environment comprising of a plethora of variables and where the only certainty is uncertainty, the teacher has no option but to adopt the role of a mentor and guide. Teacher and students become partners in the learning experience, seeking to draw meaning from what has occurred.

This shift develops resilience in the learner and a reliance on the team and themselves to derive understanding. This understanding is applied back into the learning experience through new decisions and actions. The feedback provided by the game and the input from the student establishes a continuous learning loop. The short feedback cycles support learning by trial and error in a risk free environment (DeKanter, 2005). The gaming environment reframes the nature of the learning experience in the classroom.

This is the real potential of gamification in the classroom. Online education, or eLearning, has failed to deliver on its initial promise of reshaping learning in the twenty-first century (Lee & Duncan-Howell, 2007; Penna, Stara, & De Rose, 2007; Romiszowski, 2004). The reason for this is the lack of interactivity and motivation provided by the medium (Pursel & Bailey, 2005). The gamification of the learning experience offers the opportunity to overcome these issues.

19.4 Virtual Worlds and Gaming

Just as there is much debate about the games and the nature of gaming, so there is on the nature of virtual worlds (Bell, 2008; Kapp & O'Driscoll, 2010). In its simplest form, virtual worlds are rich interactive environments in 3D where the learner has a virtual presence as an avatar (Toro-Troconis & Mellstrom, 2010). Bell (2008) proposes that a virtual world is 'a synchronous, persistent network of people, represented as avatars, facilitated by networked computers' (p. 2). This means that the virtual world supports synchronous communication, is dynamic, continuous and supports networking. It involves avatars and networked computers. Virtual worlds provide the learner with control over their experience and enables collaboration (De Freitas, 2008). PierSim meets all these criteria.

PierSim is a game-oriented scenario that seeks to simulate the business environment. It has been designed to blend the virtual world (in-world) with the world of the classroom (out-world) to create a dynamic learning environment. Although virtual worlds, such as *Second Life*, cannot ordinarily be classified as games because they lack predefined challenges and goals (Livingstone, 2007), Toro-Troconis and Mellstrom (2010) recognise that virtual worlds provide the potential for game-based learning to occur. PierSim is an example of the successful realisation of this potential. It must be remembered that this potential is realised because the learner overlays the learning process of action and reflection across the simulation.

19.5 A Case Study: PierSim

19.5.1 Why PierSim? What's Wrong With Business Education?

The future success of any economy is dependent upon entrepreneurship and innovation (Braunerhjelm, 2010; Kukoc & Regan, 2008; Libecap, 2000; Wong, Ho, & Autlo, 2005). It might be expected therefore that business and entrepreneurship education within schools is given high priority by the Australian government. Yet business entrepreneurship and education is often viewed as an extra-curricular activity rather than embedded within subjects. Business education was not considered within Phase One and Phase Two of the national curriculum in Australia (Australian Curriculum, Assessment and Reporting Authority, 2012). Only twenty hours in the early years and forty hours in years 9–10 has been allocated to the business curriculum in a school year and the learning elements are often submerged within other subjects. The concept of entrepreneurship and its associated skills is not afforded the importance it warrants in the curriculum document (Australian Curriculum, Assessment and Reporting Authority, 2012; Wood, 2011).

The integration of entrepreneurship and innovation into the business curriculum in Australian schools will require a change in mindset. The teaching methodology will need to change to include a more experiential approach driven by student-centred learning. Greater involvement of the corporate sector in schools is required (Hatak & Reiner, 2012). At the government policy level, curriculum changes need to occur in order to embed entrepreneurship and innovation. Politically and ideologically, teachers have traditionally been opposed to the tenets of private enterprise being espoused within the educational context (Down, 2006; O'Brien & Down, 2002). Furthermore, their experience is often limited to school, university and back to school as a teacher. This makes the teaching of business as a real-world experience highly challenging and demanding for the teacher. Under such pressures, it is highly probable that the teacher will seek comfort in the pages of a textbook.

Within the school system, Peter Strong, the Executive Director of the Council of Small Business in Australia, has identified that there is a need to develop business entrepreneurship in our students in order to generate future economic growth for Australia. In a study of entrepreneurship education in secondary schools by Hatak and Reiner (2012) the need to embed entrepreneurship within the curriculum was considered to be essential. Traditional textbook methods rarely give students sufficient understanding of even the basic ideas in a subject area (Ashmore, 2012; Kirk, Mathews, & Kurtts, 2001; Medbery, 2012).

There are significant barriers to the development of entrepreneurship in our young people. Firstly, the level of importance and funding required for the training of teachers and the development of school-based entrepreneurship programmes by the educational funding bodies is lacking. Secondly, the curriculum is not orientated towards the development of entrepreneurial skills. Thirdly, teachers often lack experience and the entrepreneurial mindset to be able to deliver an effective learning experience. Fourthly, time and resource constraints in the school often limit the entrepreneurial experience that can be delivered. Faced with these barriers, gamification of the business environment provides the opportunity for the development of business skills in the school environment.

Given the challenges faced by educators in this area, PierSim was developed to provide a real-world business simulation in a virtual environment (Fig. 19.2). PierSim provides students with the opportunity to operate a business in competition with students also operating other businesses. To date, PierSim has been effectively used in secondary school environments, the youth leadership program, Chrysalis and in the foundation year course for the University of Queensland. The virtual

Fig. 19.2 Wholesaler in PierSim

world provides an opportunity to create a significant learning experience, to develop entrepreneurial skills and to support teachers in teaching the business curriculum.

19.5.2 What is PierSim

PierSim is a 3D business simulation operating on an Open Sim platform. The simulation allows teams of learners to compete against each other within an economy and implement the business and management principles that they have learned in the classroom. The variables within the environment can be manipulated to create a range of scenarios that challenge the learner using the principles of gamification to create an enhanced learning experience. There are seven institutions using PierSim from high school business classes to a university foundation year business course that is compulsory for some international students to attend before enrolling in an undergraduate degree.

Learners can operate individually or in teams depending on the particular classroom context. Each selects one of fifty available businesses ranging from pizza businesses, supermarkets and coffee shops through to hotels, banks and wholesalers, and seeks to operate them profitably (Fig. 19.3). They must do so in a context where exchange rates, interest rates, sustainability issues, epidemics, supply-demand issues and environmental issues are volatile.

Learners are faced with the challenge of having to maintain the health, satisfaction and relationship of their avatars (staff) in order to produce quality products (Fig. 19.4).

The learner must manage the profitability of their company, the pricing strategy, the purchasing and inventory strategy, the sales and marketing strategy, change management, customer relationships and the risk management strategy whilst eval-

Fig. 19.3 Hotel Island in PierSim

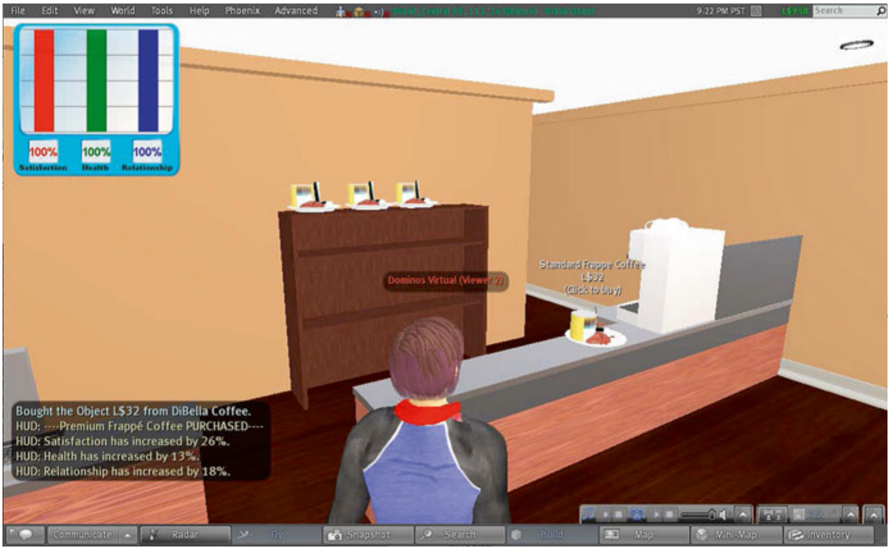


Fig. 19.4 DiBella business in PierSim

uating the moves of their competition and the changes in the environment in order to develop and implement their competitive responses. This is often performed in the context of a team in terms of maintaining accounting records and preparing and delivering business plans and annual reports.

The learning environment mixes in-world and out-world environments to create a seamless market place for students to operate their businesses within the virtual

Fig. 19.5 The learning environment

world and the classroom simultaneously. Screens are placed around the perimeter of the classroom for each of the businesses creating a space for student interaction (Fig. 19.5).

As students develop strategies as a management team in the classroom and implement them both within the virtual world and within the business world of the classroom, the teacher is able to control all the variables in the game which enables the recreation of a wide range of scenarios in-world. These include events such as economic booms and recessions, environmental disasters, supply problems and command economies. The teacher becomes as much a player in the game as the students. Within the learning environment, the economic decisions of the company management affect the environment. Students must work on a collaborative approach that can both sustain the environment and the profitability of the business (Fig. 19.6). The open-ended environment of virtual worlds is ideal for these ethical decision-making processes as there are no rights and wrongs only decisions and consequences.

The learning platform has been used by over 3,000 students and has demonstrated the effectiveness of the use of gamification principles to engage and motivate the learner. PierSim has been used to teach economics, business management, accounting, teams and leadership, business ethics, HR management and awareness of global issues. It is currently being used at St. Columbans, St. Josephs Nudgee College, St John Fisher, Ormiston College, International Education Services, Brisbane Boys College and the Chrysalis leadership programme.

Fig. 19.6 Strategising for a business

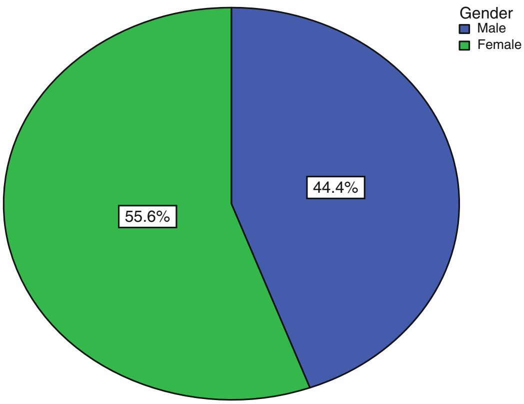


Fig. 19.7 Gender profile of sample

19.5.3 Sample

A sample of 250 students participating in PierSim were selected randomly. The sample comprised 139 females and 111 males aged between 15 and 20 years old (Fig. 19.7).

19.6 Results

Evaluations have been conducted with teachers and students participating in PierSim. Each student participating in PierSim completed a questionnaire (Appendix). Of those students intending to pursue business subjects at university, close to 100 % responded that the increased understanding of business would better

Table 19.1 Experience using Pier Sim

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Experience	250	2	3	5	3.67	0.620

Table 19.2 Learning about business

		Frequency	Percent	Cumulative percent
Valid	No	43	17.2	17.2
	Yes	207	82.8	100.0
	Total	250	100.0	

prepare them for their studies. In addition, 82.8 % confirmed that the experience was fun and interesting and that this had assisted their learning. Class attendance during the PierSim sessions, compared to other sessions, was elevated by approximately 30 %. During the delivery of the program, in those classes that crossed a lunch break, learners usually refused to take a break preferring instead to continue with the simulation.

19.6.1 Descriptive Statistics

The students found the experience working with PierSim to be satisfying ($\mu = 3.67$) with the range being neither satisfying or non-satisfying to extremely satisfying (Table 19.1). No student found the experience to be unsatisfying.

82.8 % of the students believed that PierSim taught them something about business (Table 19.2).

19.7 Teach About Business

Of the 207 students who considered that they had learnt something about business playing PierSim, the following elements were the learning outcomes (Table 19.3).

Two hundred and twenty-two of the respondents would recommend PierSim to other students. The recommendations are presented in Table 19.4.

When compared to the classroom experience, the majority of the students ($n = 195$) saw the experience as more engaging than the traditional classroom experience (Table 19.5).

The two primary reasons that were cited by the students for these responses were that PierSim presents theory in a practical and realistic manner and that the experience was interactive, competitive and enjoyable.

The information contained in Table 19.6 indicates that the traditional gender bias of gaming towards males was not a factor in PierSim. In fact, the female students gained a greater understanding of business than their male counterparts.

Table 19.3 Learning outcomes

Element	Number	Percentage ($n = 207$)
Learnt about the need to develop flexible strategies that can adapt to changes in the environment	141	68
Learnt how to operate a business	138	55
Learnt the importance of being competitive and profitable	138	55
Learnt the importance of considering environmental factors	138	55
Learnt the importance of managing purchases	94	45
Learnt the importance of teamwork	67	32
Learnt the need for recordkeeping	29	14
Learnt the importance of marketing	10	9

Table 19.4 Recommendations for PierSim

Element	Number	Percentage ($n = 222$)
Enables the student to understand about business	167	75
It is an effective learning strategy	158	71
Learn the importance of working as a team	56	25
Learnt the need to be flexible and adaptive to change	56	25
It is enjoyable and fun	56	25
Learnt the need to maintain records	29	13

Table 19.5 Comparison with the classroom experience

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Comparison classroom	250	2	1	3	2.74	0.526

Table 19.6 Learnt about business

		Gender		Total
		Male	Female	
Teach about business	No	26	17	43
	Yes	85	122	207
Total		111	139	250

	Value	df	Asymp. Sig. (two-sided)	Exact Sig. (two-sided)	Exact Sig. (one-sided)
Chi-square tests					
Pearson chi-square	5.429[b]	1	0.020		
Continuity correction[a]	4.672	1	0.031		
Likelihood ratio	5.404	1	0.020		
Fisher's exact test				0.028	0.016
Linear-by-linear association	5.408	1	0.020		
N of valid cases	250				

[a]Computed only for a 2×2 table
[b]0 cells (0.0 %) have expected count less than 5. The minimum expected count is 19.09

Table 19.7 Satisfaction with experience

		Gender		Total
		Male	Female	
Experience	Neither satisfied or dissatisfied	33	30	63
	Satisfied	44	30	74
	Very satisfied	34	79	113
Total		111	139	250

	Value	df	Asymp. Sig. (two-sided)
Chi-square tests			
Pearson chi-square	49.280[a]	2	0.000
Likelihood ratio	62.042	2	0.000
Linear-by-linear association	26.390	1	0.000
N of Valid Cases	250		

[a]0 cells (0.0 %) have expected count less than 5. The minimum expected count is 15.10

The information in Table 19.7 reveals that female students had a higher level of satisfaction with the virtual world than their male counterparts.

Interviews with teachers reveal that using PierSim changed their role. The teachers found that they became more a facilitator than an instructor. The teacher was an active learner in the process in partnership with the student. At times, the teacher adopted a consultancy role assisting the student to integrate theory with practice. Teachers commented that the change in relationship promoted a deeper discussion and reflection on the theory by the students.

19.8 Interpretation

There are a number of interesting observations that arise from this feedback. The first is that the majority of the students understand the learning outcomes of PierSim even though it is a simulation game (Table 19.2). Within this cohort, the emphasis of the learning is away from the traditional focus on marketing and towards adaptive strategies and the holistic elements of operating a business (Table 19.3). Table 19.3 reveals that playing PierSim highlights the need for business managers to consider the environmental impacts of their actions.

The second observation is that although the students identified that PierSim was a game simulation, the fun and enjoyable elements were not the primary drivers for recommending the experience (Table 19.4). Rather it is the learning that is derived from the experience that dominates the responses and it is this primary strength that the students recognise. The learning experience is highly integrative and engaging rather than being perceived as just a fun activity. The students are able to discern the learning that is contained in the experience. This supports the findings of Prensky (2001) that people enjoy playing games because they learn from them.

Gaming and virtual worlds have traditionally been viewed as a masculine social space (Toro-Troconis & Mellstrom, 2010). However there does appear to be a gender balance occurring in this sphere. The research in this context reveals a higher level of engagement of the female students in the game than their male counterparts, a higher level of learning from the experience and a higher level of satisfaction. Within the school environment of St. John Fisher, an all girls Catholic school, students dress up in corporate uniforms and compete with a level of energy and engagement that is heart-warming from an educationalist's viewpoint.

19.9 Conclusion

The future of gamification in delivering real benefits to the learner rests with the integration of the process of learning into the game elements. Essentially the future resides not with the gamification of learning but rather the learnification of games. Instead of the current focus of seeking to apply gamification to learning by using aspects such as badging, the future lies in the reconfiguration of the gaming experience so that it supports learning. The gaming element becomes the active experience: the raw material for reflection and insight. As an experience, the 'game' engages, absorbs and energises the learner and the teachers. The game transforms and transmutes their traditional classroom roles and the classroom experience. The game does not become a conduit for learning and the development of knowledge unless the process of reflection and analysis is applied to the 'game'. Virtual worlds, such as PierSim, provide the opportunity for this continuous loop of learning to occur in rapid succession.

The evaluation of PierSim by past learners suggests that virtual worlds provide the potential for the support of active, contextual and experiential learning that cannot be duplicated by a textbook alone. It is gender and age neutral. High levels of interactivity, submersion and engagement, coupled with the enjoyment of the 'gaming experience', energises the learning experience. Educational outcomes are improved for both the teacher and the learner. The blank canvas of virtual worlds provides the opportunity for educators and game developers to enter into unique partnerships for the creation of dynamic new learning experiences. The unique gaming design of PierSim as a blend of in-world and out-world experiences is an acknowledgement of the learning potential of both the virtual world and the 'real' world. Blending the finite world of the classroom with the infinite virtual world creates a required unique dynamic synergy that transforms business education. The future rests not with the gamification of learning, but the learnification of games.

For further information on PierSim contact:
E: mail: craven@pieronline.org
Mobile: +61 (0) 421976853
Phone: + 61 (7) 38327699
Website: piersim.com

19.10 Appendix: Questionnaire

Review Of PierSim

1. **Rate your experience using PierSim on the following scale (Circle One)**

1 2 3 4 5
Not Extremely
Satisfying Satisfying
Average

2. **Did your involvement teach you anything about business ? (Circle One)**

YES NO

(If you circled No, go to question 4)

3. **Write three things that you learnt about business from your involvement in PierSim?**

____
____
____
____
____
____

4. **You have to recommend PierSim to a a new student. Write three sentences that you would say to the new student.**

____
____
____
____
____

5. **When compared to the traditional classroom experience, do you consider PierSim to be: (Please circle one)**

Less Engaging No Different More Engaging

What was the reason for your response?

____
____
____
____
____
____

6. **Gender (Please tick one)**

☐ **Male** ☐ **Female**

Thankyou for your feedback. Any further comments that you might like to add can be emailed to me at craven@pieronline.org

References

Ashmore, C. (2012, May 23). Why we're so bad at teaching entrepreneurship. *Time*. Retrieved from http://business.time.com/2012/05/23/why-were-so-bad-at-teaching-entrepreneurship/

Australian Curriculum, Assessment and Reporting Authority. (2012). *Draft shape of the Australian curriculum: Economics and business*. Canberra, ACT: ACARA.

Bell, M. W. (2008). Towards a definition of "virtual worlds"'. *Journal of Virtual Worlds Research, 1*(1), 2–5.

Brand, J. E., Lorentz, P., & Mathew, T. (2014). *Digital Australia 14*. Gold Coast, QLD: Faculty of Humanities and Social Sciences, Bond University.

Braunerhjelm, P. (2010). Entrepreneurship, innovation and economic growth—Past experience, current knowledge and policy implication. *CESIS electronic working paper series, no. 224*. Stockholm, Sweden: Centre for Excellence for Science and Innovation Studies.

Caillois, R. (2006). The definition of play and the classification of games. In K. Salen & E. Zimmerman (Eds.), *The game design reader: A rules of play anthology* (pp. 122–155). Cambridge, MA: MIT Press.

De Freitas, S. (2008). *Serious virtual worlds: A scoping study*. Coventry, England: Serious Games Institute.

Deci, E. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*(1), 105–115.

DeKanter, N. (2005). Gaming redefines interactivity for learning. *TechTrends, 49*(3), 26–31.

Department of Education and Early Childhood Development. (2009). *Effective schools are engaging schools. Student engagement policy guidelines*. Melbourne, Australia: Office of Government School Education.

Deterding, S., Dixon, D., Khaled R., & Nacke, L. E. (2011). Gamification: Toward a definition. Retrieved from http://hci.usask.ca/uploads/219-02-Deterding,-Khaled,-Nacke,-Dixon.pdf

Down, B. (2006). Developing critically reflective teachers in 'wacky' times. *Proceedings of the 2006 Australian Teacher Education Association Conference* (pp. 84–95).

Dye, J. (2010). The role of media in the family. The predictable risks and surprising benefits of family media use. *Focus findings.* Retrieved from http://www.focusonthefamily.com/about_us/focus-findings/parenting/the-role-of-media-in-the-family.aspx

Fassett, D. L., & Warren, J. T. (2004). "You get pushed back": The strategic rhetoric of educational success and failure in higher education'. *Communication Education, 53*(1), 21–39.

Fink, L. D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. San Francisco, CA: Jossey-Bass.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation and learning: A research and practice model. *Simulation and Gaming, 33*(4), 441–467.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Hansen, R. (2000). Role of experience in learning: Giving meaning and authenticity to the learning process in schools. *Journal of Technology Education, 11*(2), 23–32.

Hatak, I., & Reiner, E. (2012). *Entrepreneurship education in secondary schools*. Vienna, Austria: Institute for Small Business Management and Entrepreneurship.

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., & Ludgate, H. (2013). *NMC horizon report: 2013 higher education edition*. Austin, TX: The New Media Consortium.

Juul, J. (2005). *Half-real: Video games between real rules and fictional worlds*. Cambridge, MA: MIT Press.

Kapp, K. M., & O'Driscoll, T. (2010). *Learning in 3D: Adding a new dimension to enterprise learning and collaboration*. San Francisco, CA: Wiley.

Kirk, M., Mathews, C. E., & Kurtts, S. (2001). *The trouble with textbooks*. National Science Teachers Association. Retrieved from http://www.nsta.org/publications/news/story.aspx?id=46067

Kohn, A. (1999). *The trouble with gold stars, incentive plans, A's, praise and other bribes*. Boston, MA: Houghton Mifflin.

Kolb, D. A. (1984). *Experiential learning. Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Kukoc, K., & Regan, D. (2008). Measuring entrepreneurship. *The Treasury.* Retrieved from http://archive.treasury.gov.au/documents/1352/HTML/docshell.asp?URL=02_Entrepreneurship.asp

Lee, K., & Duncan-Howell, J. (2007). How do we know e-learning works? Or does it?'. *E-Learning, 4*(4), 482–496.

Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology, 28*(1), 129–137.

Libecap, G. D. (2000). *Entrepreneurship and economic growth in the American economy*. Oxford, England: JAI Press.

Liberante, L. (2012). The importance of teacher-student relationships, as explored through the lens of the NSW Quality Teaching Model. *Journal of Student Engagement: Education Matters, 2*(1), 2–9.

Livingstone, D. (2007). Learning support in multi-user virtual environments. *Proceedings of the European Conference on Game-Based Learning, University of Paisley, Scotland, 25–26 October*.

Medbery, J. (2012). Reinventing education to teach creativity and entrepreneurship. *Co-exist.* Retrieved from http://www.fastcoexist.com/1679771/reinventing-education-to- teach-creativity-and-entrepreneurship

O'Brien, P., & Down, B. (2002). What are teachers saying about new managerialism? *Journal of Educational Enquiry, 3*(1), 111–133.

Penna, M. P., Stara, V., & De Rose, M. (2007). The failure of e-learning: why should we use a leaner centred design? *Journal of e-Learning and Knowledge Society, 3*(2). Retrieved from http://www.je-lks.org/ojs/index.php/Je-LKS_EN/article/view/254

Prensky, M. (2001). *Digital game based learning*. New York: McGraw-Hill.

Pursel, B. K., & Bailey, K. D. (2005). *Establishing virtual learning worlds: The impact of virtual worlds and online gaming on education and training*. State College, PA: IST Solutions Institute, The Pennsylvania State University.

Richardson, S. (2011). Uniting teachers and learners: Critical insights into the importance of staff-student interactions in Australian university education. *AUSSE Research Briefing, 12*, 1–18.

Romiszowski, A. J. (2004). How's the E-learning baby? Factors leading to success or failure of an educational technology innovation. *Educational Technology, 44*(1), 5–27.

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.

Toro-Troconis, M., & Mellstrom, U. (2010). Game-based learning in *Second Life*. Do gender and age make a differences?'. *Journal of Gaming and Virtual Worlds, 2*(1), 53–76.

Weber, K. (2004). The relationship between student interest and teacher's use of behaviour alteration techniques. *Communication Research Reports, 2*(4), 428–436.

Weber, K., & Patterson, B. R. (2000). Student interest, empowerment and motivation. *Communication Research Reports, 17*(1), 22–29.

Whitton, N. (2010). *Learning with digital games: A practical guide to engaging students in higher education*. New York: Routledge.

Wong, P. K., Ho, Y. P., & Autlo, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small Business Economics, 24*, 335–350.

Wood, F. Q. (2011). *Entrepreneurship in Australia: the missing links*. Sydney, NSW: United States Studies Centre, University of Sydney.

Wood, L. C., Teras, H., Reiners, T., & Gregory, S. (2013). The role of gamification and game-based learning in authentic assessment within virtual environments. In S. Frielick, N. Buissink-Smith, P. Wyse, J. Billot, J. Hallas, & E. Whitehead (Eds.), *Research and development in higher education: The place of learning and teaching, 36,* 514–523.

Chapter 20
Theoretical Considerations for Game-Based e-Learning Analytics

David Gibson and Peter Jakl

20.1 Introduction

Considering the potentially voluminous and diverse data from user performance and interactions involved in digital game-based learning and gamified e-learning experiences introduces time-sensitivity, rapid feedback, goal-directed behavior tracking and other assessment challenges into analytics. In what follows, the features of a theoretical landscape for analysis are introduced, to help promote awareness and the evolution of educational measurement and assessment.

In brief, the two broad schools of traditional educational research methods, qualitative and quantitative, are bridged and bound together to create a middle ground for model-based scientific approaches required to deal with the challenges of game-based and gamified digital performance assessment. Unlike 'mixed methods' research, which combines qualitative and quantitative approaches in various sequences, model-based data-science approaches are a synthesis of methods, resting on a different epistemological foundation.

Traditionally, qualitative and quantitative approaches have been seen as occupying separate territories (Lincoln, Guba, Lincoln, & Guba, 1985) and while hypotheses-driven science has been the epitome of educational research, the new methods arising from data mining and model-building science have only recently begun to appear in the literature as important alternatives for the study of learning in digital environments (Barab & Duffy, 2000; Gibson & Knezek, 2011; Pirnay-Dummer, Ifenthaler, & Spector, 2010). As evidence of the early status of the field, in 2005, the first workshop bearing the name "Educational Data Mining" (EDM)

D. Gibson (✉)
Curtin University, 8-15 Rule Street, North Fremantle, WA 6159, USA
e-mail: david.c.gibson@curtin.edu.au

P. Jakl
Pragmatic Solutions, Westlake Village, CA, USA
e-mail: peter@pr-sol.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_20

was held in Pittsburgh as part of the conference of the Association for the Advancement of Artificial Intelligence, and the association's international conference on educational data mining has been held annually only since 2008. In addition, one of the earliest conferences on learning analytics was held in 2011.

The new analytic methods are appearing because a digital performance (e.g. a user interacting with a digital application to accomplish some goal) with appropriate computational support can undoubtedly involve big data. For example, in a gamified e-learning environment, the activities involved in point scoring, competition with self and others, and operating within rules of play can produce voluminous data from a diverse set of inputs, and lead to a need for speedy decisions and adaptive responses by the e-learning application as well as the player. Where in the past, a complex and highly interactive performance, such as collaboratively solving a problem, was an impractical if not intractable assessment challenge to assess in a face-to-face setting; now when performed in a digitally supported gamified environment, nearly every action and interaction can be documented, sampled, recorded and analyzed. But how do teachers, students, researchers and evaluators then know what to look for? Enter the methods of learning analytics for data discovery, pattern finding, and machine-supported inference based on 'big data' and 'complexity' science.

Learning analytics in classroom-based gamified systems fulfill several needs. For example, analytics are used to help instructors, learners and even the gamified applications to identify and respond to events based on:

1. How effectively students comprehend the content
2. How masses of other comparable learners or experts have utilized the performance space
3. How effectively both groups and individuals transfer and apply knowledge to new settings
4. How people respond, work collaboratively, make decisions, and create artifacts such as short answers, constructed responses, essays, diagrams and creative works.

Analysis of the events and attributes of a learner engaged in any of the above activities in a gamified or game-based e-learning experience can establish patterns of performance behaviours and relate those patterns to valued outcomes, which can then be used to promote learning.

The next section establishes the contexts of big data and complexity science in gamified e-learning and the following sections introduce some of the key challenges and methods of analysis.

20.2 Big Data and Complexity Science

Big data is voluminous, diverse, and time-sensitive. According to IBM, 90 % of the volume of data in the world today has been created in the last 2 years alone (IBM, n.d.). These features of size, variety and rate are present in game-based and gamified

Table 20.1 Artifact production rates

Interaction type	Interaction frame count per item	Artifacts produced per 10 min interval
Short essay test	1–5 min	2–10
Short answer test or complex turn-based game (e.g. chess)	10–30 s	20–60
Medium difficulty multiple choice test (e.g. simple computation skill)	5–10 s	60–120
True/false quiz or simple turn-based game (e.g. checkers)	Under 5 s	300 or more
Twitch-speed digital game (e.g. car racing, target shooting)	0.02 s	30,000 or more
Biofeedback (e.g. an EEG headset at 128 frames per second)	0.008 s	76,000 or more

e-learning, where the goals of control might include presenting the student with the next challenge, adjusting the difficulty of the practice environment, or adapting the curriculum and resources available to improve learning. Such learning experiences almost always involve near real-time interactions between learners and a computer, where the software tracks sequences of actions and the resources used during the engagement.

Voluminous. The records available for learning analytics often contain significantly more information than has been traditionally documented and analyzed in learning engagements. For example, in a traditional 10-min segment of a test or quiz, a learner might create 10–20 artifacts, but during the same amount of time in a gamified digital simulation, over 70,000 artifacts might be recorded (Gibson & Clarke-Midura, 2011). Table 20.1 displays an example of the typical range of the volume of artifacts available for game-based e-learning analytics during various time frames that capture user interactions. The interaction frame count of an item is the length of time it takes to digitally create and store the item.

Diverse. Digital games and simulations may include a wide variety of data types (e.g. biometric, unstructured, gestural) as well as performance targets (e.g. inferred ability, emotions, performance capabilities, routine skills, levels of expertise, and higher order thinking). Data types include unstructured input such as audio, video, click streams, and log files. Digital performances can also entail higher order targets for learning and assessment. For example, the learner in a game designed for learning might be engaged in the *epistemic frame* of a profession (Shaffer, 2007), which is the collective practitioners' understanding of the skills, knowledge, identity, values, and epistemology of that field of practice. For example, "The doctor will BE you now" proclaims a chapter in a book on teaching ethics via games (Sharkasi, 2010). These immersive experiences can provide psychometricians with complex higher order thinking constructs such as *projective identity* (Gee, 2008), a process where *embodiment* (e.g. 'walking in someone else's shoes,' or 'feeling your way around') reveals thinking. In addition, embodiment includes the action-first nature of habits, gut reactions, heuristic thinking (Gigerenzer, Todd, & ABC Research Group, 1999) and physical manipulation of resources, all of which can be considered extensions of thought due to *distributed expertise* (Brown et al., 1993). Note also the added dimension of *social knowledge* (e.g. professional identity, values and epistemology) that reaches beyond the strictly individual focus of traditional psychometric measures of ability, personality and motivation. These examples illustrate that big data is not only numerous but highly varied, spanning both cognitive and non-cognitive dimensions of thought and action.

Time-sensitivity. Big data arrives quickly and must be processed at a fast rate, as illustrated in Table 20.1 by the column labeled 'Interaction frame count per item.' The large volume of potential information is only made meaningful if patterns can be recognized and related to each other and the rest of the world. In order to identify meaningful patterns to adapt a learning experience, inform a learner, or control some mechanism, methods are needed for rapid assessment and feedback. Nature has solved this problem with *fast and frugal heuristics* (Reimer & Raeskamp, 2006) which provide models for dealing with the challenges of big data. In the world of data science for example, the problem of quick thinking is solved with methods such as *rule-based filtering*, where solution algorithms are sometimes evolved via genetic algorithms based on data mining and discovery methods operating in a range from unsupervised learning (e.g. computers working on their own in near-real time) to supervised learning (e.g. computers and humans working together in time consuming post-hoc mode).

Complexity science is an interdisciplinary field, which studies the common properties of multifaceted, multilayered and convoluted systems in nature, society and science (Nicolis, 1989). Complex systems have many loosely coupled elements *flexibly interacting* and *dynamically co-evolving* to produce *emergent phenomena* such as global behaviours that are generally *nonlinear*; the behaviours cannot be explained in terms of a linear combination of interactions between the individual constituent elements (Holland, 1995). A gamified e-learning experience is potentially an example of a complex system if the player has freedom to make decisions and the digital application has several ways to respond to those decisions. The ongoing co-evolution of the progress of such an activity involves *time-dependent interdependencies* among events. For example, one event created by a player's move leads to a new state of the game, which leads to a new decision point by both the application and the player, so at each step of the evolution of the system, there is a dynamic co-dependency on the immediate past state of the system for both the player and the gamified application.

These aspects of big data (speed, variability and size) and complexity science (interdependence, multilayered events, time sensitivity, dynamics of system co-evolution, emergent phenomena) - give rise to new analysis challenges concerning data from game-based and gamified e-learning.

20.3 Data from Game-Based and Gamified e-Learning

'Game-based e-learning' implies that there is a high degree of *learner choice* about what actions and resources to use, a *goal* that the learner is seeking to acquire or attain, and *obstacles and challenges* being faced along the way. 'Gamification' adds mechanisms for providing transparent feedback about goal attainment via *point scoring* and *competition with self and others*, while a player operates within the *rules of play*. Without the goal, the experience might be an open play space, such as a sand box. Without obstacles or challenges, the experience might be a recreational pastime. Without a high degree of choice, the experience might become a tedious activity. The goal gives direction and reward. The obstacles give the potential for interest, perseverance and achievement. Choice provides the autonomy of learning from self-directed experience, which is also supported by the transparency of points and goal tracking. These affordances of a digital game are the minimum set needed in good game-based e-learning. However, the specifics of each e-learning experience then augments the experience's affordances for learning with important additional features needed for a player to acquire knowledge, utilize that knowledge, and for anyone to assess the situated and contextualized learning evidence based on the user's interactions—what does the learner make and do in the digital space during the time of the game and how are those artifacts considered as evidence of the user's knowledge and know-how?

Inferring what someone knows and can do based on digital interactions thus depends on the affordances of the game or other e-learning experience *as a performance space for assessment* (Mayrath, Clarke-Midura, & Robinson, 2012; Tobias & Fletcher, 2011). Combining *digital performance* with *performance assessment*, this concept of a gamified e-learning experience includes all types of performance in which computer technologies have taken on a primary rather than an auxiliary role in the content, techniques, aesthetics or the delivery of someone's expression and where the digital record is used as evidence of learning. The concept implies new challenges for psychometrics due to the increased complexity of the digital record. The actions of a game-playing test-taker for example, unfold as performances in *time* and cover a multivariate *space* of possible events. But unfolding performances in time and space do not easily fit the standard assessment models, where the responses are often narrow performances that are artificially time constrained. For example, in multiple-choice tests, the student selects from a limited range of answers and time is primarily used as a cut-off for completion of the test as a whole.

Data from game-based e-learning, in contrast, raises the possibility of *nonlinear behavior*, because the changed learning environment, which has responded to the learner, is now the baseline for the next move. In an assessment, such change and adaptability entails *interaction and dependency* of the prompt with the test taker, which raises additional measurement challenges concerning the independence of the stimuli. For example, if the adaptive application does its job well and helps the test taker perform better over time, there should be a reduction in error variance over time. But this violates a condition of statistical approaches that assume independent stimuli with no relationship to previous stimuli, and no change in the rate of error. Recycling of information violates the assumption that outputs are a simple linear sum of the inputs.

In addition to the technical problems of new dimensions of assessment and new nonlinear challenges for analysis, the targets of assessment are also changing, from basic skills and declarative knowledge toward the integration of knowledge applied to complex open-ended tasks requiring critical thinking, communication, collaboration, and creativity (Bennett, Persky, Weiss, & Jenkins, 2007; Koch & DeLuca, 2012). This shift toward *higher order thinking* complicates the performance space with constructs that test the boundaries of the sociological (e.g. communication), psychological (e.g. collaboration) and procedural (e.g. creativity and critical thinking) domains of measurement.

Emblematic of the shift in measurement toward higher order thinking, the means of expression have expanded. In contrast with the constrained choices of standard test items, performance tasks in a digital-media learning environment often have *relatively unconstrained parameters* such as interactions with the mouse, keyboard and screen, storyline choices, open-ended text responses, recorded speech, drawing, use of digital tools including simulations of real-world tools, historical traces from problem solving decisions, and biometric information such as facial expressions, skin responses and brain states. These novel communication formats and information sources constitute not only a new performance space for expression but also a larger problem space for educational measurement. With increased complexity in both the stimuli and responses, the measurement options and challenges are numerous, as evidenced by recent research exploring the problems and possibilities of the emerging generation of technology-based assessments (Bennett, 2001; Bennett et al., 2007; Choi, Rupp, Gushta, & Sweet, 2010; Clarke & Dede, 2010; Clarke-Midura, Mayrath, & Dede, 2010; Mayrath et al., 2012; Quellmalz et al., 2012; Rupp, Gushta, Mislevy, & Shaffer, 2010; Shaffer et al., 2009; Stecher, 2010; USDOE, 2010).

So, the measurement challenges represented by digital performance space features such as unconstrained and multidimensional simultaneous input of video, sound, and constructed artifacts, interactive adaptability, nonlinearities, personalization, temporal and spatial features, and higher order thinking, demands new psychometric methods (Clarke-Midura, Code, Dede, Mayrath, & Zap, 2012). In the follow sections new terms of reference are proposed for e-learning analytics from game-like and gamified performance spaces.

20.4 Atomistic Data Challenges

Data items at the atomistic level cross over the boundary between quantitative and qualitative research. In traditional educational research, a core item is the *count* of some quantity, while in game-based learning analytics, the core item is an *event*, which may or may not be counted but which itself has structure. An event is a ‘1’ of something that has a beginning, middle and end, which entails *time*. In addition, each item has *attributes*, which qualitatively adhere to and classify the event.

Time and event segmentation. One of the most basic questions concerning time-sensitive data analysis is that since systems evolve over time, *how much time do we need in an analysis* and *when is the best time to stop gathering and start making sense* of the situation? Is there a form of continuous interpretation that should be employed, and should it use all the data or a particular window of time?

Making fine-grained observations with process details is based in two components of a time-based assessment event: the *situation or scenario* (e.g. the context that gives rise to and may contain the event), and the *actions* and *products* (digital performance artifacts) made by the user. A digital performance elicited by a scenario can be segmented into *event frames*, which others have called "slices, episodes and activity segments" (Choi et al., 2010).

The concept 'event' is meant to capture the holism of the beginning, duration and ending of some *time-based unit of reference*. The concept 'frame' is meant to convey a *schema of interpretation for that unit*. The event frame thus identifies that the disaggregation units of analysis of a dynamic performance are not point-like objects; they have *a time component that is essential to their meaning*. Summaries of the unit as a whole do not help elucidate its details; and comparing whole-event summaries from event to event must be done with considerable care to avoid glossing over the fine-grain details of the events and introducing an attendant problem of *incommensurable interpretations* (Feyerabend, 1970). In addition, the units of analysis must be *recognizable in relationship to some structure of meaning* that is more significant and informative than a number summarizing the mean of some population of data points.

Cyclic dynamics. When a user makes a choice and the digital e-learning application responds to those choices, the interaction can create *self-reinforcing loops* or cycles of causes, in which both the user and the application are causes and effects of each other in a set of on-going relationships. Stopping these cycles is an arbitrary moment in the co-evolving causal network. For example, imagine measuring the state of a room, a cooling engine and a thermostat on a day that begins cool, warms up and then cools down again. Early in the day the cooling engine is off, the state of the room and the outside temperature is cool. In the middle of the day, the cooling engine is on, the room is warm and the outside is warmer still. At some point, the outside becomes as cool as the inside and the cooling engine is still running but shuts off once the thermostat reaches its goal. As the room leaks cool air, the probability of the cooling engine coming on goes up, but as the room leaks cool air slower than the engine cools the room, the probability of the engine shutting off goes up and once it is off, the self-reinforcing cycle repeats.

In a learning context, an example of a self-reinforcing loop is the student who does not care about grades or pleasing the teacher (or the same can be said about one who is highly motivated by grades and does want to please the teacher). Caring or not caring are beliefs about the value of the results of behavours. The non-caring student expects bad grades and gets them; the caring student expects good grades and gets them. Behaviours that align with the belief, cause feedback in the environment, such as grade marks from the instructor that tend to fulfil the belief system. A non-caring student gets low marks and the caring one gets high marks, as expected, leading to reinforcement of the belief. But maximums can sometimes be reached that reverse the causes. Perhaps the non-caring student faces a second year at the same grade level and has to decide whether to drop out or to start caring enough to get by. Perhaps the caring student meets a teacher who grades on quality only regardless of effort and the student has to learn to stop caring about the grade and focus on the quality of the work.

The external drivers of such a systems may also be varying. For example, the outside temperature cycle boundaries will be different in each season, requiring measurement for months on end. The grading system might change to pass-fail and upset a lot of beliefs about pleasing the teacher in order to receive the highest mark. Such external forcing variables can also be both causes and effects connected to the main loop under consideration. So, the simple practice of assuming that a cause precedes an effect—a mainstay of linear causality - is unwarranted in certain cases.

To measure these kinds of systems and their cyclic dynamics, several measures need to be taken for a long enough period to capture the full cycle. A snapshot taken at any point in time (e.g. any summative assessment) of a system with cyclic interactions, catches the system at some point in its loops, but the full story is not captured in that one picture. What is needed are methods of building models that include 'effects as causes' as the complexities of interactions evolve, and methods that represent the differential phases of a loop of relationships when there are nonlinear causal factors in a dynamic situation.

The process of building a model from snapshots of a dynamic system is called a '*nonlinear state space reconstruction*' (Sugihara et al., 2012). It is nonlinear because it is only approximately cyclic, it is a state space because all the data falls within a finite band or manifold of behaviour. That is, every state of the system will be in one of the spaces created by the finite possibilities for each variable at some point in time. It is a reconstruction because you have built a model of the system's relationships based on data. Such reconstructions of the underlying manifold governing the dynamics of a system can map to and uncover the causal relationships in a complex system (Schmidt & Lipson, 2009). State space reconstructions may be key to the future of assessment of digital performances in learning contexts.

Multicausality. Choosing an event frame for averaging, finding minimums and maximums and performing other calculations, is challenging because significant causes may be present at *multiple time scales*. At some scales, short-range dynamics are crucial to long-range causes, but would be obscured by summation over time. Methods are needed to represent and analyse multivariate relationships that are changing over time (perhaps rapidly), without oversimplifying them to inert quantities, when their impacts on the system are subtle, perhaps weakly coupled, and time-sensitive. For example, a cause may be building for some time before it exerts its influence on the system. One potential solution is to capture the network statistics of many performances and use inductively evolved rule sets of network relationships as a foundation for near-real time assessments relating a current performance to that network (Holland, Holyoak, Nisbett, & Thagard, 1986). This is discussed further in the section on holistic data challenges.

Superposition. This concept points to the fact that event frames can overlap and be superimposed, so that during certain time periods, more than one event frame and interpretation might be applicable. For example, a burning ball, which might be both spinning and getting cooler, has separable frames of analysis that may or may not have a causal connection and may or may not be visible given available technologies. The boundaries of intersecting latent or unobservable variables change with new technology. For example, there was a time when it seemed impossible to talk about measuring emotions or brain states during learning. However, now brain waves and states can be documented during a physical task, and visual maps showing steps of processes as well as intentions and affect can be created immediately before and during actions.

The aforementioned theoretical and technical tools for analysis of complex actions in a game-based e-learning space support the idea that digital tasks can become the basis for assessment inferences. Analyses of game-based e-learning may involve overlapping, multiple, non-exclusive representations that help elucidate and inspire intuitions about the data and lead to further hypotheses, they are not expected to definitively prove some position about the data that draws discussion to a close.

Atomistic features such as those explored above are metaphorically the equivalent, in a traditional linear quantitative model, of the summaries and related operations on means of populations. The new ‘events as data points’ may come in the form of *strings*, *sequences*, *series*, *and motifs* as well as *products*, *documents* or even a *whole corpus of evidence*, and as such these new clusters of data require recognition, classification, and validation. In natural language processing this is done in a sequence of *tokenization*, followed by *tagging*, followed by *stemming*, and other processes to form *n-grams* or *vectors*. In the assessment of complex attributes, the n-grams of *event frame clusters* may jointly stand as evidence of a complex latent variable such as “leadership” or “problem-solving.” It is expected that *n-grams* in the cognitive and non-cognitive digital performance domains will have neighbor structures and cluster relationships that are coherent with schemas, mental models and the real world.

20.5 Holistic Data Challenges

The previous section outlined some of the key ‘atomistic’ data challenges concerning questions such as: what is complex dynamic data when it is evidence of learning and performance; how levels of aggregation acquire meaning; and what happens to meaning as things change. In this section, the discussion briefly addresses the contexts and processes of learning analytics within the larger sphere of scientific inquiry. The premise is that scientific inquiry has transformed from the early twentieth century hypothesis-driven methods associated with the ‘scientific method’ to a computationally empowered model-building associated with ‘data science’. As a result, educational research is changing to accommodate new insights and possibilities arising from game-based e-learning analytics.

To answer a scientific question using model-driven data science methods, after exploring background and prior knowledge, one starts with data instead of a hypothesis (Cangelosi & Parisi, 2002). One proceeds by generating, synthesizing or combining large quantities of data from disparate sources, and utilizing interchangeable steps of analyzing existing data, or building and running simulations that create data. These core steps of “analyze-model-simulate-generate” stand in contrast to the “hypothesize-experiment-analyze” steps in the traditional scientific method. Thus, a visual representation, an operational model, or a theory built from the ground up using data mining methods can be considered a rough analog of a statistical summary in traditional psychometrics.

For example, if we think of the resources in a digital performance space as nodes in a network, and the links between the nodes representing the probability of moving from one node to another, the resulting data summary can underlie a visual representation and an operational model of the space (Fig. 20.1). An analytics application such as Leverage (Gibson & Jakl, 2013) can build an inductive model from

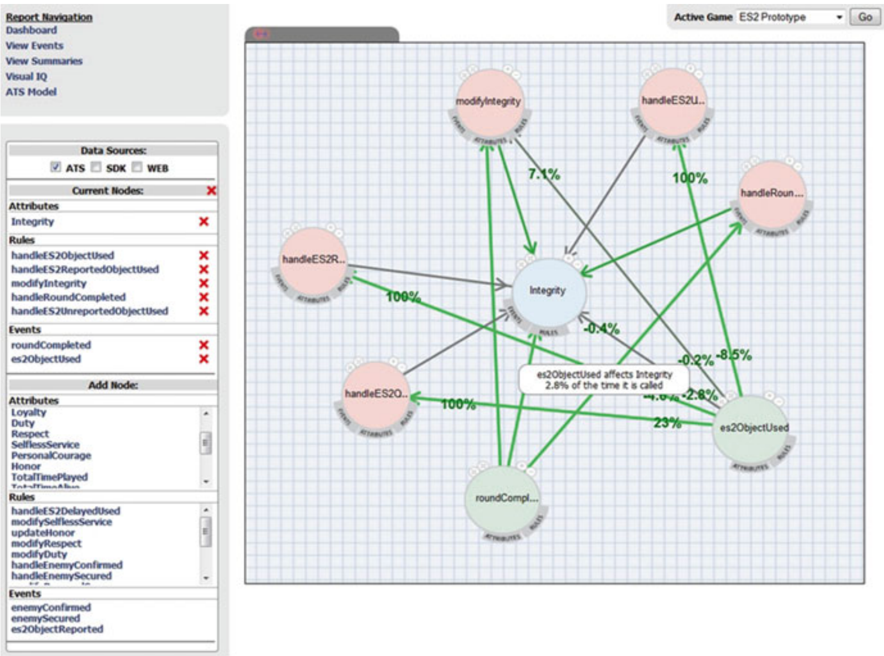


Fig. 20.1 Leverage database visualization of the historical performance on selected nodes of a digital performance space documents the empirical probability of sequences of nodes in a user’s trajectory

actual use of a digital space, and apply the *empirical probabilities* (Gigerenzer et al., 1999) from real use to make probabilistic inferences about the trajectories from node to node in the network. This allows the summary of the performance space to evolve over time, but also to be used in the present moment to estimate or guess what the user is most likely to do.

The paths of performance can also be further identified and filtered so that if the user is for example, female and there are gender differences in the historical performance profile (or any number of other differentiating characteristics), then the estimates can be personalized. The personalized estimates can trigger different messages and adaptive responses that the application can use to differentiate, personalize and adapt the user's experience. New nodes can appear as a result of rules—for example, 'if over 85 % of the population uses one of only two 'next steps,' then create a new node to hold all the responses that have less than 2 % of the population.'

A network model can thus evolve both resources and links based on user actions. Such evolution is a distant cousin of 'norming' and the use of 'item response theory' in testing, where the population's average performance on test items is part of determining the difficulty of each item as well as in placing the test taker within some normed group of performers. However, in game-based learning analytics, the focus is on the pathway of multivariate resources as evidence of a complex performance capability (Quellmalz et al., 2012), rather than a cluster of item-level performances as evidence of possession of a univariate attribute.

The holistic state space of performances for any particular gamified digital e-learning experience is a *collocation* (or *juxtaposition*) of the real trajectories through the space. The space is created by the actual things users have done. So, the simplest dictum for building a holistic model of learner interactions is 'save everything,' which raises challenges of scalability, long term data storage, and the need for a system that allows post hoc exploration of the data. With everything saved, a games-based analysis can reconstruct the actual trajectories and potential pathways of the digital performance space.

Each trajectory carries with it additional attributes of each user, allowing filtering and comparing (Gibson & Jakl, 2013). The data challenge here at the holistic level is one of model building. Since many different models can be built from the same database, there is generally no single correct answer or perfect model. Each model contains partial information as well as evidence to support or reject several questions of the model builder such as: what counts as evidence of knowledge and skill in this instance; which judgments are of most interest for one's current purposes (e.g. comparing users, assessing performance to a standard, differentiating the user's experience, finding and presenting the next best experience, meeting the user's expectations); and how have different kinds of users already experienced the performance space.

Given intersectionality of the multiple probabilistic trajectories, a theoretical foundation is needed for processing many rules related to a single event. Such an foundation is provided in *subsumption architectures* (Brooks, 1986, 1999) and *quasi-homomorphisms* (Holland, 1995; Holland et al., 1986). The subsumption architecture captures the idea that many simultaneous rules can be true, and when exceptions arise, a new smaller subset rule can be formed (and *subsumed* as a subset) to handle the exceptions. This architecture allows big general rules to keep firing simultaneous with lower rates of firing of their exceptions; and for rule space evolution to occur if the exceptions grow too big. The quasi-homomorphism captures the idea that the process of attempting to map to the real world helps decide via fitness when a new rule is needed. These are foundations for making machine learning inferences that underlie genetic algorithm methods such as *symbolic regression* (Schmidt & Lipson, 2009). Symbolic regression searches the space of expressions as well as the fitness of those expressions while attempting to maximize some measure of fitness, and has been used in game-based learning analytics (Gibson & Clarke-Midura, 2011).

These foundational ideas allow the 'save everything' holistic data approach to be amenable to a multiplicity of *post hoc* discoveries that document the long-term relationship between user actions in relation to gamification affordances, rule-driven determinations of those actions, and the representation of target learning behaviors. Once rules have been discovered, they can then be used *a priori* to predict or to form an expectation of performance. In this holistic space-time of *post hoc discovery* bridged with *a priori expectation* of rules, the atomistic data challenges can be addressed as part of the process of building a reasoned and reasonable structure for understanding what users know and are able to do.

20.6 Summary

Gamification of e-learning, that is, the process of utilizing game-like methods to motivate and reward learning, involves the use of rapid feedback to adjust the user experience by informing, guiding and rewarding the user based on dynamic interactions. The rapidity of the feedback is often accompanied by a variety of information modalities and types (e.g. visual, auditory, text, symbolic, semantic, operational) as well as by the sheer volume and high rate of information exchange. These three conditions fulfill the definition of 'big data' (i.e. voluminous, diverse, and time-sensitive) and gives rise to the need for an appropriate learning analytics approach to building the rules engine for the gamified environment; especially when the rules need to be discovered within the masses of data created by the actual use of the digital resources and affordances, as opposed to the planned uses in a traditional 'game' created with a small and finite set of game rules.

Thus, with the advent of gamified applications for learning, the instruments and procedures for measuring learning and performance are shifting away from point-in-time (e.g. means taken on a slice of time) to patterns-over-time methods (e.g. gamified trajectories evolving during some period of time). This has allowed the discussion of learning analytics and assessment to move from static numbers to the structure of reasoning (Mislevy et al, 2012), which in turn has created a need for new theoretical understandings of performance or knowledge-in-action.

In particular, reasoning evidenced in a digital space is not a static edifice but an evolving performance in time, whether due to the combined actions of a population or the individual trajectory of an individual. In addition to time and spatial components, the fine resolution of highly varied data captures and the speed of automated analyses have created a set of data challenges for game-based learning analytics. Methods based in data-mining, machine learning, model-building and complexity theory add to the theoretical foundation for dealing with the challenges of time sensitivity, spatial relationships, multiple layers of aggregations at different scales, and the dynamics of complex digital performance spaces.

References

Barab, S. A., & Duffy, T. (2000). From Practice fields to communities of practice. In D. H. Jonassen, & S. M. Land (Eds.) *Theoretical foundations of learning environments*, *1*(1), 25–55. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.162.3127

Bennett, R. (2001). How the internet will help large-scale assessment reinvent itself. *Education Policy Analysis Archives, 9*(5), 1–23.

Bennett, R., Persky, H., Weiss, A., & Jenkins, F. (2007). *Problem solving in technology-rich environments: A report from the NAEP technology-based assessment project. The Nation's Report Card* (p. 180). Retrieved from http://nces.ed.gov/nationsreportcard/pdf/studies/2007466.pdf

Brooks, R. (1986). A robust layered control system for a mobile robot. *Journal of Robotics and Automation, 2*, 14–23.

Brooks, R. (1999). *Cambrian intelligence: The early history of the new AI*. Cambridge, MA: MIT Press.

Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J. (1993). Distributed expertise in the classroom. In G. Salomon (Ed.), *Distributed cognitions: Psychological and education considerations*. New York: Cambridge University Press.

Cangelosi, A., & Parisi, D. (2002). Computer Simulation : A New Scientific Approach to the Study of Language Evolution. In A. Cangelosi & D. Parisi (Eds.), *Simulating the evolution of language* (pp. 3–28). London: Springer.

Choi, Y., Rupp, A., Gushta, M., & Sweet, S. (2010). Modeling learning trajectories with epistemic network analysis: An investigation of a novel analytic method for learning progressions in epistemic games. In *National Council on Measurement in Education* (pp. 1–39).

Clarke, J., & Dede, C. (2010). Assessment, technology, and change. *Journal of Research in Teacher Education, 42*(3), 309–328.

Clarke-Midura, J., Code, J., Dede, C., Mayrath, M., & Zap, N. (2012). Thinking outside the bubble: Virtual performance assessments for measuring complex learning. In M. C. Mayrath, J. Clarke-Midura, & D. Robinson (Eds.), *Technology-based assessments for 21st Century skills: Theoretical and practical implications from modern research* (pp. 125–148). Charlotte, NC: Information Age Publishers.

Clarke-Midura, J., Mayrath, M., & Dede, C. (2010). Measuring inquiry: New methods, promises & challenges. *Library, 2*, 89–92.

Feyerabend, P. (1970). *Problems of empiricism*. Cambridge: Cambridge University Press.

Gee, J. P. (2007). Learning and Identity: What does it mean to be a Half-Elf? *What Video Games Have to Teach Us About Learning and Literacy*, 45–69.

Gibson, D., & Clarke-Midura, J. (in press). Some Psychometric and Design Implications of Game-Based Learning Analytics. In D. Ifenthaler, J. Spector, P. Isaias, & D. Sampson (Eds.), *E-Learning Systems, Environments and Approaches: Theory and Implementation*. London: Springer.

Gibson, D., & Jakl, P. (2013). *Data challenges of leveraging a simulation to assess learning*. West Lake Village, CA. Retrieved from http://www.curveshift.com/images/Gibson_Jakl_data_challenges.pdf

Gibson, D., & Knezek, G. (2011). Game changers for teacher education. In P. Mishra, & M. Koehler (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 929–942). Chesapeake, VA: AACE.

Gigerenzer, G., Todd, P., & ABC Research Group. (1999). *Simple heuristics that make us smart* (p. 416). Oxford: Oxford University Press.

Holland, J. (1995). *Hidden order: How adaptation builds complexity*. Cambridge, MA: Helix Books/Perseus Books.

Holland, J., Holyoak, K., Nisbett, R., & Thagard, P. (1986). *Induction: Processes of inference, learning, and discovery*. Cambridge, MA: MIT Press.

IBM. (n.d.). *Big data*. Retrieved from http://www-01.ibm.com/software/au/data/bigdata/

Koch, M. J., & DeLuca, C. (2012). Rethinking validation in complex high-stakes assessment contexts. *Assessment in Education: Principles, Policy & Practice, 19*(1), 99–116.

Lincoln, Y. S., Guba, E. G., Lincoln, E., & Guba, Y. (1985). *Naturalistic inquiry* (p. 416). Newbury Park, CA: Sage Publications.

Mayrath, M., Clarke-Midura, J., & Robinson, D. (2012). Introduction to technology-based assessments for 21st century skills. In M. Mayrath, J. Clarke-Midura, D. Robinson, & G. Schraw (Eds.), *Technology-based assessments for 21st century skills: Theoretical and practical implications from modern research* (p. 386). Charlotte, NC: Information Age Publishers.

Mislevy, R., Behrens, J., Dicerbo, K., Frezzo, D., & West, P. (2012). Three things game designers need to know about assessment. In D. Ifenthaler, D. Eseryel, & X. Ge (Eds.), Assessment in game-based learning: Foundations, innovations and perspectives (pp. 59–81). New York: Springer Science & Business Media B.V.

Nicolis, G. (1989). *Exploring complexity: An introduction*. New York: WH Freeman.

Pirnay-Dummer, P., Ifenthaler, D., & Spector, M. (2010). Highly integrated model assessment technology and tools. *Educational Technology Research and Development, 58*(1), 3–18.

Quellmalz, E., Timms, M., Buckley, B., Davenport, J., Loveland, M., & Silberglitt, M. (2012). 21st century dynamic assessment. In M. Mayrath, J. Clarke-Midura, & D. Robinson (Eds.), *Technology-based assessments for 21st Century skills: Theoretical and practical implications from modern research* (pp. 55–90). Charlotte, NC: Information Age Publishers.

Reimer, T., & Rieskamp, J. (2006, November). Fast and frugal heuristics. *Encyclopedia of Social Psychology*. doi:10.1016/j.psychsport.2006.06.002

Rupp, A., Gushta, M., Mislevy, R., & Shaffer, D. (2010). Evidence-centered design of epistemic games: Measurement principles for complex learning environments. *Journal of Technology, Learning, and Assessment, 8*(4), 1–45.

Schmidt, M., & Lipson, H. (2009). Symbolic regression of implicit equations. *Genetic Programming Theory and Practice* (Vol. 7 (Chap 5), pp. 73–85).

Shaffer, D. (2007). Epistemic games. *Innovate, 1*(6). Retrieved from http://innovateonline.info/pdf/vol1_issue6/Epistemic_Games.pdf.

Shaffer, D., Hatfield, D., Svarovsky, G., Nash, P., Nulty, A., Bagley, E. et al. (2009). Epistemic network analysis: A prototype for 21st-century assessment of learning. *International Journal of Learning and Media*, *1*(2), 33–53. Retrieved from http://www.mitpressjournals.org/doi/abs/10.1162/ijlm.2009.0013

Sharkasi, N. (2010). The doctor will be you now: A case study on medical ethics and role. In K. Schrier & D. Gibson (Eds.), *Ethics and game design* (pp. 275–290). Hershey, PA: IGI Global.

Stecher, B. (2010). *Performance assessment in an era of standards-based educational accountability* (p. 46). Standford, CA: Stanford University.

Sugihara, G., May, R., Ye, H., Hsieh, C., Deyle, E., Fogarty, M., et al. (2012). Detecting causality in complex ecosystems. *Science, 338*(6106), 496–500. doi:10.1126/science.1227079.

Tobias, S., & Fletcher, J. D. (2011). *Computer games and instruction*. Charlotte, NC: Information Age Publishing.

USDOE. (2010). Learning powered by technology: Transforming American Education. *Educational Technology* (p. 88).

Chapter 21
Critical Perspective on Gamification in Education

Christopher J. Devers and Regan A.R. Gurung

21.1 Introduction

It is no surprise that video games are very popular. Ads for games are seen online, on television, Facebook, and even mobile devices. Eight of the top ten paid apps (04.22.2013) on the Apple app store are games, and game sales often outsell movies (Charlton, 2012). Given that gaming is popular, entertaining, and motivating, educators are exploring how gaming may influence learning and are creating schools (Corbett, 2010) and curricula (Olsen, 2009) around gaming. However, like many educational reforms (Sarason, 1990), K-12 schools are often quick to implement a new fad (i.e., etext, computers, gaming), but fail to ask what it means for student learning. Schools often spend millions on technologies that have not been proven effective in either laboratories or K-12 environments. Therefore, this chapter offers a critical perspective on gamification with an emphasis on learning. We derived a broad hybrid definition of gamification from both the gamification literature (Deterding, Dixon, Khaled, & Nacke, 2011) and serious games literature (Zyda, 2005), and define it as purposeful experiences that utilize game design and game elements. Overall, the chapter first focuses on the basics of learning (Blakemore & Frith, 2005; Bransford, Brown, & Cocking, 2000; Byrnes, 2007; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Stigler & Hiebert, 2009; Willingham, 2009); second, explores the advantages and disadvantages of technology in relation to teaching and learning; third, discusses how technology has influenced education

C.J. Devers, Ph.D. (✉)
Center for Learning and Innovation, College of Adult and Professional Studies,
Indiana Wesleyan University, 1900 West 50th Street, Marion, IN 46953-4974, USA
e-mail: christopherdevers@gmail.com

R.A.R. Gurung
Human Development and Psychology, University of Wisconsin-Green Bay,
Green Bay, WI, USA
e-mail: gurungr@uwgb.edu

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_21

(i.e., reform) in the past; fourth, reviews gaming research and what it means to student learning with respect to both current and past research trends; and last, argues that using a scholarship of teaching and learning (SoTL) framework can help create a more evidence based approach to the use of gamification in education.

21.2 Basics of Learning

Over the last 20 years, much has been written about how we learn (Blakemore & Frith, 2005; Bransford et al., 2000; Byrnes, 2007; Dunlosky et al., 2013; Stigler & Hiebert, 2009; Willingham, 2009). For example, factual knowledge, thinking, context, and practice are fundamental building blocks of learning (Willingham, 2009). Specifically, when learning new material, it is important for students to first learn factual knowledge within the context of what they already know, and then apply it to more complex situations. Additionally, repeated practice can help solidify factual knowledge and provide an opportunity for students to think hard about a topic, as they practice. More specifically, practice testing, distributed practice, interleaved practice, self-explanation, and elaborative interrogation are distinctive techniques that have all proven to be effective ways of learning (Dunlosky et al., 2013). Technology and games can provide opportunities for students to participate in traditional learning methods, as well as offers advantages due to the digital features that many technologies provide.

21.3 Technology

Technology offers numerous advantages and disadvantages over traditional methods of learning. One advantage is that technology can easily provide practice testing (Dunlosky et al., 2013), distributed practice (Delaney, Verkoeijen, & Spirgel, 2010), instant feedback (Schooler & Anderson, 1990), and flow (Csikszentmihalyi, 2008)—all of which can facilitate a customized learning experiences for students. For example, games often provide practice testing and distributed practice, while online education can provide intelligent progress monitoring that provides tailored instruction and practice for students. Additionally, gamers frequently repeat specific tasks over different game levels, which provides practice testing and disturbed practice. Many role-playing games offers the opportunity for self-explaining, as gamers, at times self-explain when trying to complete a difficult task or explain to another gamer how to complete a task. Technology, and specifically gaming, can provide students with a digital environment that incorporates many of the proven traditional methods of learning.

Even though technology offers these advantages, there seem to be missing components, as more often than not, technology does not have a positive impact on learning (Fried, 2008; Goodwin, 2011; Higgins, Beauchamp, & Miller, 2007; Marklein, 2010; Vigdor; Ladd, 2010 & Richtel, 2011). It may be that technology often fails to positively impact learning because it is missing a social component or that there are embedded distractions. For example, etexts appear to offer many advantages over paper text, as they are searchable, can be bookmarked, offer instant definitions, and can have rich media embedded within the text. However, students still prefer printed books (Woody, Daniel, & Baker, 2010), and it is possible that all the rich features of etext distract from learning (DeStefano & LeFevre, 2007; Mayer, Hegarty, Mayer, & Campbell, 2005). An additional disadvantage of technology is that it often has a high initial cost and maintenance, complicated and long implementations, and requires training. Past research can provide guidance when using technology for teaching and help us understand its impact on student learning (Poirier & Feldman, 2012). If most technology does not improve learning and has a high cost, then we should be critical of the claims being made about gaming and its uses in education. Additionally, even though technology can support many of the previously mentioned learning methods, current educational reforms that have a strong technology focus have not been successful (Warschauer, 2006) and can provide guidance, especially regarding what not to do, when thinking about implementing games in education.

21.4 Educational Change and Technology

Technology has been influencing education for years. Excitement arose when paper, pens, highlighters chalkboards, calculators, overhead projectors, dry erase boards, data projectors, audience response systems, computers, tablets, virtual reality, and gaming found their way into education accompanied by doubts about their suitability (Baron, 1999). Fortunately for students, many of these innovations did not impede learning but the same cannot be said for many of the technologies (i.e., laptops, gaming, etc.) that find their way into homes and schools.

Some policy makers and educators thought that home computers would greatly impact education and possibly help close the achievement gap. However, the evidence suggest that home computers have negatively impacted learning (Stross, 2010). For example, with low-income students (5–8 grade), Vigdor and Ladd (2010) found a negative relationship between student performance (math and reading) and the adoption of home computers with Internet access (broadband). A similar trend was found with low-income Romanian children when they were provided computers at home (Malamud & Pop-Eleches, 2011). Fortunately, the negative relationship appears to depend on how the computer and/or Internet access is utilized, as lower performance scores are not universal for all students (Battle Juan, 1999). It is most likely that a lack of supervision is one reason for the negative association, and with proper supervision, computers may have a positive impact on learning. Nonetheless, given the data, it is likely that providing home computers and Internet access to low-income families would widen the achievement gap, not narrow it (Vigdor & Ladd, 2010).

Hoping to increase student learning and performance, many K-12 schools implemented a one-to-one laptop program. Teachers and administrators realized that after a few years of using computers in classrooms, there was not an increase in learning as they had hoped. Overall, the data suggest that one-to-one laptop initiatives have little or no positive impact on learning (Goodwin, 2011; Grimes & Warschauer, 2008; Hu, 2007; Lowther, Strahl, Inan, & Bates, 2007; Shapley et al., 2009; Silvernail & Gritter, 2007). Additionally, in higher education, using a laptop in class is often a distraction to others and is also negatively associated with learning (Fried, 2008; Hembrooke & Gay, 2003; Sana, Weston, & Cepeda, 2013; Truman, 2005). It is possible that using laptops in class encourages multitasking (Hembrooke & Gay, 2003; Ophir, Nass, & Wagner, 2009; Sana et al., 2013; Tugend, 2008), which distracts others from learning.

Overall, providing Internet connected computers in the home where activity is unmonitored, in K-12 schools, and higher education classes, appears to have little to no impact, and at times, a negative impact on learning. It is likely that the computers themselves are not the reason for a decrease in learning, as they are able to offer advantages over traditional methods of learning, but rather a lack of supervision and how they were used (i.e., social networking, watching videos on YouTube, etc.) that led to a decrease in learning. Unfortunately, these two examples are fairly consistent with the influence that other technologies have on learning—interactive whiteboards, video games, etc.—and can provide direction when exploring the influence of games in education.

21.5 Gaming

The use of gaming in education is not a new concept and constitutes one aspect of gamification using our definition. For years, the military (Prensky, 2003) and aviation industry (McClernon, McCauley, O'Connor, & Warm, 2011) have been successful in using simulations and virtual reality for training purposes. More recently, there has been a push in K-12 environments to use gaming for educational purposes (Gee, 2003; Prensky, 2007; Steinkuehler, Alagoz, King, & Martin, 2012). There are now a number of meta-analyses on gaming (see Kapp, 2012) mostly suggesting that games are good for learning. With the right preparation and setting (Gee, 2005; Squire, 2006), video games appear to have a positive impact on learning (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Ke, 2009; Randel, Morris, Wetzel, & Whitehill, 1992; Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013; Vogel et al., 2006; Young et al., (2012). However, much of the data on gaming are self-report, case studies, or quasi-experimental (see the meta-analyses from Wouters et al., 2013 and Young et al., 2012). Furthermore, the bulk of the research is done on video games used for learning versus the actual gamification of courses or classwork. Therefore, one should be cautious of the claims made regarding games impact on learning.

At first glance, the meta-analysis from Wouters et al. (2013) suggests that games are successful and can produce results that outperform "conventional" methods of instruction. However, looking more closely at the data, they also concluded that when experimental studies used random assignment there was not a significant difference between the control and the gaming group (Willingham, 2013). Additionally, games did not show any advantage over "passive instruction," which is described as reading a book or a lecture (arguably the most common form of instruction). Interestingly they also found that games were not more motivating, which is often seen as an advantage over other types of instruction. Thus, when experimental design is used, there does not seem to be an advantage for games. Squire, Barnett, Grant, and Higginbotham (2004) represent another study where the results can be misinterpreted. For example, they reported that the experimental group outperformed the control group. Again their research design was quasi-experimental and lacked random assignment, and as Wouters et al. (2013) found, there is no advantage to games when random assignment used. It is important that when reviewing the literature and data, to be critical of the results, as they can be misinterpreted.

The curriculum of Quest to Learn, a New York based school, is based on gaming (Corbett, 2010). While both teachers and students report that they enjoy using games to learn (self-reported and case study), the test data (i.e., standardized test scores) suggest that the school only performs slightly better than other schools on the standardized state tests, and at times, performs worse—specifically, the year and proficiently level, are determining factors that cause Quest to Learn to either score below the State average or above the state average—the data are mixed (New York City Department of Education, 2013; Sutter, 2012). Again, on the surface it appears that gaming works, as students and teachers report satisfaction. However, when looking at more objective data, such as standardized tests, it does not appear that the school is actually performing as well as reported by the teachers and students. Therefore, while overall the literature supports the use of video games for educational purposes, there is very little experimental research that is supportive (see the meta-analysis from Connolly et al., 2012)—experimental research is the gold standard and should be the main source when evaluating the effectiveness of games on learning. Some of the most promising video game research is from intelligent tutoring games/programs, which are being studied experimentally and show promising results (Aleven & Koedinger, 2002; Rutherford et al., 2010).

However, like many fads and educational reforms, it appears that many are failing to address the important questions before millions are spent on hardware, software, training, etc., and simply assume that because gaming is popular, motivating, and students like it, then they must learn something. Moreover, it seems that researchers may be asking the wrong questions (Willingham, 2013). Instead of asking, "Can students learn from games?," maybe it would be better to ask, "What is the environment in which games can be effectively used?," "How do we build games that impact learning?," or "What are the components that contribute to learning in a game?" It is very difficult to make comprehensive claims regarding games, but maybe asking the right questions can help determine the environment and components that contribute to learning in games. Similar to computers and other technologies, it is unlikely that games are ineffective, but rather we have yet to build a game that includes all the optimal components that impact learning and then match it to the right educational situation. A meta-analysis from Young et al. (2012) suggests, "The inconclusive nature of game-based learning research seems to only hint at the value of games as educational tools" (p. 80). The scholarship of teaching and learning provides an avenue for helping answer the questions: "How do we build games that impact learning?" and "What are the components that contribute to learning in a game?" It also offers a framework for more rigorous research on games in education. Not surprisingly perhaps, many elements of gaming relates to teaching. Some are more explicit than others such as motivation and rewards. Although a number of authors have evoked psychological terminology in discussions of gamification (Kapp, 2012; McGonigal, 2011; Sheldon, 2012) there are still many links yet to be made and they each have to be tested.

21.6 Scholarship of Teaching and Learning

There is no doubt that learning is complicated, but for the most part, cognitive science and educational research provide evidence and frameworks for how we learn (Blakemore & Frith, 2005; Bransford et al., 2000; Byrnes, 2007; Dunlosky et al., 2013; Stigler & Hiebert, 2009; Willingham, 2009). Technology has been at the center of many educational fads and reforms. For many, it is not a surprise that, broadly speaking, technology has failed to have an impact on education, as the research simply does not support much learning gains, if any (Abachi & Muhammad, 2014; Daniel & Woody, 2013; Fried, 2008; Goodwin, 2011; Higgins et al., 2007; Marklein, 2010; Vigdor & Ladd, 2010; Woody et al., 2010; Richtel, 2011). Additionally, most technology centered reforms are costly. Given what we know about learning, technology, and past reforms, it stands to reason that educational gaming will suffer the same fate—high cost with little change. Although there is some attention paid to whether gaming works in higher education (Kapp, 2012), and some have tried to methodologically use gamification strategy in class design (Sheldon, 2012), more needs to be done. We use the framework of the scholarship of teaching and learning (SoTL) to argue for more of an evidence based approach to testing the efficacy of gaming practices in education. It seems prudent to use our resources in areas that are more stable and proven to increase student learning, instead of what is popular. We first briefly define SoTL and then discuss how it can be used to test the efficacy of game design.

Boyer (1990) popularized the term "scholarship of teaching" although caring teachers have practiced the kind of work to which it refers for many years. When a teacher critically assesses his/her own teaching by focusing on student learning, using robust research methodology and then sharing the results in peer-reviewed formats, he/she is said to be doing the *scholarship of teaching and learning* (SoTL). SoTL entails intentional, systematic reflections on teaching and learning resulting in peer-reviewed products which are made public (Gurung & Schwartz, 2012; Potter & Kustra, 2011). SoTL can be an integral part of every academic's life and "brings powerful new principles and practices" to position decisions about key academic questions such as what students need to know and should be able to do (Hutchings, Huber, & Ciccone, 2011, p. 3). There is now an active community of instructors who provide models for how to modify instructional methods and assess their effectiveness. A basic model of the process is shown in Fig. 21.1.

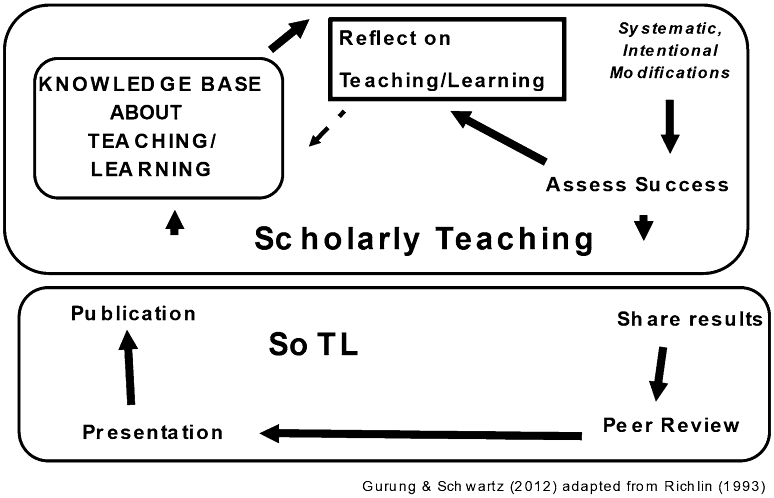


Fig. 21.1 SoTL basic procedural flow

At its heart, SoTL entails assessment of learning. You may dream up an exciting new way to present material or design a new assignment you are sure will make students learn better, but if you do not assess the effect of your innovation or pay close attention to the different ways the change can make a difference, you are not being an ethical teacher or using SoTL in a principled way (Gurung, 2012). Are my students learning? How do I know? Instructors asking such questions in regard to their own courses in contrast to when departments, universities, or school systems ask such questions, make for quintessential SoTL. When one uses gamification techniques and strategies in class design then one needs to assess whether it worked or not. Note that this is a related, though separate question from using games *as* and assessment tool in their own right (Heinzen, 2014).

To garner respect for the use of gamification and its effectiveness in the classroom, instructors using gamification need to adhere to the criteria for good scholarship. We are not simply advocating asking students if they liked the gamification or if they *seemed* to do better in class. We propose that instructors need to assess the fruits of gamification using the strict criteria of academic scholarship and SoTL. What makes scholarship robust and valid? What are the guidelines we should each follow as we conduct our own scholarship on learning? Glassick, Huber, and Maeroff (1997) identified criteria for evaluation that apply equally to traditional scholarship and also to SoTL. The results include the following six standards to be applied to assess the quality of research from any type of scholarship: Clear goals, adequate preparation, appropriate methods, significant results, effective communication, and reflective critique. Wilson-Doenges and Gurung (2013) identified a continuum of SoTL and demarcated aspirational benchmarks that also serve as guidelines for research design. Whereas qualitative and quantitative data and approaches all have a place in SoTL, the benchmarks provide clear cut standards of design and analysis. Similar to social science's methodology for research in general, SoTL should also aim for similar standards that are theory-based and intentionally designed using the best models for methodological and statistical rigor. The benchmarks are divided into three main levels with the final level comprising the gold standard for research. This increased focus on strengthening the scientific rigor of SoTL should benefit how pedagogical research is recognized across disciplines in general.

The steps for conducting research on teaching using gamification mirror most of the steps used to conduct research on any topic (Sansone, Morf, & Panter, 2003). First, the instructor identifies a question or outcome of interest and then reviews what has been published on the topic. Next, the instructor ascertains how to answer the research question or determine if the learning outcome has changed. One common approach to this sort of research is to measure relevant aspects of what the students are learning, make a change utilizing the concepts of gamification or introduce a new method or assignment, and then measure students' learning again to determine the extent to which the manipulation affected it (see Bishop-Clark & Dietz-Uhler, 2012; and Gurung & Schwartz, 2012, for exemplars of conducting SoTL research). Lee Sheldon (2012) provides a good example of part of this process.

Sheldon slowly morphed his class design from a traditional format to one utilizing gamification principles. For example, he moved from using letter grades in class to letter points. In fact, his students start class with an F and gain experience points (XPs) for every class activity. To mirror the game world, each letter grade is a different level of the game and each level has a XP requirement. His class now also had many more graded exercises, 'precisely what students expect' for a 'multiplayer classroom' (p. 58). For example, perfect attendance is rewarded with 100 points. He even changed the look of his syllabus to resemble the game world. Taking quizzes and exams became 'defeating monsters', writing papers became 'crafting', and class presentations became 'quests' (p. 26). Unfortunately, the only assessment of these changes we see are student comments. For true assessment of gamification one should focus on outcomes such as performance on tests of knowledge or other assessments of whether learning outcomes have been accomplished.

The best way to assess the utility of gamification is to conduct an experiment. A form of research that affords the most control is the true experiment, in which the researcher uses random assignment and thus has control over all of the independent variables of interest. The independent variable is what is manipulated. If an instructor compared exam performance of one section of class which featured a gamified format with another section that did not have a gamified format, the independent variable would be 'use of gamification'. True experiments are further broken down into one-way designs and factorial designs. In some studies, such as repeated measures designs, researchers hold some control over individual differences by exposing participants to more than one level of an independent variable. For example, you may compare a section of a course with a partially gamified syllabus with a section of a class that has a completely gamified syllabus. This is the tip of the iceberg in terms of research methods terminology, representing some of the most common elements of research design. There are a variety of nuances to doing robust effective research (see Morling, 2012).

One easy way to start to examine gamification is to pick a course in which you test students many times or courses that are offered consistently every semester and year. This Repeated Measures Design (RMD) works well in course designs that have several similar exams or assignments. In such designs, the key is to identify changes in responses to similar question(s) over time. The measure used repeatedly consists of the same number of questions asked in the same order, and differences in the responses will be taken to indicate changes in knowledge. However, using identical questions is not always practical or possible in most courses. To avoid this problem, many instructors modify the RMD to include a pretest and a posttest. For example, many North American, large, general education courses give the same test at the beginning and end of the semester (e.g., a test of knowledge of governmental policy in a political science course). To test whether learning is changing over the course of the semester, the teacher can test if the class average is changing over time, test if learning has changed from the beginning of the semester (using a class average) or even compare a single student's score to his or her previous score to determine if a student is improving over the course of the semester. If there is a significant difference in student learning between the two assessments, it could be due to the instruction provided in between the pretest and the posttest. Of course, an instructor cannot be sure that the change was due only to the instruction unless he/she has measured and controlled for many other possible factors such as how much and how the student studied. If, while holding other variables constant, an instructor finds a significant difference between the pretest and posttest measures, then he/she may be confident that his/her finding is a good indicator that instructional changes produced increases in learning.

This basic idea—measure learning (pretest), introduce a change (e.g., repeat quizzing), measure learning again (posttest)—allows you to test the utility of any pedagogical innovation featuring gamification and is the crux of SoTL. There are simple variations on this theme. Sometimes an instructor may not even use a pre-measure of learning. In a two-group post-test only design, one group receives a gamified innovation and another does not, and then both are measured on the same assessment. The two groups could be two sections of a class or one class divided into two or the same class over two consecutive semesters. Sometimes you can make sure all students get the new innovation or even different levels or types of an intervention. This within-participant design is useful when you want to test different variations on a theme. By having the same participants experience both (or all) variations, you do not have to be concerned about differences in learning being due to having different participants, a concern in between-participant designs.

21.7 Conclusion and Future Directions

Our key message here is that as alluring as gamification may be, once you incorporate it into class and design a study to test if it works, you then need to pay close attention to factors that can influence whether or not the innovation 'worked'. Social science research in general but quantitative experimentation in particular, nicely alerts us to the fact that the changes we may see in our students' learning may be due to a whole host of factors, one of which may indeed may be what we do as instructors or what the students have done (perhaps because of our instruction), but may also be likely due to other naturally occurring factors. People change over time (i.e., maturation). Factors outside our awareness influence results (i.e., history). It is possible that changes that we see in our student learning are due to these natural changes or factors external to our instructional interventions. Social science methodology alerts us to these two confounds, to many others, and most importantly, to ways to avoid them. Watching out for these confounds is critical when assessing the effectiveness of changes to instructional methods. Detailed descriptions of these confounds can be found in research methods books and are worth the perusal (Creswell & Piano Clark, 2012; Morling, 2012).

It is also important to ask if the changes are statistically significant. Social science methodology involves significance testing. Assessing change is one type of pedagogical endeavor that necessitates the quantitative method regardless of discipline. If you want to know if students improved after a change you made (e.g., a new assignment, an innovative presentation, group work, flipping your class—see Schwartz & Gurung, 2012), you need to know if that change would have happened by chance or if any other factors could account for it. This requires quantification of the evidence (e.g., themes brought up in a close reading, concepts used in essays, levels of meaning). When social scientists ask if the change is statistically significant, they really want to ensure that the change is due to what was done and not just due to chance. Stated in this way, it is seems hard to not care about statistical significance. If you have worked hard to change your instruction and improve student learning, it is important to know whether that change would have happened by chance and without your intervention in the first place. Before one spends more time and energy on changing instruction or even trying to get others to also change instruction based on the changes you have seen, you should be sure your changes are not random. Statistical testing does this for you.

Statistical significance need not be the ultimate and only criterion for SoTL but it is certainly something to be considered for appropriate and relevant research designs and questions. Gamification is exciting and students and instructors may enjoy experiencing it in the classroom but the true test is whether learning is changing and if that change is significant. An instructor may see exam scores increase but that change needs to be statistically significant. Furthermore, statistical significance should not be confused with or taken to be synonymous with 'significant' as used in everyday life (i.e., to mean important). Misinterpreting this term can easily make faculty from disciplines who do not use statistical testing feel as though the work they do is less important.

SoTL provides the teacher with a wide variety of findings ripe for modifying and using in the classroom. It is imperative to assess the effectiveness of any change in a robust way and be prepared for the possibility that what may work in a game may not necessarily work in a classroom. Even some science of learning results from other classroom studies may not necessarily translate to your classroom. Using basic research design methods well will at least ensure that you get a sense of what does work. SoTL can help us answer when and how gamification works, and provides a structure for future gamification research. Future research will provide us with a better understanding of the optimal components that impact learning in gamification, as well as how to match components to the right situation and environment. What is the best way to use badges and levels of accomplishment? Are there some personality or cognitive characteristics that predispose some students to benefit more from gamification than others? Are there specific disciplines or topics that are better suited for gamification? These are but some of the rich questions gamification and learning researchers can address in the future.

References

Abachi, H. R., & Muhammad, G. (2014). The impact of m-learning technology on students and educators. *Computers in Human Behavior, 30*, 491–496. doi:10.1016/j.chb.2013.06.018.

Aleven, V. A. W. M. M., & Koedinger, K. R. (2002). An effective metacognitive strategy: Learning by doing and explaining with a computer-based Cognitive Tutor. *Cognitive Science, 26*(2), 147–179.

Baron, D. (1999). From pencils to pixels: The stages of literacy technologies. In G. Hawisher & C. Selfe (Eds.), *Passions, pedagogies, and 21st century technologies* (pp. 15–33). Logan, UT: Utah State University Press.

Battle Juan, P. A. (1999). Home computers and school performance. *The Information Society, 15*(1), 1–10.

Bishop-Clark, C., & Dietz-Uhler, B. (2012). *Engaging in the scholarship of teaching and learning: A guide to the process and how to develop a project from start to finish*. Sterling, VA: Stylus.

Blakemore, S. J., & Frith, U. (2005). *The learning brain: Lessons for education*. Malden, MA: Wiley-Blackwell.

Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. San Francisco: Jossey-Bass.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Byrnes, J. P. (2007). *Cognitive development and learning in instructional contexts*. Boston, MA: Allyn and Bacon.

Charlton, A. (2012). Video games outsell DVDs to become biggest entertainment category. *International Business Times*. Retrieved from http://www.ibtimes.co.uk/articles/317940/20120322/video-game-biggest-entertainment-category-uk.htm

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661–686.

Corbett, S. (2010). Learning by playing: Video games in the classroom. *The New York Times*. Retrieved from http://www.nytimes.com/2010/09/19/magazine/19video-t.html

Creswell, J. W., & Piano Clark, V. L. (2012). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

Csikszentmihalyi, M. (2008). *Flow: The psychology of optimal experience*. New York: Harper Perennial.

Daniel, D. B., & Woody, W. (2013). E-textbooks at what cost? Performance and use of electronic v. print texts. *Computers & Education, 62*, 18–23. doi:10.1016/j.compedu.2012.10.016.

Delaney, P. F., Verkoeijen, P. P. J. L., & Spirgel, A. (2010). Spacing and the testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *Psychology of Learning and Motivation, 53*, 63–147.

DeStefano, D., & LeFevre, J.-A. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior, 23*(3), 1616–1641.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification." *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM.

Dunlosky, J., Rawson, K., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58.

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50*(3), 906–914.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Gee, J. P. (2005). Learning by design: Good video games as learning machines. *E-Learning, 2*(1), 5–16.

Glassick, C. E., Huber, M. T., & Maeroff, G. I. (1997). *Scholarship assessed: Evaluation of the professoriate*. San Francisco: Jossey-Bass.

Goodwin, B. (2011). One-to-one laptop programs are no silver bullet. *Educational Leadership, 68*(5), 78–79. Retrieved from http://www.ascd.org/publications/educational_leadership/feb11/vol68/num05/One-to-One_Laptop_Programs_Are_No_Silver_Bullet.aspx

Grimes, D., & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research, 38*(3), 305–332.

Gurung, R. A. R. (2012). Consuming the scholarship of teaching and learning: Using evidence-based pedagogy ethically. In R. E. Landrum & M. A. McCarthy (Eds.), *Teaching ethically: Challenges and opportunities* (pp. 67–76). Washington, DC: APA.

Gurung, R. A. R., & Schwartz, B. M. (2012). *Optimizing teaching and learning: Practicing pedagogical research*. Malden, MA: Wiley-Blackwell.

Heinzen, T. E., Landrum, R. E., & Gurung, R. A. R. (2014). Game-based assessment: The mash-up we've been waiting for. In T. Reiners & L. Wood (Eds.), Gamification in education and business (pp. xx-xx). New York, NY: Springer.

Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education, 15*(1), 46–64.

Higgins, S., Beauchamp, G., & Miller, D. (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology, 32*(3), 213–225.

Hu, W. (2007). Seeing no progress, some schools drop laptops. *New York Times*. New York. Retrieved from http://www.nytimes.com/2007/05/04/education/04laptop.html

Hutchings, P., Huber, M. T., & Ciccone, A. (2011). *The scholarship of teaching and learning reconsidered: Institutional impact*. San Francisco: Jossey-Bass.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. San Francisco: Pfeiffer.

Ke, F. (2009). A qualitative meta-analysis of computer games as learning tools. In R. E. Ferdig (Ed.), *Handbook of research on effective electronic gaming in education* (pp. 1–32). Hershey, PA: IGI Global.

Lowther, D. L., Strahl, J. D., Inan, F. A., & Bates, J. (2007). *Freedom to learn program: Michigan 2005-2006 evaluation report*. Memphis, TN: Center for Research in Educational Policy.

Malamud, O., & Pop-Eleches, C. (2011). Home computer use and the development of human capital. *Quarterly Journal of Economics, 126*, 987–1027.

Marklein, M. B. (2010). Can college students learn as well on iPads, e-books? *USA Today*. McLean, VA. Retrieved from http://www.usatoday.com/news/education/2010-08-10-ebooklearning10_CV_N.htm

Mayer, R. E., Hegarty, M., Mayer, S., & Campbell, J. (2005). When static media promote active learning: Annotated illustrations versus narrated animations in multimedia instruction. *Journal of Experimental Psychology: Applied, 11*(4), 256–265.

McClernon, C. K., McCauley, M. E., O'Connor, P. E., & Warm, J. S. (2011). Stress training improves performance during a stressful flight. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 53*(3), 207–218.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin.

Morling, B. (2012). *Research methods in psychology: Evaluating a world of information*. New York: Norton.

New York City Department of Education. (2013). *Quest to learn* [data file]. Retrieved from http://schools.nyc.gov/SchoolPortals/02/M422/AboutUs/Statistics/default.htm

Olsen, S. (2009). Educational video games mix cool with purpose. *The New York Times*. Retrieved from http://www.nytimes.com/2009/11/02/technology/02games.html

Ophir, E., Nass, C., & Wagner, A. D. (2009). Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences of the United States of America, 106*(37), 15583–15587.

Poirier, C. R., & Feldman, R. S. (2012). Using technology to enhance teaching and learning. In R. M. Schwartz & R. A. R. Gurung (Eds.), *Evidence-based teaching for higher education* (pp. 39–58). Washington, DC: American Psychological Association.

Potter, M. K., & Kustra, E. (2011). The relationship between scholarly teaching and SoTL: Models, distinctions, and clarifications. *International Journal for the Scholarship of Teaching and Learning, 5*(1), 23. Retrieved from http://digitalcommons.georgiasouthern.edu/ijsotl/vol5/iss1/23/.

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE)—Theoretical and Practical Computer Applications in Entertainment, 1*(1), 1–4.

Prensky, M. (2007). *Digital game-based learning*. St. Paul, MN: Paragon House.

Randel, J. M., Morris, B. A., Wetzel, C. D., & Whitehill, B. V. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation and Gaming, 23*(3), 261–276.

Richtel, M. (2011). In classroom of the future, stagnant scores. *The New York Times*. Retrieved from http://www.nytimes.com/2011/09/04/technology/technology-in-schools-faces-questions-on-value.html

Rutherford, T., Kibrick, M., Burchinal, M., Richland, L., Conley, A., Osborne, K., et al. (2010). *Spatial temporal mathematics at scale: An innovative and fully developed paradigm to boost math achievement among all learners*. Paper presented at American Educational Research Association (AERA), Denver, CO.

Sana, F., Weston, T., & Cepeda, N. J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education, 62*, 24–31.

Sansone, C., Morf, C., & Panter, A. (2003). *The Sage handbook of methods in social psychology*. Thousand Oaks, CA: Sage.

Sarason, S. B. (1990). *The predictable failure of educational reform: Can we change course before it's too late?* San Francisco: Jossey-Bass.

Schooler, L. J. & Anderson, J. R. (1990). The disruptive potential of immediate feedback. *Proceedings of the Twelfth Annual Conference of the Cognitive Science Society* (pp. 702–708). Cambridge, MA.

Schwartz, E., & Gurung, R. A. R. (2012). *Evidence-based teaching in higher education*. Washington, DC: American Psychological Association.

Shapley, K., Sheehan, D., Sturges, K., Caranikas-Walker, F., Huntsberger, B., & Maloney, C. (2009). *Evaluation of the Texas technology immersion Pilot: Final outcomes for a four-year study (2004-05 to 2007-08)*. Austin, TX: Texas Center for Educational Research.

Sheldon, L. (2012). *The multiplayer classroom: Designing coursework as a game*. Belmont, CA: Cengage.

Silvernail, D. L., & Gritter, A. K. (2007). *Maine's middle school laptop program: Creating better writers*. Portland, OR: Center for Education Policy, Applied Research, and Evaluation, University of Southern Maine.

Squire, K. (2006). From content to context: Videogames as designed experience. *Educational Researcher, 35*(8), 19–29.

Squire, K., Barnett, M., Grant, J., & Higginbotham, T. (2004). Electromagnetism supercharged!: Learning physics with digital simulation games. *Proceedings of the 6th International Conference on Learning Sciences* (pp. 513–520). Santa Monica, CA: International Society of the Learning Sciences.

Steinkuehler, C., Alagoz, E., King, E., & Martin, C. (2012). A cross case analysis of two out-of-school programs based on virtual worlds. *International Journal of Gaming and Computer-Mediated Simulations, 4*(1), 25–54.

Stigler, J. W., & Hiebert, J. (2009). *The teaching gap: Best ideas from the world's teachers for improving*. New York: Free Press.

Stross, R. (2010). Computers at home: Educational hope vs. teenage reality. *The New York Times*. Retrieved from http://www.nytimes.com/2010/07/11/business/11digi.html

Sutter, J. (2012). The school where learning is a game. *Cable News Network*. Retrieved from http://www.cnn.com/interactive/2012/08/tech/gaming.series/teachers.html

Truman, G. E. (2005). An empirical assessment of student computer use behaviors in the classroom. *Hawaii International Conference on System Sciences* (Vol. 1, pp. 6a–6a).

Tugend, A. (2008). Multitasking can make you lose … um … focus. *The New York Times*. Retrieved from http://www.nytimes.com/2008/10/25/business/yourmoney/25shortcuts.html

Vigdor, J. L., & Ladd, H. F. (2010). *Scaling the digital divide: Home computer technology and student achievement*. Cambridge, MA: National Bureau of Economic Research.

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research, 34*(3), 229–243.

Warschauer, M. (2006). *Laptops and literacy: Learning in the wireless classroom*. New York: Teachers College Press.

Willingham, D. (2009). *Why don't students like school: A cognitive scientist answers questions about how the mind works and what it means for the classroom*. San Francisco: Jossey-Bass.

Willingham, D. (2013). *Meta-analysis: Learning from gaming*. Retrieved from http://www.daniel-willingham.com/1/post/2013/02/meta-analysis-learning-from-gaming.html

Wilson-Doenges, G., & Gurung, R. A. R. (2013). Benchmarks for scholarly investigations of teaching and learning. *Australian Journal of Psychology, 65*(1), 63–70.

Woody, W. D., Daniel, D. B., & Baker, C. (2010). E-books or textbooks: Students prefer textbooks. *Computers & Education, 55*(3), 945–948.

Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology, 105*(2), 249–265.

Young, M. F., Slota, S., Cutter, A. B., Jalette, G., Mullin, G., Lai, B., et al. (2012). Our princess is in another castle: A review of trends in serious gaming for education. *Review of Educational Research, 82*(1), 61–89.

Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer, 38*(9), 25–32.

Chapter 22
Implementing Gamification: Requirements and Gamification Platforms

Philipp Herzig, Michael Ameling, Bernhard Wolf, and Alexander Schill

22.1 Introduction

Gamification, the *"use of game design elements in non-game contexts"* (Deterding, Dixon, Khaled, & Nacke, 2011), has emerged as a novel aspect for information systems (IS). Current studies provide empirical evidence that the addition of game design elements increases participation (Thom, Millen, & DiMicco, 2012) or factors such as flow, enjoyment, or perceived ease of use (Herzig, Strahringer, & Ameling 2012). Therefore, the addition of game design elements in IS such as Enterprise Resource Planning or Customer Relationship Management systems, is a promising approach to increase the users' motivation, enjoyment, and efficiency on the job.

However, introducing gamification into existing or new systems is an expensive task with regards to development efforts. Simultaneously, the benefits for gamification are difficult to guarantee and to measure which makes the entire project a risky undertaking. The risk for enterprise IS is even higher due to their tight coupling with business processes, organizational structure, or the business model they support (Krafzig, Banke, & Slama, 2005).

In order to reduce initial development efforts as well as maintenance costs in the long run, gamification solutions emerged on the market. However, the requirements, features, methods, and architectural approaches often remain unclear or unstructured. Moreover, different solutions for various purposes exist. This makes

P. Herzig (✉)
SAP Innovation Center, SAP SE Konrad-Zuse-Ring 10, 14469 Potsdam, Germany
e-mail: philipp.herzig@sap.com

M. Ameling • B. Wolf
SAP SE, Chemnitzer Straße 48, 01187 Dresden, Germany
e-mail: michael.ameling@sap.com; b.wolf@sap.com

A. Schill
TU Dresden, Nöthnitzer Straße 46, 01187 Dresden, Germany
e-mail: alexander.schill@tu-dresden.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_22

it arguably difficult for IT experts who are in charge of planning, executing, and operating the gamification project to select the technology or approach that fits best to the conceptual requirements from gamification designers. Moreover, IT experts have to take additional organizational requirements of other stakeholders into account which further influences technology decisions.

To support this decision process, we provide a preliminary systematization of gamification solutions based on a comprehensive requirements definition in the following. For each described class, we highlight advantages and disadvantages. This classification provides guidance for architects to align the specific set of business requirements with the technology features of the various solutions.

First, we introduce the general gamification development process and describe roles and tasks which are involved within large gamification projects. Second, we describe conceptual requirements for gamification. These requirements are derived from prior theoretical work. Third, we map these conceptual requirements onto functional and non-functional requirements for IS. Fourth, we classify and compare gamification solutions and present technical trade-offs that are necessary to understand for implementation. Finally, we demonstrate how to apply the classification using two of our practical use cases which have different requirements. Namely this concerns the gamification of a car-sharing solution as well as reaction games for a soccer club from German Bundesliga.

22.2 The Gamification Process

In this paper, we understand gamification as a software development process (Fig. 22.1) which it based on the Rational Unified Process (RUP) by Kruchten (2004). Within the depicted process each box represents one workflow comprising multiple tasks and roles. The thin arrows represent the flow of *artifacts* between workflows. The gray arrows indicate that there is a bilateral change of activity, e.g., between roles involved in the various tasks and workflows. The following roles are considered:

First, the *end user* is a role which is shared by a group of people who are experiencing the gamification in the end. They participate in a set of identified business processes and should engage with these processes better or more often after gamification has been introduced. Depending on the context, the *end users* are either employees (business-to-employee) or customers (business-to-customer) who are participating in internal or external processes of the company respectively.

Second, *gamification experts* are persons with high expertise in designing compelling and engaging game or gamification designs. Preferably those persons have very good knowledge of psychological models and methods as well as general game design methodologies and tools. Furthermore, persons of this role have already designed a couple of successful gamification applications before.

Third, *domain experts* are persons with profound knowledge of the target business processes and its target *end users*. *Domain experts* should have high understanding on the positive and negative aspects that *end users* are experiencing within the target business processes. Furthermore, the ideal person for this role is responsible for the processes and, thus, interested in improving it.

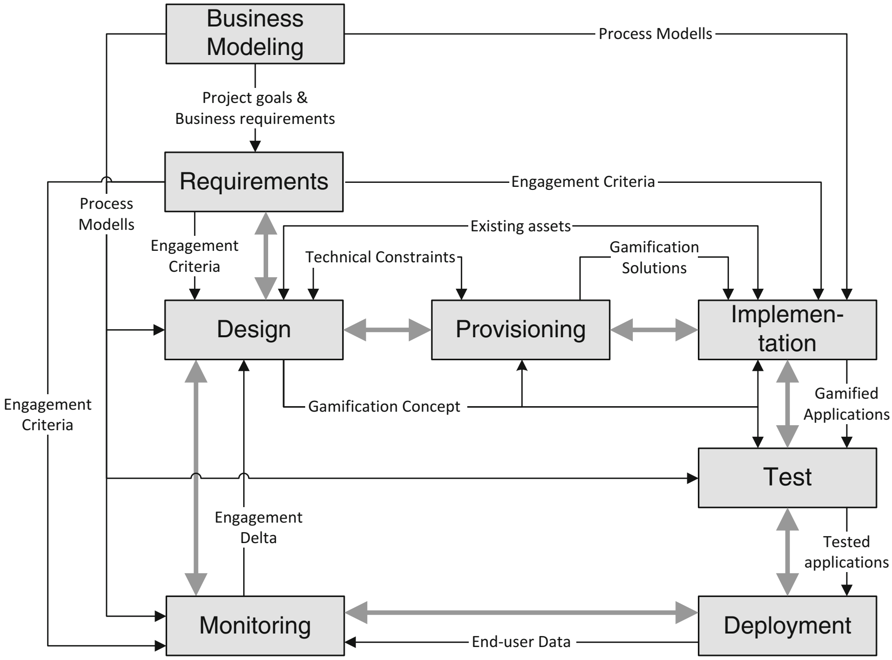


Fig. 22.1 Adopted gamification development process

Fourth, *business experts* are persons who are responsible for the overall project and have to manage the project's budget, deadlines, and stakeholders. Overall, these persons are responsible for the successful execution of the project and to achieve the initial project goals.

Fifth, *IT experts* preferably have high expertise in designing, provisioning, assembling, and deploying large scale IT systems in the company. These persons exactly know the existing IT landscape of the company and are responsible for the seamless integration of new components and tools into the existing infrastructure. Moreover, these persons advise domain, business, and gamification experts on the decision for the right software components and tools to successfully deploy the gamification solution on top of the existing business processes.

In the following, the respective workflows of the development process are explained in more detail.

22.2.1 Business Modeling

The business modeling workflow has the same goal as defined in the RUP. The domain experts explain the set of business processes which are intended to be gamified to all other involved stakeholders except end users. The goal of this phase is that all participants get a common understanding of the business processes including its merits and drawbacks. Moreover, the general objectives of the project have to be identified. This includes the type of end users who should be engaged (employees, customers, external stakeholders) and other important environmental variables. Finally, the project's vision and the goals are communicated to all project members. All responsible roles participate in this workflow except the end user.

22.2.2 Requirements

In the requirement phase, the respective use cases are analyzed based on the project's goals. Furthermore, the *end users* have to be analyzed with regards to motivation, engagement, and participation within the target processes. This analysis can be conducted qualitatively or quantitatively, for example, using interviews or questionnaires. The analysis has to cover at least what (may) the target group motivates already or in general to participate in the considered processes and what are reasons to not participate. As a result of this analysis, a list with reasons for and against the process as well as motivating factors should be compiled.

Besides the analysis of the current situation, business, domain, and gamification experts should explicitly agree on the target situation and the metrics (e.g., engagement criteria) that measure the project's success, e.g., what should the outcome of the gamification be (e.g., 50 % increased user retention).

Key personnel involved in this workflow includes: *gamification experts*, *domain experts*, *business experts*, and *end users*.

22.2.3 Design

The *design* phase is primarily concerned with the specification of a meaningful *game* or *gamification* design. From the design perspective, it is the most complicated one since all stakeholders have to agree on a specific and precise design alternative. This phase, furthermore, is supposed to have multiple iterations as known from classical game design (e.g., Salen & Zimmermann, 2004).

In each iteration the gamification concept is refined and revised by the gamification experts based on the outcome of previous iterations.

Second, the proposed or revised concept is presented to the *domain* and *business experts* using presentation slides or spreadsheets.

Third, if these stakeholders propose modifications to the concept, the gamification experts start over from the first step and revise the gamification concept accordingly.

Table 22.1 Specification workflow

Step	Description	Responsible role
#1	Creation/revision of gamification concept	Gamification experts
#2	Presentation of gamification concept to domain experts	Gamification experts
#3	Proposal of modifications to gamification concept	Domain experts, business experts
#4	Prepare gamification concept for playtesting	Gamification experts, IT experts
#5	Playtesting the current concept with end users	Gamification experts

Fourth, if the stakeholders approve the concept, playtesting sessions can be organized (Salen & Zimmermann, 2004). To prepare these sessions, the gamification experts may either develop the gamification alone using a low-fidelity prototype or consult *IT experts* to implement a proof-of-concept as software solution (high-fidelity).

Fifth, the prototype of the gamification is playtested with a group of *end users* who share their opinion, identify problems, or proposes improvements based on the experience with the early prototype. These suggestions and improvements lead back to the first step and results in a revised version of the gamification concept.

This workflow is repeated until all stakeholders have agreed on a specific gamification concept. Hence, output of this workflow is the precise definition of the intended gamification concept. The design workflow is presented in Table 22.1.

22.2.4 Provisioning

In this phase, the *IT experts* take over the gamification concept as design specification and analyze the market to select an appropriate gamification solution. This decision is influenced by technical constraints of the existing IT infrastructure, the gamification concept itself, and the business processes that emerged as artifacts out of the previous steps. Hence, *IT experts* are responsible for the execution of this workflow. In some situations, they may consult domain, gamification, or business experts to clarify the gamification concept or to discuss additional technical constraints with regards to the gamification concept. Output of this workflow is the provisioning of all systems that are necessary to integrate including their documentations, APIs, and tools. Nonetheless the output of this workflow might also be that no gamification solution can be reused and that a custom implementation has to be provided. In this case, the output of this workflow comprises further the right resources which allow for the successful implementation.

22.2.5 Implementation

After the provisioning phase, the *IT experts* are responsible to assemble, implement, and integrate all components for the final gamified application. If the *provisioning* resulted in the reuse of integrated, generic, or achievement solutions (Sect. 22.4), this phase concerns the integration of the company's IS and the respective gamification solution. Further, the gamification concept has to be configured within the target gamification solution. If, however, the *IT experts* decided against the reuse of existing solutions, the IT department has to implement the gamification on its own. Therefore, implementation takes place within the existing IS or as independent part providing appropriate interfaces for integration. Furthermore, additional services might be assembled and integrated, e.g., identity, user management, or e-mail services. Additionally, custom user interfaces have to be implemented to present the gamification to the end user in an easy to use way.

In this workflow, primarily the *IT experts* of the company are involved. Output of this workflow is the gamified application in a first running prototype.

22.2.6 Test

The testing phase joins all the artifacts from the prior workflows and tests requirements and assumptions against the running prototype. This includes technical tests for functional correctness and non-functional attributes. Additionally, this workflow includes domain, gamification, business experts, and end users to test whether the application behaves as designed or not. Output of this workflow is the tested gamified IS.

22.2.7 Deployment

If all tests have been passed successfully, the *IT experts* are responsible for the final deployment in the IT landscapes and to open access to all end users.

22.2.8 Monitoring

This phase concerns the monitoring of the running gamification concept. The *deployment phase* continuously outputs operational user data signifying the usage of the target processes. This data is assembled and aggregated in the monitoring phase in accordance with the engagement criteria and process models defined by the requirement phase. Based on the comparison of these three aspects, additional modifications and suggestions for improving the gamification design (*engagement* *delta*) might be derived. This delta is communicated back to the *gamification experts* who start again at the *design phase* and propose modifications to the gamification concept.

22.3 Requirements

In the following section, we describe functional and non-functional requirements of gamification that are important to the *provisioning* and *implementation* phases respectively. We root these technical requirements in general conceptual requirements for gamification. Therefore, we describe conceptual gamification requirements first. Afterwards, we map conceptual to technical requirements for IS.

22.3.1 General Gamification Requirements

Since researchers have not agreed on a common taxonomy of game concepts yet (Bjoerk & Holopainen, 2005), we conducted a literature review to identify common elements. For structuring the requirements, we used a preliminary taxonomy provided by Deterding et al. (2011). In this taxonomy five levels for gamification design are introduced: *Game interface patterns* (L1), *Game Design Patterns* (L2), *Game Design Principles* (L3), *Game Models* (L4), and *Game Design Methods* (L5). While levels *L1* and *L2* are concerned with *what* visual concepts exist and *how* these elements relate to each other, all other levels (*L3–L5*) comprise design methods to create compelling game or gamification designs. We assume that only elements on *L1* and *L2* are related to the technical realization. Therefore, all other levels are omitted for further consideration.

22.3.1.1 Basic Concepts (L1)

For the first level of Deterding's taxonomy, we describe the atomic visual elements of gamification in Table 22.2. For each element we provide a name, possible synonyms, subtypes of the element, and references to its definition. For example, we describe the visual element *Point* where possible synonyms are *Metric*, *Measure*, or *Currency*. Moreover, there are different types of points such as advancing, redeemable, karma, skill, or reputation points.

Further visual elements belonging to *L1* can be identified from the literature. Those are aggregations or compositions of the atomic elements according to some aggregation function. For example, an avatar is the composition of specific amounts of, e.g., points, badges, role, or skills for a particular player. A leaderboard is the aggregation of avatars and their points etc. All identified aggregations are presented in Table 22.3.

Table 22.2 Visual (Basic) game mechanics

Game design element	Synonyms	Subtypes	References
Point	Measure, metric, currency	Advancing, redeemable point, karma, reputation	Zichermann and Cunningham (2011), Bunchball Inc. (2010), Werbach and Hunter (2012)
Mission	Goal, challenge	Individual, collective	Schell (2008), Zagal, Mateas, Fernández-Vara, Hochhalter, and Lichti (2005), Kapp (2012), Dormans (2012)
Role	–	–	Reeves and Read (2009)
Skill	–	–	Reeves and Read (2009), Zichermann and Cunningham (2011), Schell (2008)
Feedback	None	Informational: points, notification, achievements, narration; corrective: notifications	Kapp (2012), Reeves and Read (2009), McGonigal (2011)
Event	User actions	Operative, resultant, external, interim	Schell (2008)
Achievement	Badge, Trophy, virtual good	Expected, unexpected, partially (un-)expected	Zichermann and Cunningham (2011), Bunchball Inc. (2010), Montola, Nummenmaa, Lucerano, Boberg, and Korhonen, (2009), Hamari and Eranti, 2011
Good	–	Virtual, real	Reeves and Read (2009), Bunchball Inc. (2010)
Narrative context	Storytelling	–	Reeves and Read (2009), Kapp (2012)
Notification	Alert	–	Schell (2008), Deterding et al. (2011), Kapp (2012)

22.3.1.2 Gamification Rules (L2)

Besides concepts on *L1*, we consider concepts on *L2* which concerns elements determining *how* the gamification is "played". According to Schell (2008): *"Rules are really the most fundamental [game] mechanic. They define the space, the objects, the actions, the consequences of actions, the constraints, and the goals"*. While the concepts on *L1* determine the existence of concepts on a meta-level, rules determine the gamification logic and how instances of the L1 concepts evolve over time.

This evolution depends, for example, on:

- *User Actions* (e.g., user *u* does action *a*) (Schell, 2008).
- *External Events* (e.g., mission completed during a rainy day) (Schell, 2008).

Table 22.3 Visual (Aggregated) game mechanics

Game design element	Synonyms	Aggregates	References
Space	Gameplay	All elements	Schell (2008), Zagal et al. (2005)
Context	Objects' state	Points, levels, achievements, goods, skills	Schell (2008)
Avatar level	Level, player level	Points	Zichermann and Cunningham (2011), Bunchball Inc. (2010), Kapp (2012)
Avatar	None	Context, roles, notifications, avatar levels, goals	Zichermann and Cunningham (2011), Bunchball Inc. (2010), Kapp (2012), Reeves and Read (2009)
Virtual economy	Marketplace	Avatars, virtual goods, virtual currencies	Reeves and Read (2009)
Leaderboard	Highscore, scoreboard	Points, avatars	Zichermann and Cunningham (2011), Bunchball Inc. (2010)
Communication system	None	Notifications	Reeves and Read (2009)
Team	Cooperation	Avatars	Zichermann and Cunningham (2011), McGonigal (2011)

- *Interim Events* (e.g., event as interim result) (Schell, 2008).
- *Gamification Context* (e.g., user u has already 50 points) (Schell, 2008).
- *Constraints* such as temporal, spatial, Boolean, numeric, or random logic (e.g., user u did action a 1 day after completing mission b) (Kapp, 2012; Schell, 2008; Werbach & Hunter, 2012)
- *Randomness* (e.g., the user's action a is only considered in 50 % of all cases) (Deterding et al., 2011; Kapp, 2012; Schell, 2008)
- *Joint Actions* (e.g., users u_1 and u_2 did action a together/against each other) (Zichermann and Cunningham, 2011)
- or other user-independent or environment constraints (e.g., only the first 50 users may get a badge).

These elements are considered as the *conditional* part of rules. Besides conditions, rules comprise *consequences* which are applied once conditions are fulfilled. Further, consequences are instances of atomic elements of *L1*, e.g., points, badges, or missions.

22.3.2 Functional Requirements

To support the technical realization of gamification on *L1* and *L2*, a gamification solution has to offer the following functional features:

Entity Support: The ability to provide a variety of entities reflecting concepts of *L1* (e.g., notions for *badges*, *point*, *missions*, or *skills*) and their relationships (e.g., *aggregations* of points).

Entity Definition and Management: The ability to support the design, definition, and management of *L1* entities, i.e., creating, updating, or deleting instances of entities at design and runtime (e.g., creating a badge instance with name, description and graphical image). The current state of entities has to be made persistent as well.

User Management: The support of management and configuration of user data (e.g., that the user may flag his gamification profile as "anonymous").

State Retrieval: The support of parametrizable queries based on the state of entities (e.g., retrieving a personal profile containing a summary of *L1* elements for the player).

Rule Management: The ability to support the design and definition of rules (e.g., give user *u* five points for action *a*).

Rule Reasoning: The powerfulness of rules determines whether arbitrary gamification concepts can be implemented or not. Therefore, the rule language and its operators (e.g., logical, temporal, spatial, join, or filter operators) must be Turing-complete. This allows rule reasoning over a variety of dimensions such as user actions, objects, state, and constraints at runtime according to the rules defined at design time.[1]

Analytics: The support of gamification data analysis by its stakeholders over a wide range of dimensions such as time, users, applications, companies or tenants in order to monitor and improve the impact of the gamification concept (e.g., has user retention increased through the new badges introduced last quarter).

[1] For a complete list of rule requirements see Herzig, Jugel, Momm, Ameling, and Schill (2013).

22.3.3 Non-Functional Requirements

The non-functional attributes shape the overall design and architecture of a gamification solution. In this paper, we only consider quality attributes that are useful with regards to the assumptions of the *gamification development process*. However, we acknowledge that further quality attributes are important as described in Herzig, Ameling, and Schill (2012).

Flexibility: The gamification concept has to be changeable to adopt new design demands and business requirements after the *deployment* and during the *monitoring* phase. For example, if the *gamification experts* decide to give users three points instead of five points for a particular user action, this has to be changeable without rebuilding or redeploying the IS.

Invasivity: Refers to the degree, how invasive the gamification solution has to be implemented into the host application. Non-invasivity fosters a decoupling of functionality from technology, i.e., the IS must be independent from short-term technology innovations (Erl, 2009; Krafzig et al., 2005). This attribute mainly influences the decisions taken in the *provisioning* phase.

Integrability: Refers to the degree, how much effort is necessary to integrate the gamification solution into the IS within the *implementation* phase.

Reusability: Refers to the degree, how reusable the gamification solution is in different contexts in order to reduce development and maintenance costs in the long run. As such, it directly influences all phases of the gamification process starting from the *provisioning* phase.

Performance: The evaluation of rules, i.e., detection of patterns in conjunction with object state, has to be processed at least in perceived (soft) real-time (e.g., <500 ms, Miller, 1968) for large amounts of concurrent users (e.g., McGonigal, 2011) after *deployment*.

Manageability: The persisted data must be manageable across the gamification's life cycle. For example, data has to be aggregated or anonymized after a particular time to ensure legal compliance in some countries or domains (*monitoring* phase).

Analyzability: Refers to the degree how much data is accessible to provide the desired insights into user behavior (*monitoring* phase).

22.4 Gamification Solutions

Based on a survey of 29 gamification solutions, we systematically derive four main classes below. For each class we describe its general functionality, present implications for requirements, and give examples.

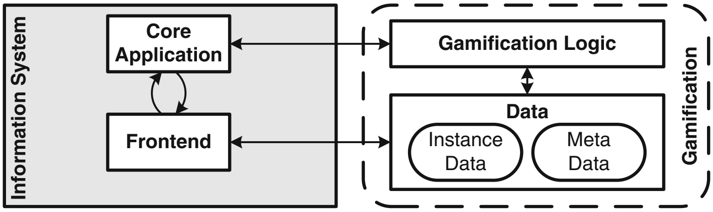


Fig. 22.2 General scenario for adding gamification to an information system

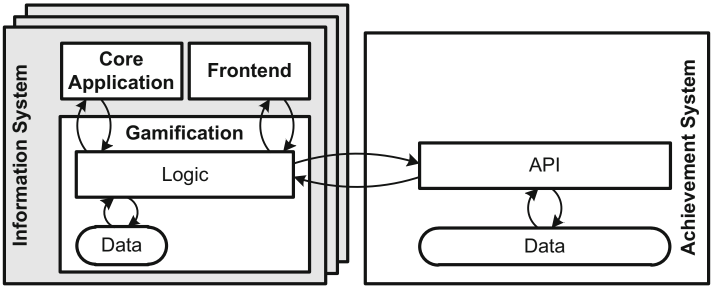


Fig. 22.3 Gamified information system using an achievement system

In general, an IS may comprise the backend system containing logic represented by the *core application* and a *frontend* that users interact with (Fig. 22.2). The gamification may be considered as a separate aspect to this system containing logic (rules), metadata, and instance data (relationships) which are continuously updated at runtime based on the gamification logic. While the users interact with the system as usual, the backend of the IS communicates with the gamification solution which calculates and stores the user's progress. Ultimately, the frontend of the business application has to represent the user's gamification results in the frontend. Based on this general scheme, we describe variants of gamification solutions in the following.

22.4.1 Achievement Systems

Achievement systems (AS) are defined as *"secondary reward systems that have been developed for digital games. They integrate functionality that adds subgoals to the actual game experience"* (Montola et al., 2009). The AS is external to the actual system and exposes the domain entities via standardized interfaces to the IS (Fig. 22.3). Entities such as badges are defined at design time. At runtime, when the IS decides to updates the player's state (e.g., by giving a reward), it requests the AS to store this data. Vice versa, the IS may retrieve the player's current state from the AS, e.g., to display the data in the frontend of the application. Moreover, the achievement system may offer another separate client that visualizes the player's gamification data in profiles or leaderboards for each game individually.

Hence, AS have to comply at least with *entity support*, *entity management*, and *analytics*. Additionally, at least rudimentary *user management* functionality must be available.

The major drawback of AS is that *rules* are not supported and the gamification logic has to reside within the IS. Consequently, a part of the gamification data, e.g., interim gamification results, reside within the IS too. This limits their *flexibility* with regards to design changes as well as *reusability* in arbitrary contexts to some extent. Moreover, the IS has to be modified intensively to integrate with the achievement system which contradicts with *invasivity*. In all analyzed cases, integration has to be done programmatically without additional support (medium *integratability*). Since only parts of the gamification data (e.g., feedback mechanisms) are available to the AS, *analyzability* is only given to some extent. None of the analyzed systems supports *manageability* of data.

From 29 evaluated systems, 11 were identified as AS (Table 22.4). Implementations of AS for games are: XBox Live, Playstation Network, Steam, iOS GameCenter, and GamInside. Most of the AS identified for gamification (Beintoo, Mplifyr, Bigdoor.com, Leaderboarded) come with a predefined value system which cannot be customized, i.e., currencies or points are statically defined. Contrarily, UserInfuser and OpenBadges are highly customizable AS. Some AS provide a limited number of *gamification concepts* only, such as points and leaderboard (e.g., Leaderboarded) or badges (e.g., OpenBadges).

22.4.2 Integrated Solutions

An integrated gamification solution (IG) has been developed directly for and within the IS (Fig. 22.4). Hence, the solution is tied to the IS's structure, interfaces, and semantics. Therefore, implementation is very fast at early stages of development since features required by the target application have to be implemented only.

Table 22.4 Analyzed achievement systems

System	Target	Source
XBox Live	Games	http://www.xbox.com/
Playstation Network	Games	http://de.playstation.com/psn/
Steam	Games	http://steamcommunity.com/dev
iOS Game Center	Games	http://developer.apple.com/
GamInside	Gamification/loyality	http://gaminside.com/
Beintoo	Gamification	http://www.beintoo.com/
Mplifyr	Gamification/loyality	https://www.mplifyr.com/
Bigdoor	Gamification/loyality	http://www.bigdoor.com/
Leaderboarded	Gamification	http://www.leaderboarded.com/
UserInfuser	Gamification	https://code.google.com/p/userinfuser/
OpenBadges	Gamification	http://openbadges.org/

Fig. 22.4 Integrated solution

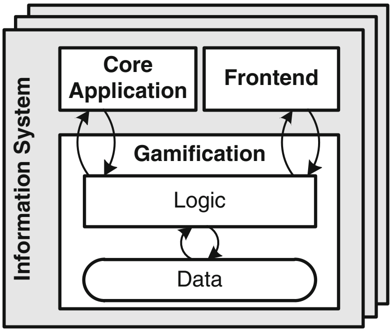


Table 22.5 Analyzed integrated platforms

System	Domain	Source
GIGYA	Social/web 2.0	http://www.gigya.com/gamification/
PLAYVOX	Human resources	http://www.arcaris.com/
PRACTICALLY GREEN	Sustainability	http://www.practicallygreen.com/
ZURMO	CRM	http://www.practicallygreen.com/
CELLCAST	Learning solution	http://www.onpointdigital.com/cellcast/
RESULTS.COM	Sales	http://us.results.com/
PUNCHTAB	Websites	https://www.punchtab.com/

We argue that the overall *performance* of this approach is high, since all calculations can be directly processed within the system. Similarly, *analyzability* can be considered as high, since all data is available for analysis. Due to the tight integration, *integratability* is obsolete to be considered.

However, we argue that this approach does hardly scale horizontally. For instance, *reusability* is given to a lesser extent and, thus, the gamification solution has to be implemented repeatedly for each system separately. In all surveyed cases, these systems are also domain-specific, i.e., they ship with a set of parametrizable game design elements and rules tied to a particular domain such as sales or sustainability. Therefore, their *flexibility* is limited to a large extent. Due to the tight coupling of IS and gamification, *invasivity* is high. In addition, in no case *manageability* of gamification data was observed. Finally, the approach results in data silos, i.e., users can hardly share their gamification data across application boundaries without additional efforts since no generalization, standardization, or interoperability is considered. Table 22.5 list current examples of integrated platforms for various domains.

22.4.3 Generic Gamification Platforms

A generic gamification platform (GGP) is completely decoupled from the IS, i.e., the gamification's state and logic are separated from the IS (Fig. 22.5). This allows for an almost *non-invasive* introduction of gamification into the IS. In all cases,

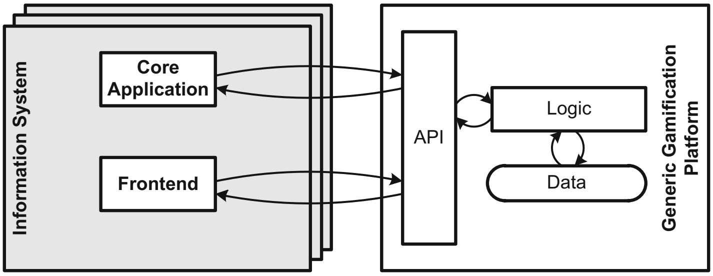


Fig. 22.5 Generic gamification platform

Table 22.6 Analyzed generic gamification platforms

System	Source
BUNCHBALL	http://bunchball.com
BADGEVILLE	http://badgeville.com/
IACTIONABLE	http://iactionable.com/
ENTERPRISE GAMIFICATION PLATFORM	Herzig, Ameling, et al. (2012), Herzig, Jugel, et al. (2013), Herzig, Wolf, et al. (2013)

generic platforms offer designers a large set of *L1* entities. In GGPs, designers configure the gamification in the platform, i.e., defining rules and metadata prior to runtime in a declarative manner. In all analyzed cases, this process is supported by tools and provides a high degree of *flexibility* along the gamification process.

During runtime, the platform collects arbitrary *user actions* from the application and uses the *rules* to reason over the users' events considering previous context data of user.

Non-functionally, the platform can be *reused* across multiple systems within the company or even across companies. This allows for the definition of standardized interfaces and design artifacts and makes interoperability between information systems easier. Moreover, *integratability* is highly supported through gamification components and widgets offered by all analyzed GGP implementations. Our analysis yielded that four platform can be considered as generic gamification platforms (Table 22.6).

However, such a generic service approach is also the most challenging one from a conceptual and technical perspective since many different design methodologies have to be supported. Additionally, due to the complete separation of IS and gamification, ensuring high *performance* is complicated. For example, *user actions* might be lost or delayed while transmitted between IS and GGP. Moreover, we observed that the powerfulness and expressiveness of rule definitions are limited in current systems. More precisely, all analyzed platforms, except Herzig, Jugel, et al. (2013), Herzig, Wolf, Brunstein, and Schill (2013), allow rule definitions in structured query language (SQL) only. Standard ANSI-SQL is, however, not Turing-complete (Wang, Zaniolo, & Luo, 2003). For example, all platforms allow filter operators on events. Event aggregation is limited to *count* and *sum*, only

IActionable supports all classical SQL aggregation methods. Additionally, events can be correlated only using the logical operators *and* and *or*. Moreover, sequencing operators are only available in Bunchball's platform. Although the platforms allow the processing of *object state*, this context is maintained independent from the event processing, i.e., context cannot be processed together with events. As implication, this does not allow the definition of non-linear mission designs or context-based reasoning. Furthermore, the processing of continuous event streams is not foreseen. Since features such as temporal, spatial, or join operators are not supported, these platforms are also not suitable to detect arbitrary complex situations. These drawbacks have been addressed by Herzig, Ameling, et al. (2012), Herzig, Jugel, et al. (2013), Herzig, Wolf, et al. (2013).

22.4.4 Others

In this category, all other kinds of services for gamification are subsumed. For example, Gameboxed and Snowfly offer gamble plugins for Facebook or CRM respectively which can be used by companies for the inclusion on their social network page. When users play these gambles they may earn tokens which can be redeemed for give-away articles later on.

Gamify offers a central virtual world where companies may offer merchandizing activities (comparable to Second Life). However, in this case neither gamification concepts nor rules can be defined by designers.

Additionally, some providers (e.g., PlayGen) offer the implementation of gamification in custom development projects. In most cases, this comprises the implementation of serious games for education or e-learning in some business-related domain (e.g., security, health). However, these approaches neither try to reduce development or maintenance costs nor do they comply with the non-functional requirements. Nonetheless, such implementations might benefit to a large extent from the solution approaches described before.

22.5 Requirements Mapping

Based on the individual characterization, we summarize results in Table 22.7. We acknowledge that our aggregation may only provide a general tendency, since some features are implementation-specific.[2] For example, we present *entity support* to be only partially supported by AS since some implementations only provide few L1 concepts (e.g., OpenBadges). Other implementations of AS may provide a diversity of such concepts (e.g., UserInfuser).

[2] The full assessment for each system and all requirements can be requested from the authors.

Table 22.7 Comparison of classes (AS: Achievement systems, GGP: Generic gamification platforms, IG: Integrated solution, ✓: supported, (✓): partially supported, –: not supported, ↑: high, →: medium, ↓: low, ∘: not considered)

Requirements	AS	IG	GGP	Others
Number	11	7	4	7
Entity support	(✓)	(✓)	✓	(✓)
Entity management	✓	✓	✓	(✓)
9 user management	(✓)	✓	✓	(✓)
State retrieval	✓	✓	✓	(✓)
Rule management	–	(✓)	✓	–
Rule reasoning	–	(✓)	(✓)	–
Analytics	✓	✓	✓	–
Degree of flexibility	→	↓	↑	∘
Degree of invasivity	→	↑	↓	∘
Degree of reusability	→	↓	↑	∘
Degree of integrability	↓	∘	→	∘
Performance	→	↑	↓	∘
Degree of analyzability	→	↑	↑	∘
Degree of manageability	→	↓	↑	∘
Degree of complexity	↓	↓	↑	∘

According to Table 22.7, all solutions support at least partially the definition and management of *entities*, *users*, as well as *state retrieval*. However, all analyzed solutions define their own data model and interfaces on *L1*. Thus, a direct comparison of existing systems is hardly possible. We propose to address this shortcoming in future work, e.g., by standardizing gamification concepts and relationships to some degree. This would allow data exchange between solutions or the assessment of implementations in more detail.

Only *generic platforms* and some *integrated solutions* allow the management of gamification rules. However, the powerfulness of rule reasoning is limited in current embodiments due to missing Turing-completeness. Generic gamification platforms, moreover, provide the highest degrees of *flexibility*, *non-invasivity*, *reusability*, *integratability*, *analyzability* and *manageability*. On the other side, technical *complexity* and *performance* might be considered critical.

Contrarily, *integrated solutions* provide high *performance* and low *complexity* but can be considered critical in all other non-functional dimensions.

A trade-off between these distinct approaches are *achievement systems* which offer a medium degree of non-functional attributes. However, they do not provide the definition of gamification rules at all. Therefore, they might be only applicable if the majority of the gamification logic has to be implemented in the IS.

We did not consider any quality attributes in the *other* category, since they are not directly comparable against the requirements.

The overview given in Table 22.7 might be useful for engineers or designers to select the appropriate solution for future gamification projects. Since some features are highly implementation-specific, it is, however, still necessary to assess the individual solutions in one class based on the particular requirements of the intended project.

Moreover, we argue that future research in gamification should address the shortcomings of the respective approaches. For example, further work is necessary to understand theoretical opportunities and limitations of each approach. Additionally, experience reports on implementation projects from practitioners and researchers are currently missing. Therefore, we propose to combine research on the design and psychology of gamification with its technical realization in information systems in future work.

22.6 Application

In order to illustrate the application of our classification, we describe two real world examples in the following. For both examples, we used our implementation of a generic gamification platform to realize the gamification.

The first use case covers the gamification of an information system implementing a carpooling business process which is used by 8,000 users on a daily basis. In contrast to traditional commuting applications, employees are automatically matched once they posted their ride intents. However, the problem exists that people need to be motivated to share their car as a driver which is often perceived as loss of flexibility or convenience. A qualitative analysis has been conducted to find out what the users motivate to use the application. This analysis yielded that people especially use the application to be ecologically sustainable, to extend their social network, to arrive at work with less stress, and perceive a smaller likelihood of accidents. Based on these observations, a gamification concept has been created to reinforce these intrinsic motivations.

With regards to requirements, *flexibility*, *non-invasivity*, and *integratability* were considered as crucial by the application owners. On the other side, *performance* was not considered crucial since user action rates are relatively low (around 300 user actions per day). Therefore, we decided to implement the gamification with a generic platform. The initial implementation and integration of the gamification concept needed three working days. Moreover, rules and gamification concepts are updated (e.g., to balance the game mechanics) every two weeks without necessity to change the carpooling application.

The second use case concerns the gamification of training of a German Bundesliga club where the players should train several aspects such as reaction times and anticipation of several soccer situations. In this case, several mini serious games were implemented where players train individually or compete against their teammates.

For this implementation, we used a highly customizable achievement system because performance was considered very crucial. For instance, the measurement of reaction times has to happen with a resolution below $1ms$ (e.g., the delta between presenting a soccer situation to the player and the player's response).

Due to the aforementioned loose-coupling of *generic platforms* and consequential performance limitations, the calculation of these aspects has been implemented within the games directly. The results are then propagated to and stored within the achievement system. Based on the reaction times, the AS is used to generate competitive structures (e.g., leaderboards) or to visualize the players' progress.

In a second iteration of the project, however, we extended the achievement system to a generic gamification platform because some calculations could be isolated from the mini games. For example, the trainer should be enabled to change training thresholds and rules on-the-fly, i.e., without recompilation and redistribution of the actual application. Hence, some aspects of the gamification, e.g., calculation of reaction times, might be kept within the application and others, e.g., how many rounds a gaming sessions consists of, are maintained within the gamification platform which acts as a hybrid system comprising an achievement system and generic gamification platform.

22.7 Summary

In this paper, we introduced gamification as a software development process. Furthermore, we have outlined four classes of gamification solutions supporting the introduction of gamification into information systems. For each class we have explained its abstract functionality, derived advantages and disadvantages, and referred to examples. IT experts such as developers or architects can use this classification to plan, architect, and decide for the right technology approach by considering the trade-offs within their project context. Moreover, this classification avoids pitfalls in the planning phase from the early beginning.

Based on our practical experience in designing and implementing gamification projects in IS, we argued that generic gamification platforms provide the highest suitability for long-term gamification projects due to their enhanced flexibility, reusability, and decoupling of functionality and technology. The other approaches, however, might be of advantage when short-term projects such as marketing campaigns are aspired or the target application is more a real game, for example, in e-learning environments.

References

Bjoerk, S., & Holopainen, J. (2005). *Patterns in game design*. Rockland, MA: Charles River Media.

Bunchball Inc. (2010). *Gamification 101: An introduction to the use of game dynamics to influence behavior*. Retrieved on April 27, 2011, available on http://www.bunchball.com/gamification/gamification101.pdf

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *MindTrek '11 Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM.

Dormans, J. (2012). *Engineering Emergence: Applied Theory for Game Design*. University of Amsterdam.
Erl, T. (2009). *SOA design patterns*. Englewood Cliffs, NJ: Prentice-Hall.
Hamari, J., & Eranti, V. (2011). Framework for designing and evaluating game achievements. In *Proceedings of DiGRA 2011 Conference*.
Herzig, P., Ameling, M., & Schill, A. (2012). A generic platform for enterprise gamification. In *Software Architecture (WICSA) and European Conference on Software Architecture (ECSA)* (pp. 219–223). Helsinki.
Herzig, P., Jugel, K., Momm, C., Ameling, M., & Schill, A. (2013). GaML - A modeling language for gamification. In *6th International Conference on Utility and Cloud Computing* (pp. 494–499). Dresden.
Herzig, P., Strahringer, S., & Ameling, M. (2012). Gamification of ERP systems - Exploring gamification effects on user acceptance constructs. In *Multikonferenz Wirtschaftsinformatik* (pp. 793–804). Braunschweig.
Herzig, P., Wolf, B., Brunstein, S., & Schill, A. (2013). Efficient persistency management in complex event processing: A hybrid approach for gamification systems. In L. Morgenstern, P. Stefaneas, F. Lvy, A. Wyner, & A. Paschke (Eds.), *Theory, Practice, and Applications of Rules on the Web. Vol. Braunschweig. 8035 of Lecture Notes in Computer Science* (pp. 129–143). Berlin, Heidelberg: Springer.
Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. San Francisco, CA: Pfeiffer.
Krafzig, D., Banke, K., & Slama, D. (2005). *Enterprise SOA - Service-oriented architecture best practices*. Englewood Cliffs, NJ: Prentice Halls.
Kruchten, P. (2004). *The rational unified process: An introduction*. Reading, MA: Addison-Wesley Professional.
McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: The Penguin Press.
Miller, R. B. (1968). Response time in man-computer conversational transactions. In *Proceedings of the December 9–11, 1968, Fall Joint Computer Conference, Part I*, AFIPS '68 (Fall, part I) (pp. 267–277). New York, NY: ACM
Montola, M., Nummenmaa, T., Lucerano, A., Boberg, M., & Korhonen, H. (2009). Applying game achievements systems to enhance user experience in a photo sharing service. In *MindTrek'09: Proceedings of the 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era* (pp. 94–97).
Reeves, B., & Read, J. L. (2009). *Total engagement: Using games and virtual worlds to change the way people work and businesses compete*. Boston, MA: Harvard Business Press.
Salen, K., & Zimmermann, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.
Schell, J. (2008). *The art of game design: A book of lenses*. Amsterdam: Elsevier.
Thom, J., Millen, D. R., & DiMicco, J. (2012). Removing gamification from an enterprise. In *Proceedings CSCW* (pp. 1067–1070).
Wang, H., Zaniolo, C., & Luo, C. R. (2003). Atlas: A small but complete sql extension for data mining and data streams. In *Proceedings of the 29th International Conference on Very Large Data Bases - Vol. 29, VLDB '03* (pp. 1113–1116). VLDB Endowment.
Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Philadelphia: Wharton Digital Press.
Zagal, J. P., Mateas, M., Fernández-Vara, C., Hochhalter, B., & Lichti, N. (2005). Towards an ontological language for game analysis. In *DiGRA 2005 Conference*.
Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile Apps*. Sebastopol, CA: O'Reilly Media.

Chapter 23
Workplace Psychology and Gamification: Theory and Application

Philipp Herzig, Michael Ameling, and Alexander Schill

Abstract The objective of gamification is to engage and motivate people in non-gaming contexts, for example, at the workplace. However, practitioners often understand gamification as the introduction of extrinsic rewards (e.g., points, badges) as kind of non-monetary valuta and, thus, inexpensive way of rewarding people. Although these approaches work to some extent, successful and sustainable applications of game design elements foster the intrinsic motivation of people. The investigation of intrinsic motivation, human satisfaction, and well-being has been a long-term research field in work and organizational psychology. In this chapter, we describe key theories from the domain of positive and workplace psychology. Key resources and factors of these theories are then linked to gamification and game design elements. This analysis results in a general framework for quantitative gamification research which has been partially evaluated with one of our ERP gamification applications.

23.1 Theory and Definitions

Gamification, the "use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011), has emerged as a trend for information systems (IS). The general hypothesis is that gamification fosters higher levels of engagement, participation, and motivation, if applied correctly. This hypothesis is based on the observation that people are spending much time on playing games. For example, more than five million people in the USA play (video) games for 40 h a week and gamers have collectively spent 5.93 million years playing World of Warcraft

P. Herzig (✉)
SAP Innovation Center, SAP SE, Konrad-Zuse-Ring 10, 14469 Potsdam, Germany
e-mail: philipp.herzig@sap.com

M. Ameling
SAP SE, Chemnitzer Straße 48, 01187 Dresden, Germany
e-mail: michael.ameling@sap.com

A. Schill
TU Dresden, Nöthnitzer Straße 46, 01187 Dresden, Germany
e-mail: alexander.schill@tu-dresden.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_23

(McGonigal, 2011), although such games do not have external value (Caillois, 2001). The question is which game mechanisms provide these levels of motivation and if they can be isolated from games and eventually applied within non-gaming contexts to foster similar behavior.

In this paper, we specifically look at the workplace as non-gaming context. Work and organizational psychology is studying the overall *happiness* of employees and proposed multiple theories and models over the past decades. These theories have in common that there are many ways to be happy but it is impossible to find general happiness as everyone demands different rewards (Lyubomirsky, Sheldon, & Schkade, 2005; Sheldon & Lyubomirsky, 2007). These rewards can be either of *extrinsic* or *intrinsic* nature. The former is represented, for example, by real-world money, status, or goods, the latter by, e.g., positive emotions, individual strengths, or social connections. While *extrinsic* motivators lead to *hedonic behavior*, *intrinsic* rewards lead to *autotelic behavior* under which all self-motivating and self-rewarding activities are subsumed (Csikszentmihalyi, 1975, p. 10). McGonigal (2011, p. 46) argues that those autotelic activities engage people completely and are the most *"pleasurable, satisfying, and meaningful emotional states that we can experience"*.

The following chapter introduces key theories and models which target these intrinsic motivations. Furthermore, computer games and their motivating factors are analyzed. Based on this consideration, we show that there is a significant intersection between factors leading to work and game engagement. This observation leads to the proposal of general framework for quantitative gamification research at the workplace. Additionally, we present the application of this general model using the gamification of enterprise resource planning software which acts as mediator to introduce game mechanics to the job. Our results demonstrate that gamification provides promising results for higher levels of motivation on the hand and supports the leading hypothesis of workplace gamification on the other hand.

23.1.1 Engagement in the Workplace

Today the average worker spends a quarter or a third of his or her life time at work (Harter, Schmidt, & Keyes, 2003, p. 205). Overall job satisfaction is a good determinant of life satisfaction (Bowling, Eschleman, & Wang, 2010; Curhan, Elfenbein, & Kilduff, 2009; Ilies, Scott, & Judge, 2006). However, within a globalized work environment people suffer on work-related illnesses, such as burnout or depression, leading to a loss of 1,250 million working days per year worldwide (Rodríguez-Carvaja, Moreno-Jiménez, de Rivas-Hermosilla, Álvarez-Bejarano, & Vergel, 2010) and to a negatively affected life satisfaction.

Within the domain of work and organizational psychology, there are two main research streams which try to identify how the organizational environment affects employees' live and performance (Harter et al., 2003). First, the *person-environment fit* theory by French, Caplan, and Van Harrison (1982) which is based on the *flow* theory by Csikszentmihalyi (1975). In this approach it is argued that the individual's performance decreases by strain, i.e., task difficulty is too high, or by boredom, i.e., task difficulty is too low. It is necessary to avoid both states through organizational provisions (Harter et al., 2003, p. 205).

Second, *positive emotions* leading to happiness in the workplace (e.g., pleasure, enjoyment, energy) and their relationship to positive outcomes (e.g., behavioral, cognitive or health benefits) are investigated (Harter et al., 2003, p. 205). Research has found that workers in a positive mood are objectively more productive (Zelenski, Murphy, & Jenkins, 2008, p. 535) or more creative (Baas, Dreu, & Nijstad, 2008, p. 798).

More recently, researchers have begun to join both research streams by conceptualizing the abstract term "*happiness*" on the job by different latent variables, such as *engagement* or *job satisfaction*, and by exploring interdependencies between these constructs. Therefore, Table 23.1 gives an overview of possible conceptualization of happiness in the workplace (Fisher, 2010).

It is important to note that the presented conceptualizations are neither distinct from each other nor do researchers agree upon their interdependencies or taxonomic classification. For example, Fisher (2010, p. 389) argues that *thriving* and *vigor* are part of the higher-order construct *engagement*. Moreover, Schaufeli and Bakker (2010, p. 21) argue that "job satisfaction and job involvement share some meaning with work engagement but cannot be reduced to it". *Organizational commitment* is considered as consequence of *work engagement* (e.g., Bakker & Demerouti, 2008). Further, researchers agree that *flow*, when experienced on the job, is equal to the *absorption* dimension of *engagement* (Hallberg & Schaufeli, 2006, p. 120). More recently, Spreitzer, Lam, and Fritz (2010, p. 135) found, that the intersection of *thriving* and *engagement* is characterized through *vigor/vitality*.

Based on this analysis, Fisher (2010, p. 390) argues that the constructs *work engagement*, *job satisfaction*, and *organizational commitment* capture most of the variance in person-level happiness at work. Since all these variables are integrated into one single model, called the *job-demand resource model* introduced by Demerouti, Bakker, Nachreiner, and Schaufeli (2001), antecedents and consequences of *work engagement* are described in the next section.

23.1.1.1 The Job Demand-Resource Model

The job demand-resource model (JD-R) introduced by Demerouti et al. (2001) is the most used utilized model by engagement researchers (Hakanen & Roodt, 2010, p. 86) and roots in the demands-control model introduced by Karasek (1979). The assumptions of the JD-R model are consistent with prior validated theories, such as the job characteristics theory (JCT) by Hackman and Oldham (1980) or self-determination theory (SDT) by Ryan and Deci (2000).

The JD-R model is based on two important higher-order constructs: *job resources* and *job demands*. According to Bakker, Hakanen, Demerouti, and Xanthopoulou

Table 23.1 Happiness conceptualizations at the workplace

Construct	Definition
Job satisfaction	"A pleasurable or positive emotional state resulting from an appraisal of one's job or job experiences" (Locke, Cartledge, & Knerr, 1975, p. 1300).
Organizational commitment	"Personally identifying with the organization's goals and values and being effectively attached to the organization" (Fisher, 2010, p. 388).
Job involvement	"Is a state of engagement with one's job, identifying with one's work, and viewing the job central to one's identity and self-esteem, roughly opposite to the concept of alienation or meaninglessness" (Brown, 1996).
Engagement	"A positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption. Vigor is characterized by high levels of energy and mental resilience while working. Dedication refers to being strongly involved in one's work and experiencing a sense of significance, enthusiasm, and challenge. Absorption is characterized by being fully concentrated and happily engrossed in one's work, whereby time passes quickly and one has difficulties with detaching oneself from work" (Bakker & Demerouti, 2008, pp. 209–210).
Thriving	"Thriving at work combines feelings of vitality and energy with beliefs that one is learning, developing and making progress towards self-actualization" (Spreitzer & Sutcliffe, 2007).
Vigor	"A positive affective experience involving energetic resources including feelings of physical strength, emotional energy and cognitive liveliness" (Shirom, 2006).
Flow	"Refers to the enjoyment experienced when engrossed in a task" (Fisher, 2010, p. 390). Alternatively, the definition of Csikszentmihalyi and LeFevre (1989, p. 816) defines the construct as "the process of optimal experience" where "nothing else seems to matter" (Csikszentmihalyi, 2008, p. 4).
Positive psychological capital (PsyCap)	"An individual's positive psychological state of development characterized by: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed a challenging task; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering toward goals, and when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back and even beyond (resilience) to attain success" (Luthans, Youssef, & Avolio, 2007, p. 3).
Affect at work	All previous constructs are related to attitudes or cognitions. Within this constructs measures are subsumed that "assess moods and emotions at the workplace directly" (Fisher, 2010, p. 390).

(2007, p. 275), *job demands* "represent characteristics of the job that potentially evoke strain, in case they exceed the employee's adaptive capability".

The counter metrics of *job demands* are *job resources* defined as "working conditions that provide resources for individual employees" (Demerouti et al., 2001,

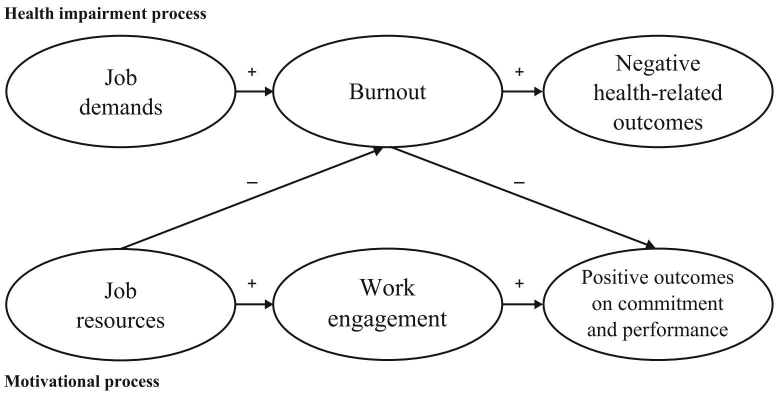


Fig. 23.1 JD-R model (Bakker & Demerouti, 2007, pp. 313–314)

p. 499). More specifically, job resources refer to "those physical psychological, social, or organizational aspects of the job that may (a) reduce job demands and the associated physiological and psychological costs; (b) are functional in achieving work goals; and (c) stimulate personal growth, learning and development" (Demerouti et al., 2001, p. 501).

Based on these two foundational variables the dual process of the JD-R model has been created depicting the outcomes of job resources and demands (Fig. 23.1).

The entire model consists of two different processes. First, a *health impairment process* which is initiated when job demands are high, i.e., mental and physical resources are highly utilized leading to illnesses, such as burnout or depression. These mental illnesses may then lead to negative organizational outcomes.

Second, a *motivational process* initiated by job resources which leads to engagement and positive organizational outcomes. Both processes influence each other whereby mental illnesses negatively correlate with positive organizational outcomes and job resources.

More recently, a meta-analysis of multiple studies validated the following *job resources*: *social support* from colleagues, *autonomy/control*, *skill variety*, *organizational climate* or *performance feedback* (Halbesleben, 2010). The same review also presented that organizational *commitment*, individual work *performance*, and *health* have a positive correlation with these *job resources* and *engagement*. On the other side, *turnover intentions* are negatively correlated with *job resources*. Furthermore, *job demands*, such as work-family *conflicts* or work *overload*, are negatively correlated with work engagement (cf. Halbesleben, 2010, pp. 109–111).

The presented job resources can be either of intrinsic or extrinsic motivational nature. First, they are intrinsically motivating because they are supporting the individual's growth, learning, and development. For example, immediate feedback supports learning and job competence. As another example, social support fulfills the need for autonomy and the need to belong. Second, they have an instrumental, extrinsically motivating value that helps the individual to achieve his or her personal work goals, i.e., foster the individual's willingness to dedicate efforts and abilities to the task in question (Leiter & Bakker, 2010, pp. 2–3).

23.1.1.2 Psychological Capital and Positive Emotions

Job resources are not the only source for engagement in the workplace. Hakanen and Roodt (2010, p. 93) hypothesized that *personal resources* might be further determinants of engagement. Based on the theory of positive organizational behavior (POB) the subset of *psychological capital* (PsyCap) can be derived which includes four important *personal resources* (Table 23.1): *hope*, *optimism*, *resilience* and *self-efficacy* (Luthans, 2002). Sweetman and Luthans (2010, pp. 58–62) show that all these variables are good predictors for *engagement* and engagement's subdimensions, i.e., *vigor*, *dedication*, and *absorption*. In the meta-review of Halbesleben (2010), *personal resources* even have the highest positive impact on engagement with self-efficacy as the strongest predictor. *Job resources* are, however, weaker predictors of engagement compared to *personal resources*.

Additionally, researchers found that PsyCap has not only a direct effect on engagement but is mediated through *positive emotions* such as enthusiasm, enjoyment, empathy, curiosity, or action. Thus, higher levels of PsyCap lead to more positive emotions which, in turn, lead to more engaged people (Avey, Wernsing, & Luthans, 2008, p. 64). Moreover, Salanova, Schaufeli, Xanthopoulou, and Bakker (2010) argue, based on conservation of resources theory (COR), social cognitive theory (SCT), and broaden-and-build theory (BB), that *PsyCap*, *positive emotions*, and *work engagement* together are forming a *gain spiral* with reciprocal relationships, i.e., increased *PsyCap* can increase *positive emotions* can increase *engagement* which, finally, increases *PsyCap* again. However, also the opposite direction is possible leading to loss spirals (Salanova et al., 2010, p. 119). *Self-efficacy* is considered as the initiator of such gain spirals according to SCT (Salanova et al., 2010, p. 123).

The presented theories are of course not the only source for engagement on the job. For example, leadership qualities play an important role, since engagement has a contagious effect in groups (Salanova et al., 2010, p. 128). Moreover, leadership can activate positive emotions which, in turn, can support gain spirals with engagement and PsyCap (Bono, Foldes, Vinson, & Muros, 2007, p. 1357). These additional factors are, however, beyond the scope of this paper.

23.1.2 Engagement in Games

This section analyzes factors leading to engagement in games based on the classification of McGonigal (2011, p. 49) Afterwards, key characteristic are compared with the *job* and *personal resources* outlined above.

23.1.2.1 Mastery

McGonigal (2011, pp. 29–30) defines four different kinds of work that can be accomplished in games: *high-stake work* which is defined as “fast and action oriented”, *busywork* as “completely predictable and monotonous” work, *mental work* which “revs up [...] cognitive faculties”, and *physical work* which needs the full body to fulfill a particular task.

All of these types are characterized through clear goals and actionable next steps to make the work satisfying. Clear goals motivate the action itself and actionable next steps tell the user how to reach these goals immediately (McGonigal, 2011, p. 55). After a goal is completed in the game, new tasks (with increased difficulty) are necessary. An enjoyable state of satisfaction occurs in that case, because users always want to perform better for themselves by completing tasks. This process is called *mastery* by psychologists which is a “virtuous cycle of productivity” (McGonigal, 2011, p. 53). Ultimately, a feedback system is necessary in order to show how much effort is still needed to finalize the task in question. As a requirement, this feedback has to be direct, immediate, and vivid in visualization (McGonigal, 2011, p. 57).

23.1.2.2 Positive Emotions and Personal Resources

A study using an electrocardiogram to measure emotions found that participants are more positively affected when they fail in the game rather than win under the assumption that positive feedback was given after a failure. Vice versa, emotions are only negatively affected on negative feedback after a failure (Ravaja, Saari, Laarni, Kallinen, & Salminen, 2005, pp. 9–11). Failing on a real-world problem, however, leads in most cases to disappointment or stress. The researchers concluded that a gamer never fails passively but spectacularly and entertainingly and, thus, declares the failure feedback as reward (Ravaja et al., 2005, p. 11).

More importantly, positive feedback drives *hope* and *optimism* to do better on the next attempt. Vice versa, if one is too good regarding the task in question, he or she gets bored ultimately (Koster, 2004, p. 40). Thus, the fun of a game only lasts if further challenge and, consequently, hope to be more successful exists. Consequences of *optimism* are increased *attention*, *thinking*, *learning* and *success* (Seligmann, 1998, p. 69). However, giving negative feedback on failure leads to negative emotions (e.g., disappointment or stress).

23.1.2.3 Social Components

Some positive psychologists argue that the greatest source of happiness are other people or social contacts (Weiner, 2008, p. 137). Social interactions can be found in many games and may unleash so-called *prosocial* emotions, such as love, compassion, admiration, and devotion belonging to the overall group of *positive emotions*

(McGonigal, 2011, p. 82). Such *prosocial* emotions are not necessarily a consequence of good game design but a side effect of a socially enabled game.

23.1.2.4 Purpose

Researchers agree that games do not generate external value. Value is, hereby, defined as something that has importance and consequence. Doing something in a game, however, has neither real-world importance nor real-world consequence (cf. McGonigal, 2011, pp. 96–97). Nonetheless, players may derive a meaning out of their game activities because within a social context they always contribute to a larger task or problem that would be impossible to solve alone. The larger the entity is that one can attach to, the more meaning and purpose can one derive out of it (Seligmann, 1998, p. 287).

Additionally, experiencing meaning or purpose may trigger further positive emotions, e.g., *awe*. For example, when *awe* is experienced, people describe the situation as epic. According to Pearsall (2007, p. 193) it is even the most satisfying emotion that one can feel. Moreover, this emotion acts, in turn, as a motivator for doing better and may foster gain spirals with engagement.

23.2 Research Model

Based on the description above, Table 23.2 presents a comparison of factors leading to work and game engagement. We show that there is a significant intersection of factors leading to engagement in both domains.

Table 23.2 Comparison of intrinsic motivators in work and game engagement

Variable	Type	Antecedent of work engagement	Antecedent of game engagement
Hope	Personal resource	YES	YES
Optimism	Personal resource	YES	YES
Resilience	Personal resource	YES	NO
Mastery	Personal resource	YES	YES
Self-efficacy	Personal resource	YES	YES
Autonomy/control	Job resource	YES	YES
Social support	Job resource	YES	YES
Feedback	Job resource	YES	YES
Skill variety	Job resource	YES	YES
Environmental climate	Job resource	YES	YES
Positive emotions (e.g., enjoyment, awe, prosocial emotions, curiosity, enthusiasm)		YES	YES

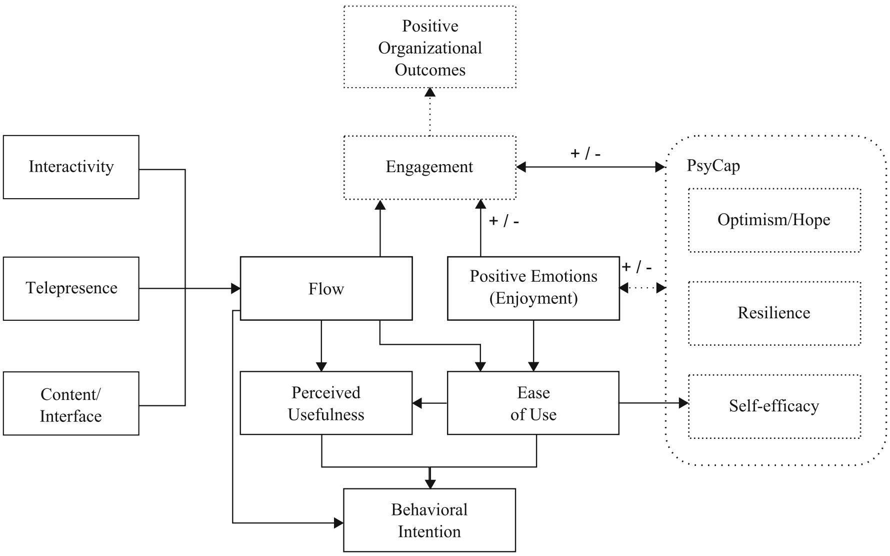


Fig. 23.2 Proposed research model for gamification

Hope, *optimism*, and *self-efficacy* as described by PsyCap can be identified in games too, e.g., through positive failure feedback or mastery processes. Therefore, it is argued that mastery as the surrounding process exists in both domains. However, *resilience* could not be identified in games, since they are played on a voluntary basis.

Furthermore, *job resources* leading to work engagement could be identified in games as well. These variables, however, are only supported, if the gamification concept includes at least one social component. Moreover, not all types of games support all job resource variables similarly. For example, *skill variety* is not given by all kinds of games (e.g., casual games).

Finally, *positive emotions* such as *enjoyment*, *compassion*, or *pride* are essential to engagement in both domains.

Since these factors seem to be equally supported in both domains, the working hypothesis is postulated that the isolation and application of game mechanics may significantly improve the engagement of employees on the job. Based on the previous work engagement theories, we propose a general framework shown in Fig. 23.2.

In this model, the JD-R model as well as the PsyCap theory are directly reflected as described in prior literature. Furthermore, the hypothesis of Salanova et al. (2010) is reflected by introducing reciprocal relationships between *positive emotions*, *engagement*, and *PsyCap* which either lead to gain or loss spirals. It is important to note that antecedents of *engagement*, i.e., job resources and demands, are omitted for better readability but have to be considered in studies as well in order to explain *engagement's* variance. Besides *positive emotions* we separated the *flow* construct from engagement in accordance with Hoffman and Novak (2009).

Besides the plain workplace theories, we also included constructs from the technology acceptance model (TAM) by Davis (1989) which roots in the theory of reasoned action (TRA) by Fishbein and Ajzen (1975). There are three reasons for this inclusion.

First, constructs such as *positive emotions* or *flow* are not only antecedents to engagement but have a positive impact on the *perceived ease of use* (PEOU) and *perceived usefulness* (PU) of technology (e.g., information systems). Since information systems are typically used to transport a gameful design, the user acceptance towards the underlying technology has to be improved as well.

Second, the JD-R and PsyCap models are difficult to measure as they require long-term studies and mature technology. The TAM, however, allows researchers to analyze usage intentions *ex ante*, i.e., even for early prototypes (Wang, 2008). Thus, it might be useful for researchers to validate their gamification approach with the TAM first to gather fast feedback using simple prototypes. If the results are promising, scholars may then conduct a longitudinal study in a larger work setting utilizing the JD-R and PsyCap constructs.

Third, improvements in TAM's constructs may have a direct influence on PsyCap. For example, *PEOU* comprises two sub-values: *efficacy* and *instrumentality*. While *efficacy* is a main factor for intrinsic motivation and may directly influence the intention to use a particular technology, *instrumentality* tends to improve performance and therefore positively affects *perceived usefulness* (Davis, Bagozzi, & Warshaw, 1989). Since *efficacy* is a key factor in PsyCap, we further argue that *PEOU* may even support one's psychological capital directly.

Table 23.3 Definition of constructs

Construct	Definition
Interface/content (IF)	"User interface and content of the system" (Choi, Kim, & Kim, 2007).
Telepresence (TP)	Presence is defined as "the natural perception of an environment" and telepresence as "mediated perception of an environment", e.g., in an computer-mediated environment (Steuer, 1992).
Interactivity (IA)	"The extent to which users can participate in modifying the form and content of a mediated environment in real time" (Steuer, 1992).
Flow (FL)	"Process of optimal experience" (Csikszentmihalyi & LeFevre, 1989) where "nothing else seems to matter" (Csikszentmihalyi, 2008) because one is engrossed or absorbed in the task.
Enjoyment (ENJ)	The extent to which "the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh & Davis, 2000).
Perceived usefulness (PU)	"The degree to which a person believes that using a particular system would enhance his or her job performance" (Davis et al., 1989).
Perceived ease of use (PEOU)	"The degree to which a person believes that using a particular system would be free of effort" (Davis et al., 1989).
Behavioral intention (BI)	"A measure of the strength of one's intention to perform a specified behavior" (Fishbein & Ajzen, 1975).

In Table 23.3 we present the definitions of all remaining constructs. The exemplary application of this model is presented in the following section based on the study of a gamified ERP application.

23.3 Application

We applied a part of the proposed research model by studying the gamification of standard sales and procuring processes using enterprise resource planning (ERP) systems as mediator. Today, these systems are pervasively used in the workplace and provide an adequate mean to study the effects of gamification towards user perception and engagement. In this section, we shortly summarize the study and its results.[1]

23.3.1 Use Case

In the study we enriched a standard ERP system through a novel ERP interface which adopts the look and feel of well-known strategy games, e.g., SimCity or Anno (Fig. 23.3). We introduced several goals (missions) and feedback mechanisms (notifications, achievements, levels) on top of business processes such as procurement, sales, or production planning. Missions, for example, comprise the processing of standard sales and purchase orders for customers or suppliers respectively.

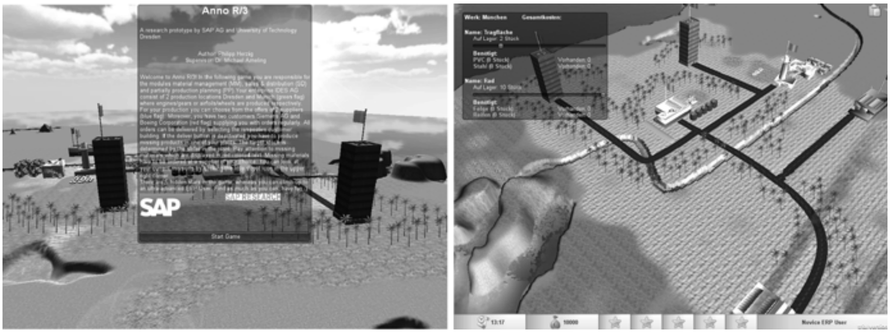


Fig. 23.3 Screenshot of gamified ERP prototype

[1] Further details can be found in Herzig, Strahringer, and Ameling (2012).

Table 23.4 Descriptive statistics of exogenous factors[a]

Variable	Mean	S.D	Median	Jarque-Bera Test
Age	25.45	5.13	24	2.2^{-16***}
Experience SAP	2.786	0.981	3	0.9307
Experience game	3.018	1.439	3	0.01429^{*}
Stars	3.786	1.436	4	0.0002488^{***}

[a]Significance levels: $^{***} < 100‰, ^{**} < 1\%, ^{*} < 5\%, ' < 10\%$

Table 23.5 Distribution of variable gender

Gender	Abs. frequency	Rel. frequency
Male	70	0.625
Female	42	0.375

Table 23.6 Correlation matrix of exogenous variables[a]

	Age	Gender	Experience ERP	Experience game	Stars
Age	1	0.007	**0.256**	**-0.202**	**-0.183**
Gender		1	0.038	**0.422**	**0.297**
Experience ERP			1	0.054	0.038
Experience games				1	**0.447**
Stars					1

[a]Correlations in boldface are significant at least against a 5 % level

After the completion of missions, users increased in level and were rewarded with one of five hidden *stars* as achievements. Some missions have to be accomplished under time constraints (e.g., plan a new production within 1 min) whereas the entire prototype ends after 15 min to allow for the comparison of results. Furthermore, the on-boarding phase was supported by gamification instructions only, i.e., the game was designed to be self-explaining and participants received no instructions before.

Based on this prototype we instructed 112 subjects to play the gamification prototype and interviewed them with regards to our model (Appendix 2). Afterwards, subjects reflected the same processes in a standard ERP system. Subsequently, we asked the same questionnaire items for the classical approach. Our questionnaire comprised standard items for each model variable from prior literature. Participants included ERP professionals, academic personnel, and novice ERP users. As shown in Table 23.4, the average respondent in the sample is 25.45 years old, has slightly more experience in games than in ERP and had achieved 3.786 out of five stars in the game prototype. Variables are not normally distributed, except *ERP* experience. Furthermore, Table 23.5 shows the distribution of the binary variable *gender*. The sample consists of 70 male and 42 female participants.

Based on these variables, significant correlations could be found, which are presented in Table 23.6. These correlations can be summarized as:

- The older the participant the lower is the experience with games (e.g., Anno) (-0.2015)
- The older the participant the higher is the experience with ERP (0.256)
- Men have higher experience in games than women (0.422)
- The higher the experience in games the more stars (achievements) are earned in the gamification prototype (0.4465)
- Men achieve more *stars* (achievements) than women (0.297).

23.3.2 Evaluation Results

Based on the questionnaire, we applied partial least squares (PLS) on the structural equation model for the traditional ERP system (Appendix 1; Fig. 23.5) and the gamification approach (Appendix 1; Fig. 23.6). Some factors (e.g., *interactivity*) were not found to be significant based on quality measure such as average variance extracted (AVE), Cronbach's α, or composite reliability (CR) (Chin, 1998; Götz, Liehr-Gobbers, & Krafft, 2010).

Based on the remaining constructs, the following observations were made: compared to standard ungamified ERP, *telepresence* is improved by 29.75 %, *interface* by 23.4 %, *flow* by 30.353 %, *enjoyment* by 53.414 %, *perceived ease of use* by 36.12 % and *usage intentions* by 12.12 %. On the other side, *perceived usefulness* decreased by -3.03 %. This fact is illustrated in Fig. 23.4.

In Table 23.7 we present factor means and standard deviations for all constructs. We observe that all mean differences are statistically significant according to *analysis of variance* (ANOVA) and *Wilcoxon-Mann-Whitney*-Test (U-Test), except *perceived usefulness* and *behavioral intention* to use the prototype.

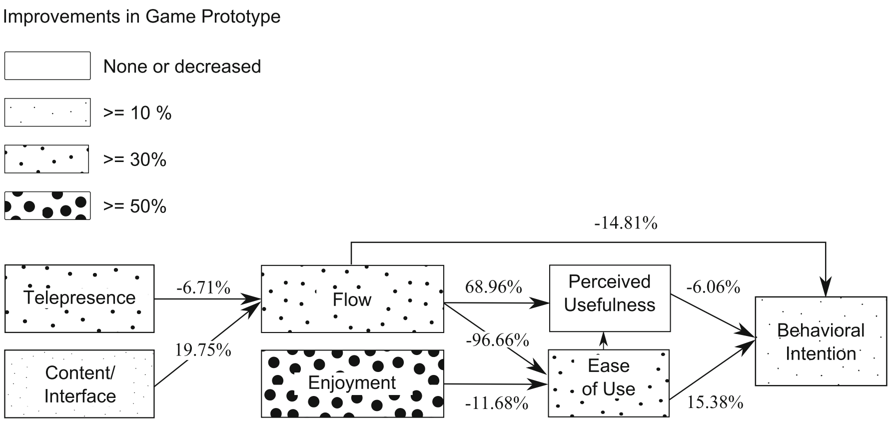


Fig. 23.4 Relative improvements in gamification prototype

Table 23.7 Mean factor comparison for all constructs

Variable	Mean	S.D.	Median	JB-Test	ANOVA	U-Test
IA$_{ERP}$	2.990	0.754	2.988	0.518	0.395	0.378
IA$_{GAME}$	3.091	0.989	3.047	0.327		
IF$_{ERP}$	**3.089**	0.878	3	0.158	1.743^{-09***}	1.831^{-10***}
IF$_{GAME}$	**3.812**	0.846	4	1.820^{-08***}		
TP$_{ERP}$	**1.946**	0.800	1.862	0.00370^{**}	3.351^{-06***}	7.815^{-06***}
TP$_{GAME}$	**2.525**	1.004	2.617	$0.0846'$		
FL$_{ERP}$	**1.924**	0.972	1.668	0.00158^{**}	1.968^{-05***}	3.207^{-05***}
FL$_{GAME}$	**2.508**	1.030	2.669	$0.0503'$		
ENJ$_{ERP}$	**2.533**	0.960	2.341	0.124	2.2^{-16***}	2.2^{-16***}
ENJ$_{GAME}$	**3.886**	0.850	4	1.381^{-08***}		
PEOU$_{ERP}$	**2.807**	0.828	2.809	0.832	2.2^{-16***}	4.441^{-16***}
PEOU$_{GAME}$	**3.821**	0.839	3.948	0.000748^{***}		
PU$_{ERP}$	3.303	0.899	3.258	0.00661^{**}	0.435	0.8299
PU$_{GAME}$	3.203	0.995	3.250	0.0373^{*}		
BI$_{ERP}$	3.408	1.108	3.670	0.0366^{*}	0.2731	0.2030
BI$_{GAME}$	3.574	1.149	4	0.00430^{**}		

Furthermore, Fig. 23.4 shows that some path weights between constructs have changed significantly, i.e., these factors explain their successors' variance more or less. For example, although *PEOU* is increased on average, *flow* and *enjoyment* explain less of PEOU's variance (between 12 and 96 %) in the gamification prototype compared to the ERP model. Therefore, we conclude the research model lacks important factors explaining the increase in PEOU further. These additional antecedents of PEOU might be derived from literature (e.g., Venkatesh and Bala, 2008).

Vice versa, *flow* has a stronger positive impact on *perceived usefulness* (68.96 %) in the gamification prototype. Nonetheless, the overall mean of PU has decreased by 3.03 %. Hence, other factors which were not observed in our study may have a strong negative effect on the prototype's usefulness. In fact, we collected further qualitative feedback from participants why they diminished *perceived usefulness*. The primary concern was that participants cannot imagine that an entire ERP system would be realized with gamification. Given that further antecedents of *perceived usefulness* are *subjective norm*, *image*, *job relevance*, *output quality* and *result demonstrability* (Venkatesh and Bala, 2008), we argue that *job relevance* and *output quality* might have the strongest negative effect on *perceived usefulness* based on the participants' qualitative feedback. This accounts for the inclusion of these additional constructs in subsequent studies.

Our results yield further that *flow* seems to have less impact on *behavioral intention*, while *perceived ease-of-use* is a stronger predictor with gamification. We conclude that the intention to use the system with gamification has not increased significantly because of two effects.

First, *perceived usefulness* is decreased. Since PU explains BI's variance twice as much (*0.462*) as PEOU (*0.286*) does (Appendix 1; Fig. 23.6), the decrease of PU (with gamification) masks the improvements of PEOU and all its antecedents.

Second, *flow*, although increased on average, has less impact on one's BI to use gamified ERP. Hence, BI does not improve linearly with the improvements in FL. We argue that both effects can be eliminated using a more mature prototype as well as a larger sample in a more realistic work setting. Nonetheless, our results are promising for future investigation of gamification on the job.

Finally, we measured age, gender, prior experience, and stars as moderators between the *PEOU-BI* and *PU-BI* relationships to observe if results differ between exogenous variables. Here, we observed the following results with gamification:

- Older participants tend to rate *perceived ease-of-use* higher (*β: 0.279, t-value: 1.867*), i.e., age moderates PEOU positively.
- Higher experience with classical ERP leads to higher *usage intentions* of gamified ERP (*β: 0.119, t-value: 1.794*).
- Subjects who earned more achievements in the gamified ERP tend to diminish *perceived ease of use* slightly (*β: 0.070, t-value: 1.693*), i.e., rewards negatively moderate PEOU.

All other variable interactions were not statistically significant, i.e., the estimated results of the model can be interpreted independently from gender, age, or prior experience with ERP and games.

23.4 Summary and Outlook

In this article, we presented factors which influence happiness and engagement on the job and compared those with factors leading to engagement in games. Based on this observation, we proposed a general research model for the investigation of workplace gamification. This research model roots in well-established prior theories such as the job demand-resource model, psychological capital, or positive emotions. Furthermore, we extended this model for conducting research with early prototypes. We demonstrated the application of the proposed model in a study with a gamified ERP prototype. We showed that the gamification approach yields improvements in factors such as *enjoyment*, *flow*, or *perceived ease of use*. However, the *behavioral intention* to use the prototype has not increased significantly because *perceived usefulness* has decreased due to the presented limitations of the study and the prototype. Hence, we propose to include further TAM antecedents in subsequent studies to explain such effects in more detail. For example, perceived usefulness could be explained by additional variables such as *output quality* or *job relevance*. Furthermore, our tested prototype is rather simple and does not qualify for usage in real work settings. Thus, the model estimation of this paper should be repeated with an improved prototype evaluated in a real work setting, preferably examined through a longitudinal study in order to confirm or reject the effects shown in this paper.

Given a broader study, we propose to include variables from the JD-R model as well since we showed that important factors such as *flow* or *enjoyment* are substantially increased by gamification. This supports the working hypothesis that gamification may increase quality on the job and improve even organizational outcomes, such as job performance or organizational commitment.

23.5 Appendix 1: Model Estimations

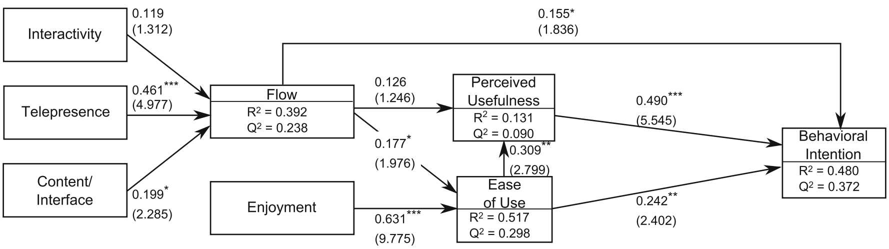


Fig. 23.5 Estimated model for classical ERP system (structural equation model)

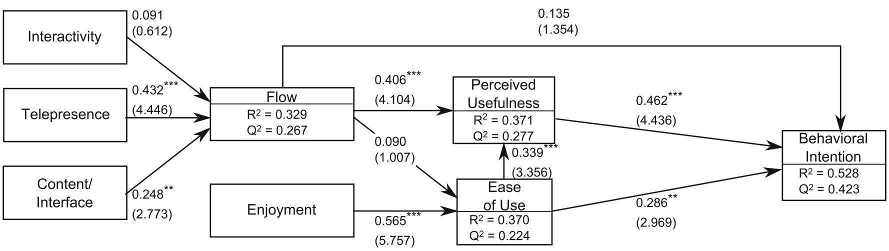


Fig. 23.6 Estimated model for gamified ERP (structural equation model)

23.6 Appendix 2: Questionnaire Items

This appendix presents the questionnaire items for each constructs of the research model. All items, except exogenous constructs, were measured on 5-point Likert scales including the levels: strongly disagree, disagree, neutral, agree, and strongly agree. (R) denotes a reverse Likert scale. The ordinal value range for moderator variables is given in $[x, y]$ notation. Since the questionnaire was used for the non-gamified and gamified ERP system, the concrete name of the solution is replaced by the letter X in the questions.

All items below can be found in the corresponding literature as defined in Table 23.3. References are, thus, omitted in the following text.

Moderators/Exogeneous Variables

- How old are you? [0,99]
- What is your gender (male/female)? [0,1]
- How would you self-assess your experience with classical ERP, e.g., SAP? [1,5]
- How would you self-assess your experience with computer games e.g., SimCity, Anno, The Settlers, or Age of Empires? [1,5]
- How many stars did you achieve in the gamification prototype? [1,5]

Interactivity

- When I use X there is very little waiting time between my actions and the computer's response.
- Interacting with X is slow and tedious. (R)
- I felt that I had the freedom to do anything in X.

Interface

- The information in X was well structured/presented.
- Navigation in X was easy for me.
- The content provided by X was easy to understand.

Telepresence

- I forget about my immediate surroundings when I use X.
- Using X often makes me forget where I am.
- After using X, I feel like I come back to the "realworld" after a journey.
- Using X creates a new world for me, and this world suddenly disappears when I stop usage.
- When I use X, I feel I am in a world created by the software.
- When I use X, my body is in the room, but my mind is inside the world created by the software.
- When I use X,the world generated by the software is more real for me than the "realworld."

Flow

The word "flow" used to describe a state of mind sometimes experienced by people who are deeply involved in some activity. One example of flow is the case where a professional athlete is playing exceptionally well and achieves a state of mind where nothing else matters but the game; he or she is completely and totally immersed in it. The experience is not exclusive to athletics: Many people report this state of mind when playing games, engaging in hobbies, or working. Activities that lead to flow completely captivate a person for some period of time. When one is in flow, time may seem to stand still, and nothing else seems to matter. "Flow" may not last for a long time on any enjoyable occasion, but it may come and go over time. Flow has been described as an intrinsically particular experience.

- Do you think you have ever experienced flow in X?
- In general, how frequently would you say you have experienced "flow" when you use the X?
- Most of the time I use X I feel that I am in flow?

Enjoyment

- I find using X to be enjoyable.
- The actual process of using X is pleasant.
- I have fun using X.

Perceived Usefulness

- Using X improves my performance in my job.
- Using X in my job increases my productivity.
- Using X enhances my effectiveness in my job.
- I find X to be useful in my job.

Perceived Ease of Use

- My interaction with X is clear and understandable.
- Interacting with X does not require a lot of my mental effort.
- I find X to be easy to use.
- I find it easy to get X to do what I want it to do.

Behavioral Intention

- Assuming I had access to X, I intend to use it.
- Given that I had access to X, I predict that I would use it.
- I would use X frequently in the future.

References

Avey, J., Wernsing, T. S., & Luthans, F. (2008). Can positive employees help positive organizational change? Impact of psychological capital and emotions on relevant attitudes and behavior. *Journal of Applied Behavioral Sciences, 44*, 48–70.

Baas, M., Dreu, C. K. W. D., & Nijstad, B. A. (2008). A meta-analysis of 25 years of mood–creativity research: Hedonic tone, activation, or regulatory focus. *Psychological Bulletin, 134*(6), 779–806.

Bakker, A. B., & Demerouti, E. (2007). The job demand-resource model: State of the art. *Journal of Managerial Psychology, 22*, 309–328.

Bakker, A. B., & Demerouti, E. (2008). Towards a model of work engagement. *Career Development International, 13*, 209–223.

Bakker, A. B., Hakanen, J. J., Demerouti, E., & Xanthopoulou, D. (2007). Job resources boost work engagement, particularly when job demands are high. *Journal of Educational Psychology, 99*, 274–284.

Bono, J. E., Foldes, H. J., Vinson, G., & Muros, J. P. (2007). Workplace emotions: The role of supervision and leadership. *Journal of Applied Psychology, 92*(5), 1357–1367.

Bowling, N. A., Eschleman, K. J., & Wang, Q. (2010). A meta-analytic examination of the relationship between job satisfaction and subjective well-being. *Journal of Occupational and Organizational Psychology, 83*, 915–934.

Brown, S. P. (1996). A meta-analysis and review of organizational research on job involvement. *Psychological Bulletin, 120*(21), 235.

Caillois, R. (2001). *Man, play and games*. Urbana, Chicago: University of Illinois Press.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research*, (pp. 295–358). Mahwah, NJ: Lawrence Erlbaum Associates.

Choi, D., Kim, H., & Kim, J. (2007). ERP training with a web-based electronic learning system: The flow theory perspective. *International Journal of Human-Computer Studies, 65*, 223–243.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety* (1st ed.). San Francisco, CA: Jossey Bass.

Csikszentmihalyi, M. (2008). *Flow: The psychology of optimal experience*. New York: Harper Perennial Modern Classics.

Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. *Journal of Personality and Social Psychology, 56*(5), 815–822.

Curhan, J. R., Elfenbein, H. A., & Kilduff, J. G. (2009). Getting off on the right foot: Subjective value versus economic value in predicting longitudinal job outcomes from job offer negotiations. *Journal of Applied Psychology, 94*, 524–534.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319–339.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resource model of burnout. *Journal of Applied Psychology, 86*, 499–512.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *MindTrek '11 Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Fisher, C. D. (2010). Happiness at work. *International Journal of Management Reviews, 12*, 384–412.

French, J. R. P., Caplan, R. D., & Van Harrison, R. (1982). *The mechanisms of job stress and strain*. New York: Wiley.

Götz, O., Liehr-Gobbers, K., & Krafft, M. (2010). Evaluation of structural equation models using the partial least squares (PLS) approach. In V. E. Vinzi, W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares* (chap. 29, pp. 691–712). Berlin, Heidelberg: Springer.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. Reading, MA: Addison-Wesley.

Hakanen, J. J., & Roodt, G. (2010). Using the job demands-resource model to predict engagement: Analysing a conceptual model. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (chap. 7, pp. 85–101). New York: Psychology Press.

Halbesleben, J. R. B. (2010). A meta-analysis of work engagement: Relationships with burnout, demands, resources and consequences. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 102–117). New York: Psychology Press.

Hallberg, U. E., & Schaufeli, W. B. (2006). "Same same" but different? Can work engagement be discriminated from job involvement and organizational commitment? *European Psychologist, 11*, 119–127.

Harter, J. K., Schmidt, F. L., & Keyes, C. L. M. (2003). Well-being in the workplace and its relationship to business outcomes: A review of the gallup studies. In C. L. M. Keyes & J. Haidt (Eds.), *Flourishing: The positive person and the good life* (chap. 9, pp. 205–224). Washington, DC: American Psychological Association.

Herzig, P., Strahringer, S., & Ameling, M. (2012). Gamification of ERP systems - Exploring gamification effects on user acceptance constructs. In *Multikonferenz Wirtschaftsinformatik* (pp. 793–804) Braunschweig.

Hoffman, D. L., & Novak, T. P. (2009). Flow online: Lessons learned and future prospects. *Journal of Interactive Marketing, 23*(1), 23–34.

Ilies, R., Scott, B. A., & Judge, T. A. (2006). The interactive effects of personal traits and experienced states on intraindividual patterns of citizenship behavior. *Academy of Management Journal, 49*(3), 561–575.

Karasek, R. A. (1979). Job demands, job decision latitude and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24*, 285–308.

Koster, R. (2004). *A theory of fun for game design*. Phoenix: Paraglyph Press.

Leiter, M. P., & Bakker, A. B. (2010). Work engagement: Introduction. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (chap. 1, pp. 1–9). New York: Psychology Press.

Locke, E. A., Cartledge, N., & Knerr, C. S. (1975). Studies of the relationship between satisfaction, goal-setting, and performance. *Organizational Behavior and Human Performance, 5*, 135–158.

Luthans, F. (2002). The need for and meaning of positive organizational behavior. *Journal of Organizational Behavior, 23*, 695–706.

Luthans, F., Youssef, C. M., & Avolio, B. J. (2007). *Psychological capital: Developing the human competitive edge*. Oxford: Oxford University Press.

Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology, 9*, 111–131.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: The Penguin Press.

Pearsall, P. (2007). *Awe: The delights and dangers of our eleventh emotion*. Deerfield Beach, FL: HCI.

Ravaja, N., Saari, T., Laarni, J., Kallinen, K., & Salminen, M. (2005). The psychophysiology of video gaming: Phasic emotional responses to game events. In D. Suzanne & J. Jennifer (Eds.), *Proceedings of DiGRA 2005 Conference: Changing Views – Worlds in Play* (pp. 1–13). University of Vancouver.

Rodríguez-Carvaja, R., Moreno-Jiménez, B., de Rivas-Hermosilla, S., Álvarez-Bejarano, A., & Vergel, A. I. S. (2010). Positive psychology at work: Mutual gains for individuals and organizations. *Revista de Psicología del Trabajo y de las Organizaciones, 26*(3), 235–253.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68–78.

Salanova, M., Schaufeli, W. B., Xanthopoulou, D., & Bakker, A. B. (2010). The gain spiral of resources and work engagement: Sustaining a positive worklife. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (chap. 9, pp. 118–131). New York: Psychology Press.

Schaufeli, W. B., & Bakker, A. B. (2010). Defining and measuring work engagement: Bringing clarity to the concept. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 10–24). New York: Psychology Press.

Seligmann, M. (1998). *Learned optimism: How to change your mind and your life*. New York: Free Press.

Sheldon, K. M., & Lyubomirsky, S. (2007). Is it possible to become happier (and if so, how?). *Social and Personality Psychology, 1*, 1–17. http://onlinelibrary.wiley.com/doi/10.1111/j.1751-9004.2007.00002.x/full

Shirom, A. (2006). Explaining vigor: On the antecedents and consequences of vigor as a positive affect at work. In C. L. Cooper & D. L. Nelson (Eds.), *Organizational behavior: Accentuating the positive at work* (pp. 86–100). Thousand Oaks, CA: Sage.

Spreitzer, G. M., Lam, C. F., & Fritz, C. (2010). Engagement and human thriving: Complementary perspectives on energy and connections to work. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 132–146). New York: Psychology Press.

Spreitzer, G. M., & Sutcliffe, K. M. (2007). Thriving in organizations. In D. L. Nelson & C. L. Cooper (Eds.), *Positive organizational behavior* (pp. 74–85). Thousand Oaks, CA: Sage.

Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of Communication, 42*(4), 73–93.

Sweetman, D., & Luthans, F. (2010). The power of positive psychology. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 54–68). New York: Psychology Press.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), 273–315.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204.

Wang, Y.-S. (2008). Assessing E-commerce systems success: A respecification and validation of the DeLone and McLean model of IS success. *Information Systems Journal, 18*, 529–557.

Weiner, E. (2008). *The geography of bliss*. New York: Twelve.

Zelenski, J., Murphy, S., & Jenkins, D. (2008). The happy-productive worker thesis revisited. *Journal of Happiness Studies, 9*(4), 521–537.

Chapter 24
The Gamification as a Resourceful Tool to Improve Work Performance

Edward T. Chen

24.1 Introduction

Wii 2, X-Box One, PS4, and handheld Nintendo DS, PSP, and Gameboy are popular gaming platforms. People are familiar with these names. We see many people, mostly children playing on these gaming devices all the time. Gamification can be simply defined as the use of games in areas that are usually considered to be a non-game environment, be it business, social or educational. Gamification is the process of applying the concepts of these various gaming tools to solve the complex and critical problems of businesses (Gronroos, 2008; Ind and Coates 2013; Lehdonvirta, 2009; Perry, 2009). If these entertainment tools mentioned above can be used to motivate the behavior of the players and influence their psychology, they can have a far reaching effect if applied outside the basic realm of entertainment (Gears, 2012; Lockton, Harrison, & Stanton, 2010, 2012; Nakajima & Lehdonvirta, 2013; Pandey & Dutta, 2013; Vassileva, 2012).

The military is often the first to recognize and act on concepts. The concept of war games predates modern warfare. Applying gaming techniques and strategies to military actions has literally shaped the world for hundreds of years. Advancements in the application of gaming techniques continue into the present day. The military acknowledges that the demographics of America's armed forces reside solidly in the age group of video game players and incorporates the gamer lifestyle into real life battle situations. The field controller for remote controlled drones is based on a popular gaming console controller. Military personnel operating remote control drones compare their daily combat assignments to playing video games (Arenas & Stricker, 2013; Cheney & Sanders, 2011; Zichermann & Cunningham, 2011).

E.T. Chen, Ph.D. (✉)
Operations and Information Systems Department, Robert J. Manning School of Business, University of Massachusetts Lowell, One University Avenue, Lowell, MA 01854, USA
e-mail: edward_chen@uml.edu

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_24

Typically gamification works by using the same underlying technology that forms the basis for the video games (King, Delfabbro, & Griffiths, 2009; Kozlov & Johansen, 2010; Lee & LaRose, 2007; Shafer, Carbonara, & Popova, 2011). Gamification, however, makes the technology more interactive, which in turn encourages users to engage in desired behaviors. It encourages the users to solve various business problems while playing games. Since video games are an effective way of grasping a user's attention, gamification ensures that the user does not deviate from the desired path and remains focused on the goal at hand. Gamification holds advantages over other problem-solving techniques by taking advantage of humans' psychological predisposition to engage in gaming (King et al., 2009; Lockton et al., 2010, 2012; Schonbrodt & Asendorpf, 2011). Gamification provides various incentives to users for doing certain tasks otherwise considered boring, thus making the boring chores as fun. After all, by nature human we want to have as much fun as possible, especially when solving problems (Anderson, 2011; Lockton, Harrison, Cain, Stanton, & Jennings, 2013; Yates & Wootton, 2012). Some examples of boring chores gamification brings to life could be those such as filling out tax forms, shopping, completing various surveys or just reading information available on websites.

Due to its potentially increasing benefits, organizations are trying to apply gamification at all levels in their business. Functional areas ranging from marketing to engage customers and to human resources to train employees are experiencing the benefits gamification brings to the table (Hoffman and Novak, 1996; Karakas & Alperen, 2012; Soonkwan & Wang, 2011; Yamabe & Nakajima, 2013). Many users consider gamification to be as unpretentious as playing games to help them complete a task they would usually avoid. But, game thinking is much more than receiving rewards for game behavior or receiving badges for skill as adopted by some companies (Raasch & von Hippel, 2013; Yamabe & Nakajima, 2013). Rather, gamification channelizes the brain to think outside the box and forces the user to remain dedicated to the issue at hand (Leadbeater, 2009).

There has been an explosion in the use of gaming techniques in the past few years. Gamification requires a thorough acceptance of the design techniques that will engage and empower the users. User acceptance remains a critical success factor with gamification (Davis, 1989, 1993; Kelley & Johnston, 2012; Montola, Stenros, & Waern, 2009; Zichermann & Cunningham, 2011). Companies can also benefit from this business technique when available data from gamified websites, applications, and processes indicate potential improvements in areas like user engagement, ROI, data quality, timeliness, or learning (Anderson, 2011; Hosack, Lim, & Vogt, 2012; Yates & Wootton, 2012).

To keep up with this emerging technology, there is an annual gamification conference called GSummit for academic researchers and IT practitioners. The GSummit Global of 2013 was held in San Francisco in April 2013. The objective of this global event is to bring together top experts to engage in game design. The GSummit is a forum where gamification techniques are explored, tested, and supported. This summit can help increase the presence of gamification in today's business world. It changes the way that education, entertainment, philanthropy, government, and customer loyalty are viewed. As the popularity and effectiveness of gamification continues to increase, more and more companies are coming to realize the benefits gamification can have for their employees as well as their business.

24.2 How Gamification Works

The gamification technology presents the user with an environment that incorporates gaming elements to specific situations or challenges they may face in real life. The level of sophistication driving the environment is based upon the task or goal to be pursued and the firm's investment constraints. In its simplest form, the application of gaming techniques can be a tally sheet used to keep score of activities ranging from ideas submitted, contacts made, or quotas achieved. Others may involve a simulated scenario with multiple features, agents, and avatars (Boellstorff, 2008; Colborne, 2010; Davis, Murphy, Owens, Kazanchi, & Zigurs, 2009; Grassian & Trueman, 2007; Partala, 2011).

More engaging and complex systems use gaming engines. The business establishes gaming rules and defines them in a gaming utility (Juul, 2005; Salen & Zimmerman, 2004). For example, a company may establish a rule that participants receive points for each sales call they make. When an employee accumulates a certain number of points, they advance to the next 'level up.' The gaming engine tracks sales calls and manages the participant's status. The engine also provides the participants with near real-time feedback on their performance and position in comparison with others (Cohen, Docksai, Tucker, & Wagner, 2012; Zichermann & Cunningham, 2011).

Acceptance of gamification solutions increases when the rewards are associated with business objectives and feedback is near real-time. Timely feedback to participants requires gaming solutions to be built on transactional systems. Each time a transaction is processed, the gaming rules are evaluated and the scoring is updated (Lowood, 2005; Raasch & von Hippel, 2013).

The manner in which feedback to the participants is provided is a function of the business information architecture. If all participants are directly connected to the company's wide-area network (WAN) and all use company issued hardware, then pushing the results and updates to participants can be handled using the internal websites. If participants are diverse, use various mobile devices, and may or may not be connected to the WAN, then use of a hosted cloud solution is preferable as such an approach leverages the connection technology managed by the service provider. In exchange for this benefit, the firm accepts a level of risk (Bajdor & Dragolea, 2011). For hosted solutions to provide participants with real-time feedback, they need access to the firm's transactional systems. Depending on the firm's business, such access may be forbidden by regulatory agencies. At a minimum, such an environment warrants close coordination with IS security groups to ensure proper firewalls and encryption strategies are invoked (Visser, Vastenburg, & Keyson, 2011).

Areas of gamification techniques can be diverse. For instance, airline pilots use a more drastic model of gamification, where a simulator presents a sensory rich environment to process learning techniques (Olstam, Lundgren, Adlers, & Matstoms, 2008). An exact replica of the cockpit of the plane, for which training is performed, is built. Each instrument, gauge, and window is either a screen or control connected to the simulator computer. Simulators, such as those used by Boeing, are mounted on complex multi-axis robotic arms. The simulator host program presents the pilot with routine and emergency situations by displaying images in 'windows' setting the values of the gauges, and controls the pitch and rotation of the robotic arm that supports the simulator. The actions taken by the pilot are evaluated by the simulator host computer which then presents the outcome of the actions by providing feedback to the pilot. This approach allows the simulator to provide a more realistic environment as the pilot feels the movement of the cockpit in response to their actions. If errors are made, they are seen as a learning opportunity where no real harm was done, users can improve their skill level in an environment without the risk of performing these actions in real-life situations.

Gamification is also used in a direct customer purchase decision situation. Companies that sell RVs offer a game-like environment where customers can sit behind the wheel and test-drive the specific make or model that they are interested in purchasing. This way, they get accustomed to the feel of driving and handling an RV. This gamification technique helps the RV companies make a sale and provides customers with ease of mind and a level of reassurance and satisfaction (Klein, 1999; Lehdonvirta, 2009).

24.3 Gamification's Technical Limitations

The technology supporting a gamification program can be as basic as a manual guiding sheet or as sophisticated as real-time elaborate solutions supported by enterprise systems (Bajdor & Dragolea, 2011). With a limited budget, there are few limits from a pure technology perspective. However, there are constraints that must be considered when implementing the gamification project (Zichermann & Cunningham, 2011).

The game strategy may rely on data that is not currently collected or available. For example, a game that awards points based upon the number of sales calls made cannot be implemented if call volume data is not available. Even if a business tracks the number of calls, it may not track the data to the individual employee. In this case, the strategy would have to shift from the individual to a level supported by the data. Perhaps the department or shift level would be more appropriate (Kelley & Johnston, 2012).

For the game to provide participants with real-time feedback, the data and supporting application must be based on transactional systems. If the game strategy is based on awarding trophies based on the total number of sales calls per month, the participants may lose interest if they do not know where they stand against the set objective throughout the month. Basing the game play on transactional systems allows for real-time or near real-time feedback to participants (Lowood, 2005).

Participants may be geographically diverse and not connected to the company network. In this case, the business may face technology constraints such as data and system access (Farhoomand & Lovelock, 2001). A gaming strategy that will include remote participants must consider the technology used to provide feedback. Most commercially available packages offer cloud-based data storage and applications that are mobile friendly (Bajdor & Dragolea, 2011; Berthon, Pitt, Cyr, & Campbell, 2008).

24.4 Gamification's Solution to Business and Technical Problems

With this fast growing burst of online mania like Web 2.0 applications and mobile connectivity options, it is harder than ever to hold a person's concentration. With all the information available at one's fingertips, there is no binding force for the customer to stay focused or even stay on a website for long enough to find out about a particular product or service. The famous English saying 'excess of everything is bad' fits perfectly into this environment. The users have plenty of tools but hardly any stimulus to use them (Lockton et al., 2010, 2012; Vassileva, 2012).

The problem stems from lack of motivation, empowerment, engagement, inspiration, collaboration, and interaction (Anderson, 2011; Deterding, 2012; Gears, 2012; Nakajima & Lehdonvirta, 2013). These are just a few of the challenges that exist in today's business and education. Researchers and practitioners are deploying gamification to fix these behavioral issues by developing techniques and tools to engage and encourage the customer, employee, student, and various audiences (Hosack et al., 2012; Lee & LaRose, 2007; Lockton et al., 2012; Vassileva, 2012). Gamification can be used to solve problems in many areas of the business. We will address the common problems in major business functions and how the gamification can be applied to solve these problems.

24.4.1 Marketing

Business Problem: In Marketing, there is an "engagement crisis." It is the phenomenon that is felt by the marketers throughout the world (van Tilburg, Francken, & da Rosa, 2014; Yang, Kang, & Johnson, 2010). There is a lack on their part to be able to keep the consumer on their website for long periods of time. Due to the explosion of various online tools, websites, and forums; the customer moves from one to the other in virtually no time at all. The marketing departments of various companies have spent enormous amounts of money to build the online tools to increase their visibility and ultimately revenue. This could all be wasted if they cannot engage the consumer long enough to even look at their products and services. Marketers need to find new ways to captivate customers so that they can be active and loyal towards their products. This engagement crisis has resulted in consumers being inactive in various programs launched by the marketing departments, thus adding to the costs with no returns. Ultimately, more than 50 % of customers are completely inactive in loyalty programs, which only further proves how essential that marketing groups have to increase active consumer participation in their companies (Nadeem, 2012; Vassileva, 2012).

How gamification can solve the problem: Marketers can use the gamification techniques to build "stickier user experiences" for their customers (Soonkwan & Wang, 2011). This means the marketers can incorporate rewarding strategies on their websites by applying the gamification tactics previously discussed. For example, Facebook offers reward points or badges (similar to gold stars) to participants who promote on their personal Facebook pages for completing activities. Also, numerous inactive loyalty programs can be revived by incentivizing the customer with rewarding their particular behaviors. Mundane tasks like providing personal information or filling out survey forms can be better achieved by developing the process into a game-like environment (Lilley, 2009; Tromp, Hekkert, & Verbeek, 2011). This can be done by adding a circle or a bar showing the percentage of completion and filling it with different colors to show the status of completion. Thus, a projector manager can better control the progress and completion time. These formats will excite some people who are usually competitive by nature and want to finish a game. Information presented this way usually proves to be very beneficial for the business, as it helps to engage users. Thus, gamification can help marketing organizations achieve their goals (Blanchard & Markus, 2004; Visser et al., 2011).

24.4.2 Community

Business Problem: There is an inability to create "brand advocates" and the failure on most companies' parts do not deliver on the promise of being able to connect the customers and all the stakeholders in one place. Most companies have not been able to share the best available practices with their customers (Kim, Choi, Qualls, & Han, 2008).

How gamification can solve the problem: The online communities could be professional, social, or various non-profit associations. Gamification can help encourage the communities to be involved by rewarding their various actions. Gamification can create an earning atmosphere, where the desired behaviors could have more points attributed to favorable goals over other undesirable behaviors (Gupta, Kim, & Shin, 2010). The reward structure can be tied to various activities, such as completing a project, posting to an article, and solving a problem. The rewards could be in the form of a special status granted to the users. LinkedIn provides these special status updates to users who frequently update their profiles (Devasagayam, Buff, Aurand, & Judson, 2010; Wu & Fang, 2010). Google provides Google Docs to allow community members to create common repository for group collaboration and idea sharing.

24.4.3 Sales

Business Problem: The biggest challenge for the sales team in this century is getting people to use the enormous amount of tools available on the company website (Cialdini, 2007). Just last year alone, corporations allocated approximately $5 billion to sales-based applications with the purpose of better enabling the sales processes to be automated. However, this purpose is defeated if the consumers for whom all the tools have been devised do not use them (Ozkaramanli & Desmet, 2012).

How gamification can solve the problem: It is important to realize that there are certain tasks that require human intervention rather than automation, such as converting leads into opportunities and closing a deal. These opportunities mark powerful inflection points in the sales process. Gamification provides sales leaders with the supple technology, flexibility, and proven frameworks required to drive valuable and engaging customer behaviors across any sales application. This in turn leads to increased revenue and ROI for the business as a whole. Gamification can entice the salespeople to use one application platform, which can break down complex tasks into various small objectives, with each objective linked to a reward depending upon the importance of the objective in the overall organizational goal. MySalesGame by Callidus Cloud is a perfect example of this feature (Lehdonvirta, 2009; Lockton et al., 2010).

24.4.4 Support

Business Problem: With the expansion of the global economy and individualized online buying behavior, support organizations are under an immense amount of pressure to serve customers promptly and efficiently. The customer support function has emerged as a specialized area in itself for businesses to provide the utmost amount of quality service to its customers (Colborne, 2010).

How gamification can solve the problem: Once again, companies can leverage the tools provided by gamification techniques to influence consumer buying behavior by educating them to use various existing support tools. The importance of support communities such as customer support, technical support, and helpdesk support has increased multifold due to the rapid growth of online tools. Through gamification, the businesses can integrate their support systems to reward behaviors that best support its customers by offering incentives to support its staff of employees, to adhere to customer quality, and to promote team spirit (Dubberly & Pangaro, 2007). Some of the examples of the support systems currently available are Zendesk, Salesforce.com's Service Cloud, and Jira.

24.4.5 Product

Business Problem: In order to support existing online tools, gadgets, and websites, thousands of applications and products have been built by product professionals. Some of these products are state-of-the-art and use enormous amounts of research and development funding. Even though these applications are popular and useful, the large price tag will only add cost to the bottom line without generating a strong return if these apps fail to engage the end-user (Forlizzi, 2008).

How gamification can solve the problem: The product teams responsible for the development of new and improved products should also have plans for the various gaming techniques like rewards, competition, and increasing challenge in the development process. Direct involvement can better enable the product teams to feature the aspects of the product that will most likely hold consumers' attention and attract them to the product. By applying gaming nature to the new product development process, the professionals can easily influence the conduct of the consumers (Crilly 2011, Forlizzi, 2008; Gronroos, 2008).

24.4.6 HR/Learning

Business Problem: An ever-increasing problem across the globe is that the workers are not engaged at work. They are not connected to the overall organizational objectives and their efforts do not support the company to achieve its goals. This translates into lost time, effort, and revenue for everyone involved. It has been estimated that the economy of the United States has lost approximately $350 billion dollars in revenue (Nevo, Nevo, & Kim, 2012). Even though training and development programs offered in most organizations add costs to the corporation's bottom line, these programs are enabled to re-engage the employees and align them with an overall business strategy. However, if these programs are not able to motivate the employees, it is all in vain (Agerfalk & Fitzgerald, 2008; Yamabe & Nakajima, 2013).

How gamification can solve the problem: HR departments can enable gaming tools to influence the attitude and manners of employees within the organization. HR teams can add layers of gaming methodologies on top of their current systems. This can lead to desired employee performances, effective talent management, successful learning and development processes, and better alignment with ultimate business strategies. HR managers can offer only those trainings that will make individual employees better at their corporate tasks by focusing on individual skill levels. This will help support employees to become an indispensable resource to the company. The gamification platform can allow HR managers to offer this incentive and aid in the overall development of the organizational workforce (Vassileva, 2012; Yates & Wootton, 2012).

24.5 The Limitations of Gamification: Problems, Implications, and Managerial Caveats

Although the concept of gamification has been around for a while, the concrete model of gamification techniques for business gains is relatively new. There are limitations involved in the gamification process that must be addressed and continuously evaluated to understand the full potential benefits of gamification.

In order to track the correct data as a business or to successfully play the game as a consumer, the gamification system shall not present any challenges stemming from confusion. Extensive training and pilot experiments must be conducted to eradicate glitches or confusing problems that could hinder the effectiveness of the virtual game (Fröding & Peterson, 2013). Both employees and gamers must be given the necessary time to learn the techniques of the game to be sure it is understandable and attractive to both audiences (O'Brien & Toms, 2010; Whitton, 2011; Yates & Wootton, 2012).

In addition, the ultimate design of the gaming system must provide meaning to the user of the game. Without meaning, a person may lose interest quickly, become frustrated, become lazy with their actions, or become extreme risk takers. If the purpose is not meaningful, fun, or attractive, players stand a great chance of misunderstanding the ultimate benefits of gaming in the first place (Klopfer, Osterweil, & Salen, 2009; Koufaris, 2002). Frustration could stem from not being able to meet the goals established by the game, which could also lead to anger or annoyance. The player may even stop playing the game once and for all. This could lead to the user transferring these emotions to his perceived image of the corporation, which may hinder the company's reputation and brand image. For companies looking to capture usable data, these side effects could skew the results in a negative way. To alleviate this risk, the game developers must keep the ultimate target audience in mind when designing the game process (Ozkaramanli & Desmet, 2012).

Virtual games can also be expensive to implement, especially if a company is looking for a high-tech, high-graphic solution (Whitton, 2012). For a small company whose funds might not be as readily available to implement a business component such as this, it can be increasingly difficult to offer customers this high-tech equipment. Sometimes, this can put organizations in a difficult position. It may mean they may lose a competitive advantage in the marketplace if a competitor can entice users with virtual games that they offer instead (Kim et al., 2008; Leedy & Ruyle, 2011).

Constant upkeep, security monitoring, and training costs can all add up drastically over the lifetime of the game. Technological issues could arise during the game's life, which must be quickly fixed and secured. Also, hardware and operating systems may need to be upgraded before a gaming system can be launched (Chen, Chiang, & Storey, 2012). This could provide a huge expense for a company. Budgeting for gamification is of utmost importance to be sure the gamification avenue is feasible for a corporation. Because safety is of utmost importance to a company's well-being, these issues should not be ignored (Vicente, 1999).

Gamification can also be costly to implement in terms of time (Chorney, 2012). Concept design, initial production, editing, trial, and ultimate publishing are processes that all take valuable energy and time to produce an effective end product. The use of personal and technological resources can be immense. As Whitton (2011) describes, it may be entirely plausible that a user spends more time learning the concepts and rules of the game than actually playing the game itself. If a company is not fully dedicated to a gamification proposal, then it might not be worth the effort to pursue such a strategy.

When gamification is implemented within a business environment, it is also important to stress that users can use gaming sources to learn, experiment, and use innovation to find new ways to solve problems. As such, it must be understood that it is encouraged for users to make mistakes while gaming, as this strategy provides a safe environment in which to learn (Whitton, 2012). Those that ignore this fact will not benefit from the opportunities gaming offers them, which could be a major drawback of gamification in and of itself.

If the gaming strategy is built around teams, it may be difficult to monitor the individual performance of the participants. However, experiments have shown that participants involved in cooperative teams were more motivated and put forth more effort than those who played as individuals. As the game is designed, a firm must consider if a competitive or cooperative approach is more likely to meet the objective as well as the impact the results can have on morale (Klopfer et al., 2009; Peng & Hsieh, 2012). In some high pressure situations, a competitive approach may even result in hostility between the participants. Therefore, when working on a game system to learn from business situations within a company, coworkers who have different backgrounds, lifestyles, personalities, and cultural values may clash over their ability to complete the game successfully (O'Grady 2012; Zichermann & Cunningham, 2011).

Lastly, in order for gamification to be truly successful in a wide range of uses, developers must learn to "evolve past the hype" it offers and learn to implement common technologies into their particular business model. Instead of falling prey to thinking limitations, creativity could be the ultimate source of gamification's success (Raasch & von Hippel, 2013).

24.6 Assessment of Gamification's Success

Generation Y makes up 25 % of today's workforce and will continue to grow. This is a generation of digital natives who live online. They were raised on computers, spending non-school hours playing video games. They rely extensively on technology to communicate and interact with each other. They have a propensity to text each other instead of calling. Even dating is frequently the result of initial online encounters. This generation expects real-time feedback, both in their standings as well as in how they compare to others. They expect to have clear goals constructed in a manner that allows achievement based on a series of small, progressive wins. They value token awards such as badges, trophies, or achievements. This generation expects to be introduced to the role they perform through coaching rather than by reading manuals. The formation of teams satisfies a social need of individuals and also serves as a motivational opportunity as individuals do not want to let the team down (Meier & Crocker, 2010).

Karakas and Alperen (2012) indicate households playing games use either computers (98 %) or game consoles (64 %). The wide-spread of these two common game devices makes it relatively easy for any member of the family to become familiar with gaming technology. Although 43 % of adults 51 and over consider themselves to be gamers (Karakas & Alperen, 2012), it is important to consider those who do not embrace the video gaming or digital culture. Gamification is truly a way for companies to access a large array of users and connect with them on a personal basis (Cohen et al., 2012).

Gamification provides a fun, enjoyable experience that creates ways to solve real-world problems in similar-to-life settings. Due to the compelling nature of such a system, gamification is likely to continue increasing in popularity with companies and consumers all over the world. We are already seeing many applications of this gaming system, whether it be with Foursquare for mobile phones or a running campaign for Nike Shoes (Leedy & Ruyle, 2011). Gamification can take many forms and can adapt the technological skills to any business or game setting imaginable. Due to its increasingly diversified applications, gamification has the ability to affect consumers of all ages, of all nations, and of all backgrounds. When combined with a disciplined and secure IT program, gamification has no boundaries.

McGonigal (2011) argues that people shall play more games and not less. We shall use them to enhance quality of life and solve the world's problems collaboratively. In one of her games called "World without Oil". She requires the gamers to imagine they are on a planet that has no oil and need to figure out how to survive. The players work together by helping each other develop strategies. McGonigal is one of the first researchers to ask the question of what games can offer society. The combination of crowdsourcing and multi-role gaming has clearly taken hold and shown business and community value (Gronroos, 2008; Hagel & Armstrong, 1996). With the popularity of social media, an increased ability to invoke large numbers of users to work on projects has become possible. We will see an increase in this form of volunteerism as innovations are made in user engagement and gamely activities (Vassileva, 2012; Wu & Fang, 2010).

24.7 Conclusion

The concept of gamification is based on the common sense that individuals would rather play than work. Many theories suggest that the brain functions differently when an individual is engaged in play than when focused on the mundane.

Physiological differences are observed and reported. The mind is more attuned to receiving information and processes stimuli much faster in a gaming environment. Often instinctive reactions, such as fight or flight, are brought to the surface during game play. Psychologists and training consultants seek to leverage these changes to the benefit of the work environment.

Based on the potential gamification presented to companies and users, it seems that the trend will grow rapidly and prove to be a success in the years to come. Gaming appeals to many people in the world and can make it easier to connect to companies, role play, innovative thinking, and problem solving. Young adults, such as those included in Generation X and Generation Y, are more technologically-savvy, which is why gaming appeals to them on both a personal and a community level. Thus, we shall focus on the design, development, and deployment of work productivity like games. Games will be an integral component of the workplace in the future. Not only because it has been reported as a valuable tool to drive engagement, but also because we have one of the strongest gamer generations entering the workforce. Gamification and gaming mechanics can be used in the workplace to enhance work performance.

Using games to help with the learning process has been around for a very long time. Whether it was a karaoke game to remember a song, competing in a spelling contest, or using more complex games like Monopoly to teach about money, games have been used to make learning more enjoyable and to increase the retention rate of information. The addition of gaming mechanics to non-game environments requires further study. The information and examples presented in this chapter clearly illustrate that it can enhance a user's desire for competition, cooperation, and accomplishment. Gamification can also raise a user's status, which will ultimately increase sales, improve customer loyalty, build community of interest, accelerate research, and foster learning. All of which are very positive outcomes that can help a broad cross section of organizations – both public and private. Opponents speculate that gamification might also be used to steer behavior in a negative manner. Some even warn it can take the form of invisible and insidious behavioral manipulation. However, tech stakeholders and analysts generally believe the use of game mechanics, feedback loops, and rewards will become more embedded in daily life. Companies and government agencies are moving to implement more game elements in networked communications to support businesses, education, health, and training.

This chapter outlines the growth of gamification in marketing, community, sales, support, product, and HR/learning. It covers recent research in gamification and provides the implications and future direction of gamification. The impact of increased gamification and the results that businesses, researchers and employers are deriving from its use are discussed. Business cases presented in this chapter have demonstrated how gamification can be used to drive sales, enhance learning, and improve user engagement when combined with crowdsourcing. Some researchers argue that gamification will continue to grow as new discoveries and new techniques are developed to support its effect (Anderson, 2011; Deterding, 2012; Klopfer et al., 2009; Peng & Hsieh, 2012; Zichermann & Cunningham, 2011).

Others suggest that it could reach a point of saturation where it may be used to promote negative behaviors and become no longer relevant for businesses (Nevo et al., 2012; Tromp et al., 2011; Whitton, 2011; Yamabe & Nakajima, 2013). As a caveat of applying any innovative technology, organizations need to design and deploy gamification in alignment with their business strategy. All in all, we do expect to see it grow in a positive and productive direction.

References

Agerfalk, P. J., & Fitzgerald, B. (2008). Outsourcing to an unknown workforce: Exploring open-sourcing as a global sourcing strategy. *MIS Quarterly, 32*(2), 385–409.

Anderson, S. P. (2011). *Seductive interaction design: Creating playful, fun and effective user experiences*. Berkeley, CA: New Riders.

Arenas, F., & Stricker, A. (2013). Gamification strategies for developing Air Force officers. *Learning Solutions Magazine*. Retrieved February 10, 2014, from http://www.learningsolutionsmag.com/articles/1190/gamification-strategies-for-developing-air-force-officers

Bajdor, P., & Dragolea, L. (2011). The gamification as a tool to improve risk management in the enterprise. *Annales Universitatis Apulensis Series Oeconomica, 13*(2), 574–583.

Berthon, P., Pitt, L., Cyr, D., & Campbell, C. (2008). E-readiness and trust: Macro and micro dualities for e-commerce in a global environment. *International Marketing Review, 25*(6), 700–714. doi:10.1108/02651330810915592.

Blanchard, A., & Markus, M. (2004). The experienced 'sense' of a virtual community: Characteristics and processes. *The Data Base for Advances in Information Systems, 35*(1), 65–71.

Boellstorff, T. (2008). *Coming of age in Second Life: An anthropologist explores the virtually human*. Princeton, NJ: Princeton University Press.

Chen, H., Chiang, R., & Storey, V. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly, 36*(4), 1165–1188.

Cheney, A., & Sanders, R. L. (2011). *Teaching and learning in 3D immersive worlds: Pedagogical models and constructivist approaches*. Hershey, PA: Information Science Reference.

Chorney, A. (2012). Taking the game out of gamification. *Dalhousie Journal of Interdisciplinary Management, 8*(1), 1–14.

Cialdini, R. B. (2007). *Influence: The psychology of persuasion* (Rev. Ed.). New York: Collins.

Cohen, A. M., Docksai, R., Tucker, P., & Wagner, C. (2012). The best predictions of 2011. *The Futurist, 46*(1), 28–39.

Colborne, G. (2010). *Simple and usable: Web, mobile and interaction design*. Berkeley, CA: New Riders.

Crilly, N. (2011). Do users know what designers are up to? Product experience and the inference of persuasive intentions. *International Journal of Design, 5*(3), 1–15.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–339. doi:10.2307/249008.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*(3), 475–487. doi:10.1006/imms.1993.1022.

Davis, A., Murphy, J., Owens, D., Kazanchi, D., & Zigurs, I. (2009). Avatars, people and virtual worlds: Foundations for research in metaverses. *Journal of the Association for Information Systems, 10*(20), 90–117.

Deterding, S. (2012). Gamification: Designing for motivation. *Interactions, 19*(4), 14–17.

Devasagayam, P. R., Buff, C. L., Aurand, T. W., & Judson, K. M. (2010). Building brand community membership within organizations: A viable internal branding alternative? *The Journal of Product and Brand Management, 19*(3), 210–217.

Dubberly, H., & Pangaro, P. (2007). Cybernetics and service-craft: Language for behavior-focused design. *Kybernetes, 36*(9), 1301–1317.
Farhoomand, A., & Lovelock, P. (2001). *Global eCommerce*. Singapore: Prentice Hall.
Forlizzi, J. (2008). The product ecology: Understanding social product use and supporting design culture. *International Journal of Design, 2*(1), 11–20.
Fröding, B., & Peterson, M. (2013). Why computer games can be essential for human flourishing. *Journal of Information, Communication and Ethics in Society, 11*(2), 81–91.
Gears, D. A. (2012). Corporate Wiki conduct: A study of organizational influences, emotion, and motivation. *Journal of Leadership, Accountability and Ethics, 9*(3), 75–85.
Grassian, E., & Trueman, R. (2007). Stumbling, bumbling, teleporting and flying. Librarian avatars in Second Life. *Reference Services Review, 35*(1), 84–89. doi:10.1108/00907320710729373.
Gronroos, C. (2008). Service logic revisited: Who creates value? And who co-creates. *European Business Review, 20*(4), 298–314. doi:10.1108/09555340810886585.
Gupta, S., Kim, H., & Shin, S. (2010). Converting virtual community members into online buyers. *Cyberpsychology. Behavior and Social Networking, 13*(5), 513–520. doi:10.1089/cyber.2009.0202.
Hagel, J., & Armstrong, A. G. (1996). The real value of on-line communities. *Harvard Business Review, 74*(3), 134–141.
Hoffman, D., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: conceptual foundations. *Journal of Marketing, 60*, 50–58. doi:10.2307/1251841.
Hosack, B., Lim, B., & Vogt, W. P. (2012). Increasing student performance through the use of Web services in introductory programming classrooms: results from a series of quasi-experiments. *Journal of Information Systems Education, 23*(4), 373–383.
Ind, N., & Coates, N. (2013). The meanings of co-creation. *European Business Review, 25*(1), 86–95.
Juul, J. (2005). *Half-real: Video games between real rules and fictional worlds*. Cambridge, MA: MIT Press.
Karakas, F., & Alperen, M. (2012). Reorienting self-directed learning for the creative digital era. *European Journal of Training and Development, 36*(7), 712–731.
Kelley, T. M., & Johnston, E. (2012). Discovering the appropriate role of serious games in the design of open governance platforms. *Public Administration Quarterly, 36*(4), 504–554.
Kim, J. W., Choi, J., Qualls, W., & Han, K. (2008). It takes a marketplace community to raise brand commitment: The role of online communities. *Journal of Marketing Management, 24*(3–4), 409–431. doi:10.1362/026725708X306167.
King, D. L., Delfabbro, P. H., & Griffiths, M. D. (2009). Video game structural characteristics: A new psychological taxonomy. *International Journal of Mental Health and Addiction, 8*(1), 90–106. doi:10.1007/s11469009-9206-4.
Klein, G. A. (1999). *Sources of power: How people make decisions*. Cambridge, MA: MIT Press.
Klopfer, E., Osterweil, S., & Salen, K. (2009). *Moving learning games forward: Obstacles, opportunities and openness, the education arcade*. Cambridge, MA: MIT Press.
Koufaris, M. (2002). Applying the technology acceptance model and flow theory to online consumer behavior. *Information Systems Research, 13*(2), 205–223.
Kozlov, M. D., & Johansen, M. K. (2010). Real behavior in virtual environments: Psychology experiments in a simple virtual-reality paradigm using video games. *Cyberpsychology, Behavior and Social Networking, 13*(6), 711–714. doi:10.1089/cyber.2009.0310.
Leadbeater, C. (2009). *We-think*. London: Profile Books.
Lee, D., & LaRose, R. (2007). A socio-cognitive model of video game usage. *Journal of Broadcasting & Electronic Media, 51*(4), 632–650. doi:10.1080/08838150701626511.
Leedy, E., & Ruyle, E. (2011). *Game mechanics in market research*. Livonia, MI: Market Strategies International.
Lehdonvirta, V. (2009). Virtual item sales as a revenue model: Identifying attributes that drive purchase decisions. *Electronic Commerce Research, 9*(1–2), 97–113. doi:10.1007/s10660-009-9028-2.
Lilley, D. (2009). Design for sustainable behavior: Strategies and perceptions. *Design Studies, 30*(6), 704–720.

Lockton, D., Harrison, D. J., Cain, R., Stanton, N. A., & Jennings, P. (2013). Exploring problem-framing through behavioral heuristics. *International Journal of Design, 7*(1), 37–53.
Lockton, D., Harrison, D., & Stanton, N. (2010). The design with intent method: A design tool for influencing user behavior. *Applied Ergonomics, 41*(3), 382–392.
Lockton, D., Harrison, D., & Stanton, N. (2012). Models of the user: Designers' perspectives on influencing sustainable behavior. *Journal of Design Research, 10*(1/2), 7–27.
Lowood, H. (2005). Real-time performance: Machinima and games studies. *International Digital Media and Arts Journal, 2*(1), 10–17.
McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin Press.
Meier, J., & Crocker, M. (2010). Generation Y in the workforce: Managerial challenges. *Journal of Human Resource and Adult Learning, 6*(1), 68–78.
Montola, M., Stenros, J., & Waern, A. (2009). *Pervasive games: Theory and design*. San Francisco: Morgan Kaufmann.
Nadeem, M. (2012). Social customer relationship management (SCRM): How connecting social analytics to business analytics enhances customer care and loyalty? *International Journal of Business and Social Science, 3*(21), 88–102.
Nakajima, T., & Lehdonvirta, V. (2013). Designing motivation using persuasive ambient mirrors. *Personal and Ubiquitous Computing, 17*(1), 107–129.
Nevo, S., Nevo, D., & Kim, H. (2012). From recreational applications to workplace technologies: An empirical study of cross-context IS continuance in the case of virtual worlds. *Journal of Information Technology, 27*(1), 74–86.
O'Brien, H. L., & Toms, E. G. (2010). The development and evaluation of a survey to measure user engagement in e-commerce environments. *Journal of the American Society for Information Science and Technology, 61*(1), 50–69.
O'Grady, P. (2012). Marketers turn to 'gamification' to encourage online interaction. *The Phoenix Business Journal*. Retrieved June 3, 2013, from http://www.bizjournals.com/phoenix/print-edition/2012/06/15/marketers-turn-to-gamification-to.html?page=all.
Olstam, J., Lundgren, J., Adlers, M., & Matstoms, P. (2008). A framework for simulation of surrounding vehicles in driving simulators. *ACM Transactions on Modeling and Computer Simulation, 18*(3), 1–24.
Ozkaramanli, D., & Desmet, P. (2012). I knew I shouldn't, yet I did it again! Emotion-driven design as a means to subjective well-being. *International Journal of Design, 6*(1), 27–39.
Pandey, S. C., & Dutta, A. (2013). Role of knowledge infrastructure capabilities in knowledge management. *Journal of Knowledge Management, 17*(3), 435–453.
Partala, T. (2011). Psychological needs and virtual worlds: Case Second Life. *International Journal of Human-Computer Studies, 69*(12), 787–800. doi:10.1016/j.ijhcs.2011.07.004.
Peng, W., & Hsieh, G. (2012). The influence of competition, cooperation, and player relationship in a motor performance centered computer game. *Computers in Human Behavior, 28*(6), 2100–2106.
Perry, D. (2009). How video games can sweep in the cash. *Business Week*. Retrieved September 22, 2012, from http://images.businessweek.com.libproxy.uml.edu/ss/08/08/0815_make_money_from_games/1.htm
Raasch, C., & von Hippel, E. (2013). Innovation process benefits: The journey as reward. *MIT Sloan Management Review, 55*(1), 33–39.
Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.
Schonbrodt, F. D., & Asendorpf, J. B. (2011). Virtual social environments as a tool for psychological assessment: Dynamics of interaction with a virtual spouse. *Psychological Assessment, 23*(1), 7–17. doi:10.1037/a0021049.
Shafer, D. M., Carbonara, C. P., & Popova, L. (2011). Spatial presence and perceived reality as predictors of motion-based video game enjoyment. *Presence, 20*(6), 591–619. doi:10.1162/PRES_a_00084.

Soonkwan, H., & Wang, Y. J. (2011). Invested loyalty: The impact of ubiquitous technology on the current loyalty paradigm and the potential revolution. *Journal of Strategic Marketing, 19*(2), 187–204. doi:10.1080/0965254X.2011.557742.

Tromp, N., Hekkert, P., & Verbeek, P. P. (2011). Design for socially responsible behavior: A classification of influence based on intended user experience. *Design Issues, 27*(3), 3–19.

van Tilburg, R., Francken, M., & da Rosa, A. (2014). *Managing the transition to a sustainable enterprise: Lessons from frontrunner companies*. New York: Routledge.

Vassileva, J. (2012). Motivating participation in social computing applications: A user modeling perspective. *User Modeling and User-Adapted Interaction, 22*(1/2), 177–201.

Vicente, K. J. (1999). *Cognitive work analysis: Toward safe, productive, and healthy computer-based work*. Boca Raton, FL: CRC Press.

Visser, T., Vastenburg, M. H., & Keyson, D. V. (2011). Designing to support social connectedness: The case of SnowGlobe. *International Journal of Design, 5*(3), 129–142.

Whitton, N. (2011). Game engagement theory and adult learning. *Simulation & Gaming, 42*(5), 597–610.

Whitton, N. (2012). The place of game-based learning in an age of austerity. *European Journal of E-Learning, 10*(2), 249–256.

Wu, S., & Fang, W. (2010). The effect of consumer-to-consumer interactions on idea generation in virtual brand community relationships. *Technovation, 30*(11), 570–581. doi:10.1016/j.technovation.2010.07.005.

Yamabe, T., & Nakajima, T. (2013). Playful training with augmented reality games: Case studies towards reality-oriented system design. *Multimedia Tools and Applications, 62*(1), 259–286.

Yang, S. U., Kang, M., & Johnson, P. (2010). Effects of narratives, openness to dialogic communication, and credibility on engagement in crisis communication through organizational blogs. *Communication Research, 37*(4), 473–497. doi:10.1177/0093650210362682.

Yates, K., & Wootton, A. (2012). Engaging employees in their benefits through fun and games. *Benefits Magazine, 49*(5), 22–26.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media, Inc.

Chapter 25
Gamification in the Enterprise: Differences from Consumer Market, Implications, and a Method to Manage Them

Basanth Kumar Neeli

25.1 Introduction

Gamification is gaining traction in the consumer market to influence and engage users to take actions towards the goals of the consumer and/or the provider. "Gamification" is an informal umbrella term for the use of game elements in non-gaming systems to improve user experience (UX) and user engagement (Deterding, Dixon, Khaled, & Nacke, 2011). Though the concept is not new, (for example, airlines have successfully used loyalty programs like frequent flier programs), the market has taken a new interest in this area. The hype and the buzz have initiated multiple studies and analyses from the research community. The market, too, has responded with multiple tools, many of which propose turnkey solutions. The term "Gamification", which was just a blip in 2010, today returns millions of matches on search engines.

Deterding, Dixon, Nacke, O'Hara, and Sicart (2011) defines Gamification as "the use (rather than the extension) of

- Game design (rather than game-based technology or other game related practices);
- Elements (rather than full-fledged games);
- Characteristics for games (rather than play or playfulness);

in non-game contexts (regardless of specific usage intentions, contexts, or media of implementation)."

Following the successful application of gamification in the consumer markets, enterprise markets are experimenting with the concept to increase engagement

B.K. Neeli (✉)
Sail Emsoft Private Limited, 402, Himalaya 1, Jayabharathi Gardens, Y Junction, Kukatpally, Hyderabad, Telengana 500018, India
e-mail: neeli.basanth@gmail.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_25

levels of employees, customers, and partners, who will, hereafter, be referred to as users. Though the definition by Deterding is apt in the domain of consumer markets, for application in enterprise domain, we feel it misses the specificity in terms of the purpose, outcomes, and the process. The goals of gamification in consumer markets are very diverse and the proposed definition acts as a generalized and objective view of the concept. However, for gamification in the context of an enterprise for engaging users, there is a need to be specific about the purpose, the results expected, and the process of gamification. We propose the following definition for gamification in the enterprise:

> Gamification in the enterprise is the use of game design elements to engage, motivate, and persuade employees, customers, and partners on work and initiatives of the enterprise, to develop positive attitudes, personal and professional achievements, and productive behaviors.

This definition augments the definition by Deterding and adds the purpose (to engage, motivate, and persuade), participants (employees, customers, partners), and outcomes (develop positive attitudes, personal and professional achievements and productive behaviors). We believe that such a specific definition allows proper use of gamification and also highlights the expectations and benefits.

Current state-of-market in gamification is heavily focused on a limited number of game design elements, such as leader-boards, statuses, etc. An excessive focus on these elements jeopardizes the success of gamification initiatives specifically in the enterprise. In fact, research firm Gartner (Gartner, 2013) predicts that 80 % of gamification initiatives in the enterprise would ultimately fail. Gartner highlights that poor design is the main reason for these failures. A poor design could be the result of employing design principles suited for consumer markets and missing long term view and objectives for the gamification exercise. Gamification in the enterprise requires analysis on multiple aspects like motivations, reasons for engagement, impact of failure, etc.

Gamification in the enterprise is not simply looking at areas where users can be rewarded with badges or by setting up leader-boards. This chapter argues that gamification, specifically in the context of enterprises, needs to understand the challenges and motivations of the users and does not stay limited to awarding points and badges. To lay a basis for discussion in this chapter, we present the notion of games and why people play games. The concept of games play a crucial role in gamification as the underlying foundation for gamification is that players are engaged with games and thus, gamified environments engage users.

25.1.1 The Notion of Games

Games have been extensively researched and Charsky (2010) presents the results on the characteristics of games. These characteristics create an environment which makes players play the game.

- **Competition** and goals which involve one player competing against another, against the virtual opponent, or against the time;
- **Rules** are constraints that limit the actions a gamer can and cannot take;
- **Choices** are the options and decisions a gamer has before and during gameplay, including expressive, strategic, and tactical approaches;
- **Challenges** are the game's tasks and activities;
- **Fantasy** could be either exogenous (without any intrinsic connection between game and learning), or endogenous;
- **Fidelity** is the representation of reality through the use of graphics, audio, video, and three-dimensional virtual worlds;
- **Context** determines the setting, narrative, story, scenario, characters, back story, problem, and so on, for the gameplay;
- **Feedback** provides the immediate response on the actions of the player;
- **Paradox of control** on all aspects of the game world creates a sense of autonomy;
- The **transformation of time** where in the player loses the sense of time while playing the game.

The research highlights that games engage users because they employ the above characteristics in a way meaningful for the players. In addition to these characteristics of games, research has been done to understand the player perspective of the game. From the perspective of players, studies have been done to understand the reasons why people are motivated to play; one of the best known works in this area is the study by Bartle (1996). Bartle presents four categories for players and their motivations. The categories are:

- **Achievers** who are driven by in-game goals, usually consisting of some form of accumulation e.g., experience points, levels, or virtual money;
- **Explorers** who are driven to find out as much as they can about the game and understanding the game mechanics;
- **Socializers** use the game to interact and work with their fellow gamers;
- **Killers** use the game to cause distress to other players and gain satisfaction.

Based on this approach, Yee (2007) presented a motivational model based on three components:

- The **achievement** component relates the desire to gain points, progress through levels, optimize performance, challenge and compete with others.
- The **social** component relates to motivational needs like working and developing meaningful relationships with others and deriving satisfaction and benefit from being part of a team; and
- The **immersion** component relates to exploring new areas of interest and getting involved in the activity.

Each of the player personalities interact and get engaged with the game differently. For example, achievers might like to show off their skills by using challenges involving defeating others, whereas explorers might like challenges involving understanding and exploring the concepts or understanding the game world.

The above studies on games suggest that games do not engage users because of points, status, and leader-boards. Instead, players are engaged because of correct usage of the characteristics, an understanding of the personalities, and the corresponding motivations and challenges. Players look for a sense of achievement, an opportunity to interact with others players, and are keen on getting involved in the narrative or the mechanics of the game. Gamification initiatives should be able to leverage on this learning to provide an engaging experience for the users.

25.1.2 Game Mechanics

Game mechanics (Game Mechanics, 2012) are rules and dynamics of the game intended to make the play/work enjoyable. For example, points are a game mechanic that can be used to reward some action of the user.

As the definition says, gamification works with elements of game design rather than full-fledged games. Game mechanics also help in building a narrative to keep users curious and make them look forward for the gamified environment to evolve as they get involved with activities. Game mechanics with a narrative provides a means of social interaction, a sense of achievement, and a feeling of being a part of the gamified environment.

25.1.3 Levels of Gamification

In the context of an enterprise, gamification can be implemented at various levels with respect to integration of game mechanics with the underlying activities being performed. The different levels of gamification are presented below:

- At a **superficial** level, the game mechanics are used independent of activity being performed; for example, ten points for every activity undertaken.
- At an **integrated** level, the game mechanics are integrated into the activity being performed; for example, points are provided based on the progress, quality of work; etc.
- At the deepest level, **embedded**, the activity is designed based on the mechanics; for example, an activity is divided into multiple sub-tasks, each providing a stage in a quest (Fig. 25.1).

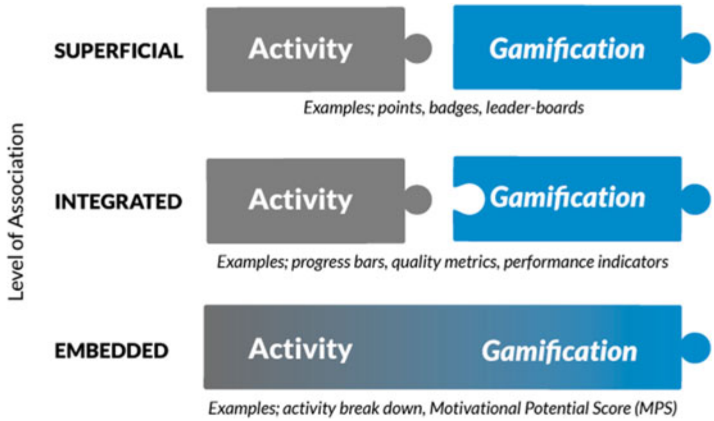


Fig. 25.1 Levels of gamification in enterprise

25.1.4 Areas of Application in Consumer and Enterprise Markets

Gamification has been used in multiple domains. The following are a few examples in the consumer domain:

- Health care—Health Month, Nike+
- Finance—mint.com
- Education—Khan Academy, StackOverflow
- Insurance—MindBloom

In the context of enterprises, some experiments have been implemented in the areas like Customer Relationship Management (CRM), education and training, innovation, project management, sustainability, Enterprise Risk Management, software development, task management, etc.

The following websites capture the updates and latest information on Gamification:

- http://enterprise-gamification.com/
- http://meta.gamify.com/
- http://gamification.org/

25.1.5 Why Gamification in the Enterprise is Different to Consumer-Focused Gamification?

As can be seen from the examples and the definition, it is clear that the possibilities of Gamification in the enterprise and consumer markets vary to some levels. For example, in the consumer markets, the rewards play a central role either for incentives or social status, but in the enterprise markets, the rewards could introduce a conflict of interest with the remunerations and pay packages. Thus, the freedom of design of reward structure in gamification for the enterprise is limited. Similarly, there are multiple aspects on which gamification differs in these two domains. For employing gamification in the enterprise, there is a need to understand these differences, their implications, and the process of analysis and implementation as against the gamification in the context of consumer markets.

This chapter provides a discussion on the differences and presents a framework to implement Gamification in the enterprise. Though the framework is generic and applicable in consumer markets as well, in this chapter we provide analyses in the context of an enterprise.

25.1.6 Next Sections

To keep the focus on gamification, the chapter does not discuss the executive, managerial, and other organizational support which is very important for the success of any initiative in the enterprise, including gamification. It should be highlighted here that the executive and organizational support is critical for the success and this is more so in the context of enterprise.

The next section presents the differences between gamification in consumer and enterprise markets, followed by a discussion highlighting the implications of the differences. Next, we present a brief overview of various extensively studies theories in the context of motivation, persuasion, and engagement, followed by the description of the proposed framework and various steps involved in the framework. Following which, we will present high level case studies highlighting the differences and how the proposed framework can help in implementing sustainable gamification.

25.2 Differentiating Gamification in the Consumer and Enterprise Market

As highlighted in the introduction, gamification in consumer and enterprise markets require different approaches. Though the mechanism and thought process used could be similar for both markets, we argue that they cannot be the same. This is not to say that the practice and case studies in consumer markets are not relevant to the enterprise, but it should be noted that the analysis and design need to be different.

The following table represents differences between gamification in consumer and enterprise markets highlighting the implications in the context of an enterprise (Table 25.1):

Table 25.1 Differences between consumer and enterprise markets

	Gamification in consumer market	Gamification in the enterprise	Implications
Purpose	Engage a targeted group of audience to respond to a call for action; for example, adopt a healthy lifestyle for people in urban areas	Engage all users in enterprise initiatives and develop positive and productive attitudes and behaviors towards work related tasks, and improve productivity in the long term	Player personalities play a crucial role as different mechanics engage different users in a different way. The mechanics and design should be geared to achieve short term (specific gamification objectives) and long term enterprise objectives
Reason for engagement	The players opt to "play" to achieve "their goals" and the environment needs to engage them. The users are already motivated as they see the set goals as their own	The users need to be persuaded to play and also they need to be engaged and motivated	Persuasive methods and behavior modeling aspects need to be designed within and outside of gamified environment. The goals of the enterprise need to be aligned in the context of goals and development aspirations of the users. Also as engagement of users tends to decline with time, boosting mechanisms need to be designed
Design of gamified environment	Designed for specific audience with focus on user experience. Players can be provided with greater control and autonomy as they perceive "their goals". For additional thrill, game rules can be exploratory and could be discovered as the users play	Designed for varied audience, with limited control and autonomy suiting the organizational objectives. Transparency on the rule of the game is a must for acceptance	The levels of engagement and motivation could be reduced because of lack of control and autonomy and thus need to be augmented by other design aspects, like progression towards career goals, personal development plans, etc.
		Mechanics like challenges could introduce friction in working relationships of the users	The design should cater to enabling cooperation rather than competition in designing challenges
Creative freedom	Innovation in creativity and graphics is unbounded. The focus is on engagement	Corporate brand, ethics, and positioning limits the usage of graphics and the possible narratives	The creativity and innovation should focus beyond graphics and it is possible that the jobs (work activities) are redesigned to suit gamification
	The design options to use fantasy elements, graphics, narratives, etc., are relatively unbounded		

(continued)

Table 25.1 (continued)

	Gamification in consumer market	Gamification in the enterprise	Implications
Motivation factors	Can use extrinsic motivation and fun for instant gratification	Need for focus on learning and progression towards career goals. There is a need to internalize the motivation factors	Research has concluded that extrinsic motivations are not sustainable. The design should cater to instant gratification for immediate acceptance and also long term growth and productive/positive behaviors. The design should move users from extrinsic motivations towards intrinsic motivations. Self Determination Theory (SDT) (detailed later) presents a continuum of motivation from extrinsic to intrinsic
Impact of failure of an initiative	Failure of a gamified application does not negatively impact other applications from the same provider	Failure of an initiative leaves a negative perception and negatively impacts other running applications and future initiatives	Detailed analysis is needed on all aspects like current perceptions, interests of targeted audience, and extended beta-runs. The environment can be opened up to specific users and then extended for all in phases
Job design	The job itself can be designed to be fun as the goal of the environment is to make the job fun. This is possible because the job is independent of other work being performed by the targeted group	The job design is usually fixed by goals of the enterprise and the functions of the users. Gamification needs to create an environment to make the job fun	Job design models need to be explored. Motivation Potential Score (MPS) of jobs need to be evaluated
Conflict of interest	There is no conflict of interest between the work and corresponding rewards as they are intertwined	The mechanics could conflict with existing enterprise mechanisms. For example, how a status in Gamification affects career progression or how game rewards work with compensation	The mechanics employed should work with the existing enterprise structure and working. There is a need to provide clarity on how the mechanics within the gamified environment and the enterprise

25.2.1 Discussion of the Differences

Below, we present a brief discussion on the differences highlighted above.

25.2.1.1 Purpose of Gamification

Gamification initiatives in the consumer markets are geared to elicit specific actions from the "players". In the context of enterprises, the initiatives need to elicit specific actions but also cater to the enterprise goals and the personal development aspirations of the users. The context and the usage of game mechanics cannot be limited to the perspective of the specific action alone. The purpose should take into account the whole enterprise. The design needs to take broader aspects into consideration including enterprise objectives and user aspirations and interests. An analysis into personality types and ways to engage all types is very critical for the gamification initiatives in the enterprise. Gamification in consumer markets tend to focus on certain categories or groups of users. Therefore, it can be designed around a heavily focused type of user. In contrast, the enterprise gamification system is focused around ALL types of users in the enterprise.

25.2.1.2 Reasons for Engagement

Gamification initiatives in the consumer domain are geared for specific users. For example, Nike+ is geared for people who already feel a need for a healthy lifestyle. The gamified environment needs to enable that goal and specific mechanics can be used. Also these initiatives can be made specific to various player personalities, like achievers, social and different environments can be provided and the player can choose an environment suitable for personality type. But in the context of an enterprise, provision of multiple environments is not a viable option as all the users should play on the same level.

25.2.1.3 Design of Gamified Environment

The design of gamified environments in consumer segment is highly open based on the targeted audience. Also the characteristics like fantasy elements, choices, paradox of control, etc., are very open. However, in the context of enterprise, these aspects are limited as the options provided should fit into the broader enterprise goals and culture. In the consumer domain, the transparency of game rules can, be a mechanic to introduce surprise and curiosity but the same is not possible in gamification in the enterprise. The rules of the games must be transparent to create an environment of trust and understanding. Research is available on design of games and can be applied to gamification as well (Frang & Mellstrand, 2012; Fu, 2011) provide case studies to understand the frameworks used in implementing a gamified systems.

25.2.1.4 Creative Freedom

The designers can use game characteristics, like providing for fantasy elements, graphics, narratives, etc., to engage their users, as providing fun and better user experience is the primary design principle. However, in the enterprise context, these options are limited based on enterprise culture, ethics, and other aspects.

25.2.1.5 Factors of Motivation

Mechanics like rewards, points, status, etc., provide motivation in a consumer gamified environment as the environment is a world in itself. In fact, these are standard mechanics in all the available solutions in the market today. The players have a "second life" in this environment and reasons for playing are extrinsically motivated. But in the context of an enterprise, the game mechanics need to be interwoven into other aspects like organizational roles, reporting structures, remuneration and pay structures, etc. The theories, like Self Determination Theory (Gagne & Deci, 2005) and goal orientation (Locke & Latham, 2002), provide a detail on how the motivation factors can be internalized.

25.2.1.6 Impact of Failure

Failure of a gamification initiative in the consumer market can easily be managed by introducing a new environment based on the feedback of a failed program. In fact it could be possible that the target audience itself has changed. For example, Mint.com could introduce a new program for a specific demographic segment. In the context of enterprise, this is not easy. A failure to engage users will impact not only the players but also the program. A single failure can derail the whole program and the other initiatives running or planned as the negative perception carries into the future.

25.2.1.7 Design of the Work

By definition, gamification is supposed to make work engaging. In the context of consumer gamification, the work can be designed in such a way that it is already engaging. As gamified environments cater to a specific segment of players, the design of activities can, accordingly, be planned. For example, a health oriented application can break fitness routine into multiple sub-tasks that can be performed at different times or at different places or with different people. In the context of enterprise, the options could be limited as the work is geared to provide value to the end customer and the engaging users (employees) is secondary. Theories like Job Characteristics Model (JCM) (Hackman & Oldham, 1976) can help in designing work in a way that is engaging and also delivers on end customer goals.

25.2.1.8 Conflict of Interest

This difference is mainly in the context of mechanics like rewards, statuses, etc. In the consumer segment, typically these are used to indicate the profile of a player and absolute value can be perceived within the gamified environment. But in the enterprise, these gamified mechanics conflict with the organizational roles. So there is a need to demark the environment while still providing a value for the mechanics used.

25.3 Leveraging Theories and Research in Existing Areas for Gamification

Gamification is about engaging users and human behavior aspects like motivation, persuasion forms an important element in engaging users. Gamification supports the other aspects of enterprise initiatives like tooling around the initiative or accessibility of tools, etc. Thus, it is very critical for the success of the initiatives that gamification plays its part by motivating and persuading users to participate in the initiatives and engage them meaningfully to sustain the motivation levels. While discussing the differences in Sect. 25.2, we have highlighted some researches in these areas. In this section, we present a brief discussion on various studies and researches in these areas.

25.3.1 Motivation

Motivation is the psychological feature that arouses an individual to action toward a desired goal and elicits, controls, and sustains certain goal directed behaviors. Self-determination theory (SDT) is a macro-theory of human motivation concerned with the development and functioning of individuals. In the self-determination theory, proposed by Gagne and Deci (2005), two types of motivation are distinguished: extrinsic and intrinsic motivation. Furthering on these notion of intrinsic and extrinsic motivations, in the context of gamification, McGonigal (2011) proposes a categorization of four major types of rewards:

- **Satisfying work** resulting in a directly recognizable effect of made efforts,
- **Experience or hope of being successful** while engaging in a learning process on how to continuously achieve better results,
- **Social connection** as the human need to share thoughts and perform tasks with others
- The **reward of being a part of something larger** than oneself, such as the pursuit of a challenge to achieve a collective goal.

Working from the goals, Locke and Latham's goal-setting theory (Locke & Latham, 2002) suggested that people tend to perform and sustain goal directed behaviors when they

- Set specific, difficult goals that have high degree of positive valance
- Understand what behaviors will lead to the goal achievement and feel competent to do those behaviors.

On similar perspectives, Elliot and Harackiewicz (1994) have proposed an integrative achievement goal conceptualization involving the following

- A **mastery** goal focused on the development of competence and task mastery;
- A **performance-approach** goal directed toward the attainment of favorable judgments of competence;
- A **performance-avoidance** goal focused on avoiding unfavorable judgments of competence.

Both SDT and goal related theories help in understanding the motivations of users and the cultural aspects like how a failure is perceived in the enterprise. This analysis is critical for the success of gamification, as this information will be used in design of game mechanics. For example, if the culture is performance-avoidance oriented, choosing a mechanic which rewards taking risk is not going help as the users will be worried about the outcome and choose not to risk whereas the same mechanic will motivate users in mastery oriented culture. The research has found that extrinsic motivation is not sustainable, specifically in the context of the enterprise (Gnauk, Dannecker, & Hahmann, 2012) and the expectation of achieving a success motivates users to participate in an initiative (Mento, Cartledge, & Locke, 1980).

Gamification is about engaging users in performing their work but in the current state of the market, the work seems to slip into the background with focus on game mechanics. This approach certainly helps in quick implementation cycles but fails on objectives as users cannot understand how the initiative is helping in doing their "job" or helping them. For success in gamification in the enterprise, there is a need to understanding the job itself and make it motivating in itself or make it more amenable for gamification.

In this context, the theory of Job Characteristic Model (JCM) proposed by Hackman and Oldham (Hackman & Oldham, 1975) could help in understanding and design of work activities. The core of the model is the three critical aspects while performing a work:

- **Meaningfulness** of the work,
- **Responsibility** for outcomes of the work, and
- **Knowledge** of the outcomes of the work activities.

These three psychological states are caused by five core job dimensions including skill variety, task identity, task significance, autonomy and feedback, which can predict the influence of the characteristics on the work performance, work motivation and work satisfaction. Hackman and Oldham propose a measure of motivation to perform a work as Motivation Potential Score (MPS) which is defined by

$$((\text{Skill variety} + \text{Task identity} + \text{Task significance}) / 3) \times \text{Autonomy} \times \text{Feedback}$$

To increase internal work motivation is to design jobs so they will (1) provide variety, involve completion of a whole, and have a positive impact on the lives of others; (2) afford considerable freedom and discretion to the employee (what action theorists refer to as decision latitude); and (3) provide meaningful performance feedback.

Another aspect of job design around the concept of “flow” has been proposed by Csikszentmihalyi (1990). The notion of flow is tightly coupled with the skills of users and “job” assigned as represented below. A task that is not challenging or requires excessive time to complete becomes boring and players lose interest; a task that is too hard causes frustration and anxiety and again players lose interest. With a person’s skills improving over time; the challenge needs to increase proportionately with the improving skills (Fig. 25.2).

For gamification in the enterprise, all users must feel they are capable of doing the tasks assigned. Game mechanics can motivate users to put in further effort and persevere but if they feel they don’t have a chance of success, users tend to drop their efforts (Mento et al., 1980).

25.3.2 Persuasion

Persuasion is a process aimed at changing a person’s (or a group’s) attitude or behavior toward some event, idea, object, or other person(s). In the context of consumer gamification, persuasion is not necessarily used as users may already be persuaded because of their own goals. For example, a gamified environment for fitness program,

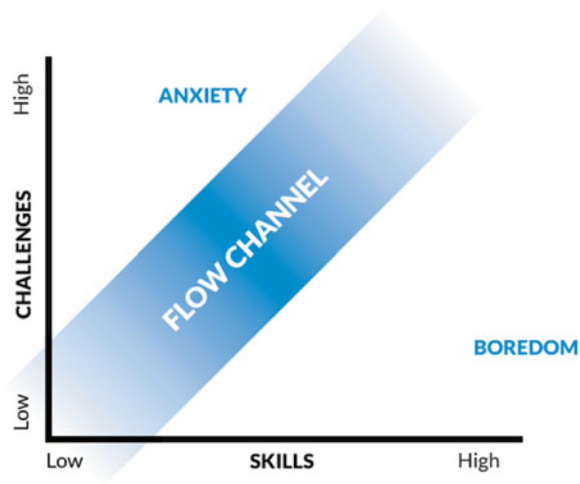


Fig. 25.2 Flow. Adopted from Csikszentmihalyi (1990)

the users to who join the program would be already “persuaded” to lead healthy lifestyle. But in the enterprise, for example, to share the knowledge, the users need to be persuaded to share knowledge and understand the need for sharing knowledge.

A large body of research focuses on the six principles of persuasion as identified by Cialdini (2001). These principles are:

- **Reciprocity**: It is easier to persuade a receiver who feels obligated to return a favor of the requestor;
- **Scarcity**: It is easier to persuade by projecting scarcity of an entity as scarce entities are valued more;
- **Authority**: People are persuaded by opinions and statements of legitimate authorities or experts;
- **Commitment and consistency**: People tend to be consistent with their earlier behaviors and commitments, thus they tend to comply requests that align with their earlier behaviors and commitments;
- **Consensus**: People tend to follow others and thus the projection that many people have complied to a request inclines them comply to the same;
- **Liking**: As emotional beings, people are inclined to comply with the requests from the people they like.

These persuasion principles have been extensively used in marketing and other related areas and have been very successful in persuading people to perform certain behaviors. Other theories, like J Fogg’s Behavior model (FBM) (Behavior Model, 2012; Behavior Wizard, 2012) also help in understand why users behave in a particular fashion and how specific behaviors can be modeled. In the context of enterprise, modeling productive behaviors is critical for the success and an understanding of these theories help in designing the mechanics that not just provide fun for the users but also create a pattern of behaviors that are helpful for both users and enterprises.

These persuasion and behavior modeling theories help designers to understand the broader objectives in the enterprise and help in design mechanics both in gamified environment and outside of it.

25.3.3 Engagement

We discuss engagement towards the end of the section on theories because engagement is a concept that is not studied extensively in the context of enterprise. There is a need for further research in modeling, measuring and enhancing engagement of users. Engagement has been defined as both the act of emotionally involving users, the state of being in gear and interacting directly with a system.

O’Brien and Toms (2008) propose a model for engagement with four distinct stages and detail the attributes that characterize each stage. The point of engagement is initiated by a combination of aesthetic appeal or novel presentation of the interface, the users’ motivations and interests, and users’ ability and desire to participate. Engagement is sustained when users are able to maintain their attention and interest in

Fig. 25.3 Phases of engagement. *Source*: O'Brien and Toms (2008)

the application, and is characterized by positive emotions. Users disengage for many reasons such as the usability of the technology (i.e., challenge and interactivity), and distractions in their environments. This stage, depending on the outcome, resulted in either positive or negative emotions. The figure below illustrates the model (Fig. 25.3).

Though this model does not entirely fit into gamification, the designers can use the theory to understand the phases in engagement and plan mechanics accordingly. For example, the authors' experience and also common sense suggests that engagement in any initiative decreases with time and there is a need to have mechanics in place to provide "boosters" at specific periods. More research is needed in this area on modeling and measurement of engagement in the context of enterprise.

In the next section, we present a framework that proposes to work with the implications discussed in the section on differences and includes the theories discussed above.

25.4 A Framework for Gamification in the Enterprise

25.4.1 Need for the Framework

As highlighted in the previous sections, designing and implementing sustainable gamification initiatives in an enterprise is complex and requires analysis on various factors including short, medium, and long term goals of the enterprise and users, organizational culture, structure, compensation mechanisms, factors of motivation and challenges for the users. Next, we propose a framework to manage these aspects. The framework being proposed is generic in that it does not relate to a specific game or gamified environment as we believe the analysis relating to challenges and motivations are contextual based on multiple parameters like demographic, cultural, social issues, and a game or a solution covering all aspects cannot be meaningfully defined at generic level. The designers and implementers need to apply the framework and derive a gamified environment from their analysis. The next parts of the section detail the steps in the framework and also link to differences and theories discussed in the earlier sections (Fig. 25.4).

25.4.1.1 Set the Goals and Objectives

It is critical to understand the expectations and objectives of gamification efforts in the context of enterprise and users goals. As highlighted in the section on differences and implications, gamification in the enterprise is not about specific action oriented goals, but the defined objectives should be in line with the current objective

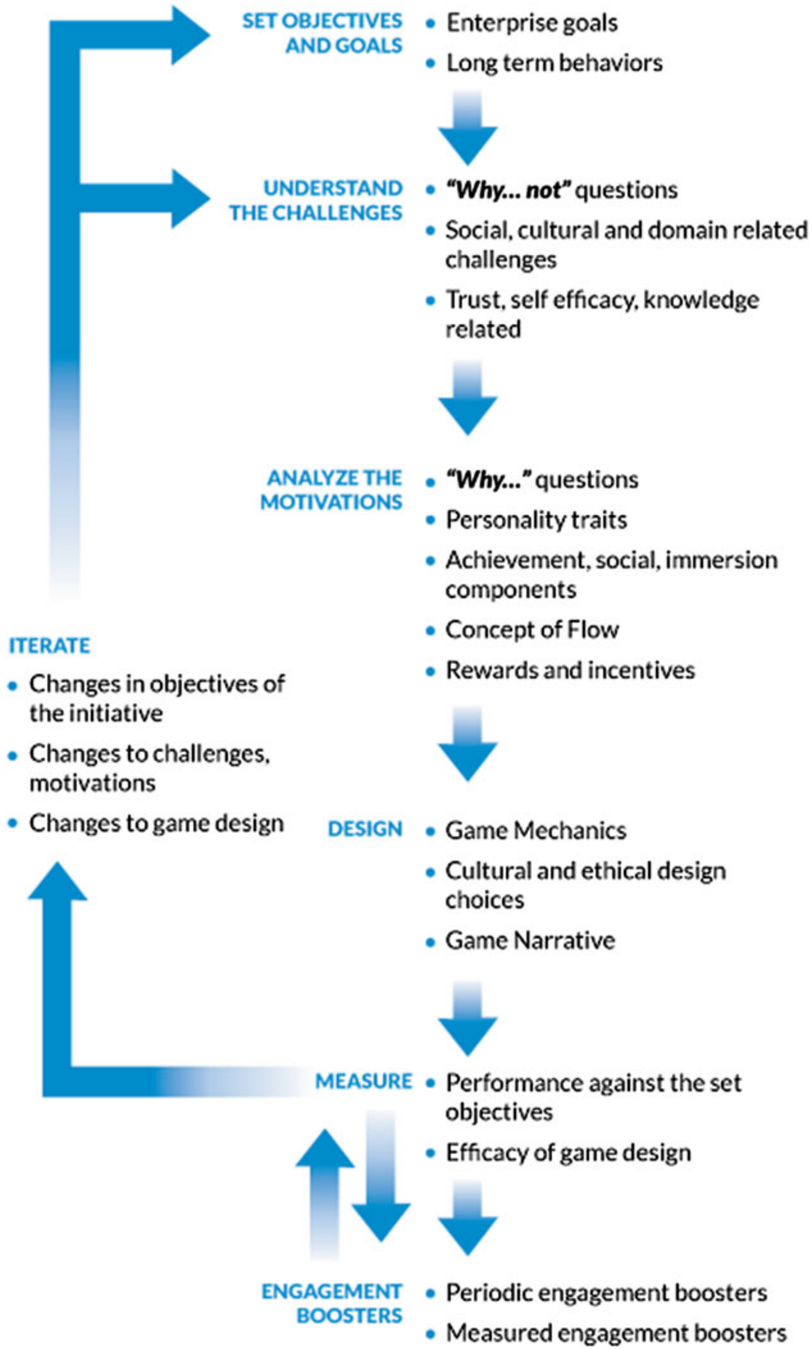


Fig. 25.4 Framework for gamification in enterprise

and there is also a need to understand how these short term immediate objectives or their relevance towards the long term objectives and values of the enterprise can be evolved. The current initiatives should be seen in the context of initiatives planned later. Without this perspective, the whole program could easily derail as users either do not see value for them or feel that this is another fad and try to wait it out or do not trust the initiatives. All these reactions are pathways to failure of introducing gamification in the enterprise.

It should be noted that gamification can be employed for engagement related goals only, for example, engaging users in an innovation program. The other aspects like tooling and accessibility of the tools is beyond the scope of gamification.

25.4.1.2 Understand the Challenges in Attaining the Set Objectives

The next step is to understand the challenges in meeting the objectives set in the previous step. The challenges can be sourced with "***why***… ***not***…" questions, for example, why are the users not able or willing to contribute their suggestions in an improvement program OR why are the users not sharing their expertise in handling exceptions. The users could be facing multiple challenges including levels of trust, self-efficacy on the capabilities, and knowledge of the domain. In addition, challenges based on cultures (power distance, fear of losing face), social challenges (relationship, team work, group dynamics like social loafing or free riding), etc., could also affect the participation of users. These challenges will be specific to enterprise and need be documented to understand the options to mitigate the challenges using gamification techniques. The issues for goal orientation—performance and mastery—come into picture here as these relate to how failure and success is perceived in the enterprise.

A thorough analysis of motivations and challenges cover details on various types of player personalities, mechanics to engage them. Also this exercise provides a way to understand the enterprise culture and issues because of the culture, organization structure, and the job characteristics as identified in JCM play a crucial role in motivating users.

25.4.1.3 Analyze the Factors for Motivation and Management of Challenges

The motivations can be understood using "***why***…" questions. For example, "why will an employee be willing help another user in handling an exception" OR "why will an employee be willing to share his knowledge with others". These questions also help in eliciting personal ambitions and goals of the employees and their association with enterprise objectives.

In addition, in the context of enterprise, perception of value derived and created (purposive value, self-discovery, interpersonal connectivity, social enhancement, entertainment value), social influence variables (trust, mutual agreement, reciprocity, group norms), and decision making variables (desires, intentions) are important to understand. Other aspects like perception of control, autonomy of work, goal setting and commitment, individual elements like emotional, cognitive needs and collaborative elements like cooperation, competition, and recognition help in motivating employees towards the objectives.

In the context of gamification in the enterprise, care must be taken to avoid a crowding effect - the phenomenon when individuals attribute the cause of action to an external reward (extrinsic motivation) rather than to intrinsic motivation, their self-determination is undermined and intrinsic motivation is crowded out by extrinsic motivation. This is critical as research has shown that extrinsic motivations are not durable and in fact detrimental in the long term.

Different personalities have different motivations (intrinsic or extrinsic) and goal orientations. This analysis should provide a detail on these motivational aspects so that the designers can implement appropriate game mechanics or design the environment in such a way that all are part of the "game".

25.4.1.4 Designing Gamified System

Once the challenges and motivations are identified, the game mechanics can be used as part of a narrative to engage users. Game mechanics are rules and dynamics of the game intended to make the play/work enjoyable. For example, for team work, incentives can be put at team level and teams are made to compete with each other while each team member is accountable for his contributions. A crowd-sourced view of the mechanics is presented at http://gamification.org/wiki/Game_Mechanics.

Once the mechanics are decided on based on the analysis from the previous steps, the next activity is the design of the gamified system. A detailed discussion of the frameworks to design gamified system is beyond the scope of this paper as it involves multiple studies into Human Computer Interaction (HCI), user experience (UX), game design frameworks, etc. (Frang & Mellstrand, 2012) and (Fu, 2011) provide case studies to understand the frameworks used in implementing a gamified systems. The implementers can refer to these case studies for details on implementation of gamified systems. An extensive design phase allows understanding the corporate ethics and freedom in design choices.

In addition, the Job Characteristics Model (JCM) and Motivation Potential Score (MPS) for the work can be used in making the job (activities) more amenable for gamification or interesting for users. Flow theory suggests that unless employees, customers or partners feel that the environment is easy and challenging at the same time, the environment will become another item in the check list of "to-be done". The design, mechanics should challenge the users while keeping them curious as to what happens next.

Persuasion and behavior modeling are two extensive areas of study that has found very good traction in marketing. We see and are influenced by these techniques everyday of our life, be it in supermarkets, internet or on TV. These theories can help designers in working out mechanics that only engage users but inculcate productive behaviors.

25.4.1.5 Measure and Improve

Measuring the efficacy of gamification initiatives needs to be twofold: firstly, there is a need to measure the effectiveness of Gamified system from the perspectives of usability, playability, engagement of users, experience and “flow” perception while playing. This measurement is usually done based on heuristics notably a method known as HEP (Heuristic Evaluation for Playability) proposed by Desurvire, Caplan, and Toth (2004). Secondly, there is a need to evaluate the effectiveness of the gamified environment in meeting the objectives that were set in the first step. Based on these two measurements, the gamification initiatives could go through iterations within the gamified environment because of the changes in design of the game or additions and enhancements to the objectives.

25.4.1.6 Engagement Boosters

In any initiative in an enterprise, the management support and others aspects create a kind of euphoric state towards to the initiative but as the time progresses there is a drop in the engagement levels and the program slowly moves towards to state of natural death. The gamification initiatives need to understand these phases and based on measurements from the previous section plan for specific engagement boosting mechanisms.

We propose that the above defined framework helps designers and developers of gamification (in the context of enterprise) to implement a solution that fits into the enterprise and caters to mitigation of the challenges and motivations identified. The process in an iterative mode creates an environment to think about the gamification initiative in a longer term rather develop-n-dump.

25.5 Case Studies

The section highlights the usage of the framework on two programs that require high levels of engagement from the users in the enterprise. These two have been highlighted as the goals of these programs are strive towards long term goals of the enterprise. The intention of these arm chair case studies is not to detail the solution but understand the implication of differences and design principles in the context of an enterprise

25.5.1 Sustainable Innovation Program

The first case study relates to an enterprise in services industry. As the users (employees, partners) interact with the customers, the enterprise wanted them to provide suggestions to innovate the operations of the enterprise. Below, we present an approach based on the framework and highlight some differences if the program had been implemented for innovation from the customer (as in consumer markets).

The objectives and goals of the program were debated from two perspectives—initiative specific and enterprise. From the innovation program, the goals identified are (1) increase in the number of people engaged, (2) raise the quality of submissions, (3) increase the depth of the ideas presented. The long term goals of the enterprise in this area were identified as (1) raise the innovation quotient of the enterprise as service industry is very competitive and innovation is needed for survival, (2) make users feel part of the journey, (3) make users feel owners of innovation.

Following the next step of identifying the challenges (***why***… ***not***… questions) in attaining these objectives, the management and the users were surveyed. It was found that (1) users are unaware of the benefits to selves from the program, (2) based on an earlier experience in the enterprise, the initiative was seen as a fad and it is more of a number game as the ideas will not be used or developed, (3) users did not feel capable of innovating or they felt that innovation is not needed in their line of work, (4) issues with performance orientation (perception of failures, taking risks, (5) management not being able to take up all the ideas into production.

Following an analysis of factors that can motivate (***why***… questions) revealed the following (1) users felt they can solve their own problems (2) users wanted to expand their network in the enterprise by exploring other areas of work, (3) users wanted to play a bigger role in the enterprises and innovation program is a possibility towards that goal.

Based on the analysis, the team came up with a narrative based on the working of a stock exchange. A brief view of the metaphor as applied for the solution and the mechanics used are as follows. Each idea presented into the system is perceived as a stock. The user is promoted as the owner of the stock. Other users can invest in the stock based on the merits they perceive, the owner's responsibility is to be get users to invest. To build a team and the depth around the stock, the owner can take help from different users to build up the idea, for example, a member from sales to evaluate the market size, an architect to check the technical feasibility etc. Multiple stocks can be merged in an effort to present a holistic solution rather than a single part. The owners are rewarded based on the growth of the idea stock and he can invest the rewards into ideas that are valuable. The owners can "sell" the ideas for rewards in the enterprise.

With this structure, the users feel responsible for the ideas and since ideas do solve some concern in their work, they tend to form teams to create enterprise level solution rather pointed solutions which may not be of interest to the enterprise. The system gets the users to network with others and thus opens a channel for cross team communication. As teams are formed more and more users are engaged into the platform by the owners and team members and this raises the participation levels. The environment also provides a platform for users to suggest and go through the implementation of innovative ideas, thus making them feel part of the enterprise journey. As the platform is open and ideas are rated by their applicability, the process of getting an idea to production is clear.

To boost the engagement for the initiatives, regular innovation days were introduced when the participation or the stock market is not trading well.

25.5.2 Experiential Learning Program

An enterprise in the telecom sector had problems with user engagement in its knowledge management program. The following section details the use of the framework in this scenario.

The program specific goals identified were: (1) users should share their knowledge on the work with other users; (2) quality of the shared knowledge needs to be improved; (3) users to work with users from other departments. The long term enterprise goals identified were (1) users learn with experiential learning (2) users acquire cross department and domain knowledge.

Following the next step of identifying the challenges (***why***… ***not***… questions) in attaining these objectives, the management and the users were surveyed. It was found that (1) the reward structure in place was conflicting with enterprise policies (2) cultural aspects like lack of trust between departments (3) departments were closed to outside participation.

On the motivations (***why***… questions), it was found that (1) users like to gain knowledge to keep themselves updated and competitive and (2) users wanted to play a bigger role in the enterprise.

Based on the analysis, the team came up with a narrative based on the working of Rally Championships. Teams were formed with different capabilities similar to a team in rally championships. This opens up users from different backgrounds and departments to work together for a common goal. Each user is provided with a “navigator” to help him chalk out a plan for progress. The metaphor allows for mistakes to happen (like driving onto a wrong route) but the overall progress will be charted. The culture changes from low failure tolerance to a level where the net outcome is evaluated. The metaphors allows the enterprise to incorporate specific challenges (similar to different races in WRC), specific conditions targeting various requirements like knowledge sharing in an area of work, or enabling learning of specific roles, etc.

With this environment, teams are formed with expertise on various fields and/or domains and the sponsors can setup specific challenges to encourage participation of certain groups, for example, the concept of navigators could be used to engage senior architects who can guide other members. The ability to form teams across departments increases the cross department trust which is crucial for experiential learning.

25.5.2.1 Learning

The learning from the case studies has been that applying the framework does provide a guideline and aids in implementing successful gamification initiatives. But to be sustain the required engagement levels, the design for gamification must incorporate the theories around motivation, engagement and persuasion. For example, case study involving innovation management, uses SDT and research by McGonigal in the areas of motivation, to create an intrinsic motivation by providing a sense of satisfaction and being of something larger. It also tries to improve MPS as proposed by JCM by providing an option to work in different work areas thus improving the skills and variety for the employees. The case study on experiential learning uses the research in goal orientation and the game design caters to a mastery oriented culture in the enterprise. It uses the principles of reciprocity and liking to encourage participation of various teams which were "closed" for collaboration earlier.

Though the focus some of these theories has not been in the area of gamification, some researches like McGonigal have shown that they can adapted to fit into gamification and to engage employees and customers.

25.6 Conclusion

Gamification in the enterprise is different from consumer markets as it needs to consider multiple aspects of the users rather than simply applying principles and mechanics that have been found successful in the consumer market. At its core, gamification must understand the challenges and motivations of the users. Targeting extrinsic motivations like rewards could be detrimental in the long term. This aspect is critical for success of the initiatives in the enterprise. Literature is abundant on various theories like SDT, Goal Setting and orientation, motivation, JCM etc. which can be leveraged to understand the challenges and build on the motivations of the users. Gamification in the enterprise needs to analyze the long term objectives in addition to initiative specific objectives. A step-by-step framework of implementing such an initiative helps the sponsors, designers and users in creating programs that deliver on both objectives.

References

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of Online Environments*. http://mud.co.uk/richard/hcds.htm.

Behavior Model. (2012). Retrieved May 18, 2012, from http://www.behaviormodel.org/

Behavior Wizard. (2012). Retrieved May 18, 2012, from http://www.behaviorwizard.org/wp/

Charsky, D. (2010). From edutainment to serious games: A change in the use of game characteristics. *Games and Culture, 5*(2), 177–198.

Cialdini, R. (2001). *Influence, science and practice*. Boston: Allyn & Bacon.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row.

Desurvire, H., Caplan, M., & Toth, J. A. (2004). Using heuristics to evaluate the playability of games. *CHI 2004*.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification". *MindTrek'11*.
Deterding, S., Dixon, D., Nacke, L. E., O'Hara, K., & Sicart, M, (2011). Gamification: Using game design elements in non-gaming contexts. *CHI 2011*.
Elliot, A. J., & Harackiewicz, J. M. (1994). Goal setting, achievement orientation, and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 66*(5), 968–980.
Frang, K., & Mellstrand, R. (2012). *Enterprise gamification of the employee development process at an infocom consultancy company*. Lund, Sweden: Lunds Universitet.
Fu, Y. C. (2011). *The game of life: Designing a gamification system to increase current volunteer participation and retention in volunteer-based nonprofit organizations*. San Antonio, TX: Trinity University.
Gagne, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior, 26*, 331–362.
Game Mechanics. (2012). Retrieved May 18, 2012, from http://gamification.org/wiki/Game_Mechanics
Gartner. (2013). Retrieved July 31, 2013, from http://www.gartner.com/newsroom/id/2251015
Gnauk, B., Dannecker L., & Hahmann M. (2012). Leveraging gamification in demand dispatch systems. *EnDM 2012*.
Hackman, J. R., & Oldham, G. R. (1975). Development of the job diagnostic survey. *Journal of Applied Psychology, 60*(2), 159–170.
Hackman, R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250–279.
Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*, 705–717.
McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin Press.
Mento, A. J., Cartledge, N. D., & Locke, E. A. (1980). Another look at the relationship of expectancy and goal difficulty to task performance. *Organizational Behavior and Human Performance, 25*, 149–1440.
O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. *Journal of the American Society for Information Science and Technology, 59*(6), 938–955.
Yee, N. (2007). Motivations of play in online games. *CyberPsychology & Behavior, 9*(6), 772–775.

Chapter 26
Designing Gamification to Guide Competitive and Cooperative Behavior in Teamwork

Niko Vegt, Valentijn Visch, Huib de Ridder, and Arnold Vermeeren

26.1 Introduction

Imagine you are up to your neck in work when one of your colleagues comes in and asks you to join a meeting within 2 h. The meeting is about a project proposal and project team formation for an important client and the problem the client wants to tackle is very interesting. You have to finish a report before the end of the day though. Still, you agree to attend the meeting but you don't want to waste your precious time just for the benefit of your colleagues. So you strive to get a personal gain from the meeting by aiming to become part of the project team. Most likely, others attend the meeting with the same intention. Resulting in a team meeting that aims to bundle forces and generate a collective and high quality project proposal but which is governed by individual concerns to become part of the project team, that might give rise to conflicts, resistance and sabotage.

The outcome of teamwork is almost never optimal due to conflicting concerns of individual team members. Factory workers, for example, don't want to get hurt. This individual concern contributes to the goal of the company to reduce the amount of accidents on the work floor. Over-cautious factory workers may, however, obstruct the productivity of the team by task avoidance or slow task completion. Differences in individual goals may block optimal collaboration and result in a sub-optimal collective outcome. Ideally, individual goals of team members are aligned in such a way that they effectively contribute to an optimal collective team outcome (Fig. 26.1).

In practice, the outcomes of teamwork are generally sub-optimal due to conflicts, hidden agendas and group dynamics (Fig. 26.2). Individual concerns may block the process towards achieving the optimal team outcome. These individual concerns

N. Vegt (✉) • V. Visch • H. de Ridder • A. Vermeeren
Delft University of Technology, Landbergstraat 15, 2628 Delft, The Netherlands
e-mail: n.j.h.vegt@tudelft.nl

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_26

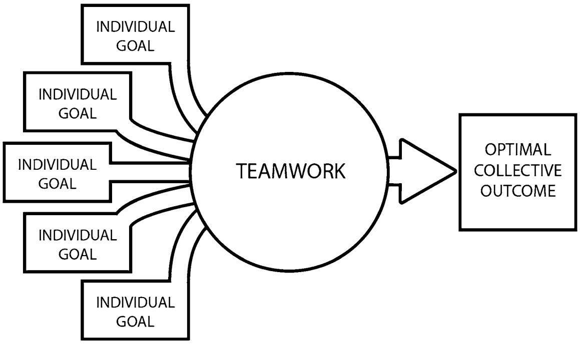


Fig. 26.1 Ideal teamwork situation

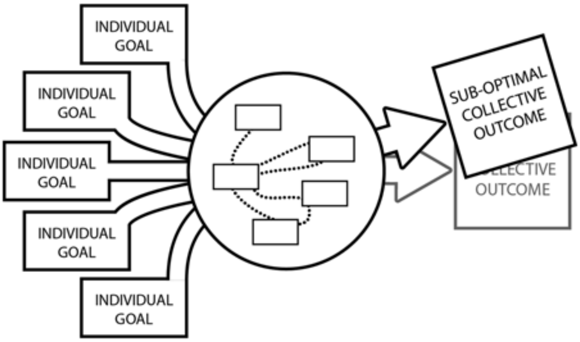


Fig. 26.2 Teamwork situation in practice

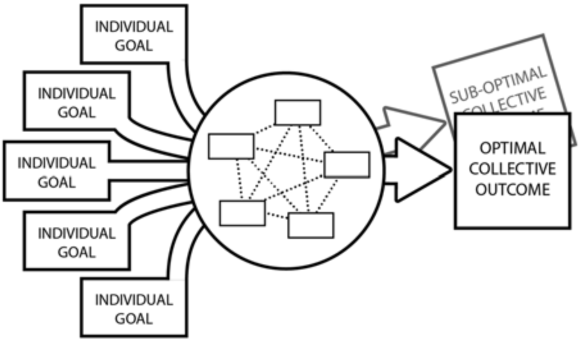


Fig. 26.3 Structured teamwork situation

and the resulting behavior tend to be implicit, resulting in a chaotic process and sub-optimal outcomes.

In order to deliver optimal outcomes the collaboration between team members needs to be improved, e.g., by structuring the collaborative process and aligning individual goals with collective goals (Fig. 26.3). This may be achieved through gamification.

Gamification is generally defined as "the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011). It has raised much interest in industry as a new way of making work more fun and motivating. Most gamification design and research is limited to increasing the motivation of users

(Hamari, 2013). In business contexts however, it is equally important to investigate and design for the effectiveness of gamification in terms of employees' performance (Mollick & Rothbard, 2013). This may be learning, behavior change, or any outcome that is valued in the real world (such as project proposals as a result of business team meetings). In this chapter we present a framework for the gamification of teamwork.

Research on teamwork (cf. Salas, Cooke, & Rosen, 2008) and research on games (Salen & Zimmerman, 2005) have been developed independently throughout history. It is only recently (Reeves & Read, 2009) that these two knowledge domains have been combined to theorize and design effective gamification of work situations. In order to understand and design the gamification of teamwork situations we need to decompose team processes into actionable elements, such as goals and tasks, as well as combine the theoretical knowledge from non-game teamwork and game design about these elements. In the next sections, a theoretical analysis of teamwork will be presented, before proceeding to the subject of how gamification can optimize teamwork. Throughout this chapter so-called *Red teams* will be used as an illustrative example, so these will be introduced first.

Red teams form an innovation in the process of developing project proposals at professional service firm Berenschot in the Netherlands. Red teams (originating from the military) are intended to boost creativity in writing a project proposal, and should result in a better proposal that increases the chances for receiving the project order. A Red team is assembled a few hours after a client request is received. The composition of the team is different every time since it depends on the availability of employees. In a meeting of 1 or 2 h the team has to generate an advice for the content of the proposal. After which a writing-team that will further develop the proposal, is distilled from the Red team.

The Red team is a typical teamwork situation in which conflicts and individual concerns impede the optimal collective outcome. Before moving to the benefits of gamification for this problem, we will first analyze the teamwork situation in more detail in order to fit the right game design to it.

26.2 Goals, Conflicts, and Behavior in Non-game Teamwork

> A team can be defined as (a) two or more individuals who (b) socially interact; (c) posses one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organization. (Kozlowski & Ilgen, 2006)

In many teamwork cases, like Red teams, it is mainly the first element of this definition that is formalized: a meeting of more than one individual. Most other aspects are left to the collaboration skills of the team members. Factors that are known to influence team performance range from team composition, to work structure, and task characteristics (Salas et al., 2008).

If a clear structure for teamwork processes is lacking, chaotic teamwork processes may result in sub-optimal outcomes. The design of a team (i.e. task structure, group composition, and group norms) should not be overlooked as it creates the conditions for effective team performance (Hackman, 1987). In short-term teamwork situations, like Red teams, it is mainly the task structure that affects team performance. Proper goal setting and good task design are important for effective teamwork and good team performance (Cohen & Bailey, 1997).

26.2.1 Goals and Task Design

Goals form an important part of a task design. Research shows that goals have been shown particularly important for motivation (Bandura, 1993). As a consequence the theory of goal setting is dominant in the field of organizational behavior, specifying the goal qualities and their effect on motivation. For instance, difficult and specific goals tend to lead to higher levels of performance than easy or vague goals (Mitchell & Daniels, 2003). Task performance is also affected by the type of goal orientation (i.e. learning-goals or performance-goals). When individuals or teams adopt a learning-goal they are concerned with mastering the task and this is found to increase performance when the task is complex. Adopting a performance-goal relates to the task outcome, regardless of mastery level, and increases performance if the task is simple (Winters & Latham, 1996).

Optimizing the goal qualities is, however, not enough to result in effective goal attainment behavior, since people need feedback to monitor the progress of their goal attainment (Mitchell & Daniels, 2003). Moreover, outcomes should be meaningful, visible, and have significant consequences for people that are not a member of the team (Hackman, 1987). Feedback is especially important for temporary teams, like Red teams, because there is not much time for group synergy to arise. For this reason detrimental processes should be avoided, like inappropriate weighting of individual contributions and focusing rewards and objectives on individual behavior (Hackman, 1987).

In relation to the overall task design an important distinction is to be made between assigned and self-initiated tasks. Although tasks may be well described in terms of stimuli, instructions about operations, and instructions about goals. The way people work might not directly be the result of prescribed tasks (Hackman, 1969). It is important to be aware that individuals may (and probably will) redefine a task, particularly in team processes. In fact, providing team members with substantial autonomy for deciding about how to do their work makes the team ‘own’ the task and responsible for the outcomes. This increases commitment and effort (Hackman, 1987).

To avoid individual goals obstructing the attainment of collective goals it is important to properly define the collective goals and tasks. In Red teams, for example, conflicting perspectives of individual team members easily result in lengthy discussions. However, if all team members are committed to the collective goal of coming up with good recommendations this should not be detrimental for the team's performance. If the conditions are right, team members themselves will come up with strategies to assure the team's performance. Theories on conflict management may provide insight into such strategies.

26.2.2 Conflict Management

In organization psychology conflict is seen as one of the main drivers for team performance, making team management a delicate practice. Teams should be flexible, also in the use of performance strategies, and should be able to switch to new strategies if necessary. In many cases, however, teams have the tendency to decide on one way to approach a task early on in the process and stick to that approach. The chosen strategy becomes part of the fabric of the team and tends to prevail throughout the whole process (Hackman, 1987). Conflict stimulation can encourage the reconsideration of performance strategies. In order for conflicts to enhance rather than decline team performance several conditions need to be considered, including *tension level*, *conflict orientation*, and *type of interdependence* (van de Vliert & de Dreu, 1994). The tension level in conflict situations should be moderate because too much or too little cognitive-emotional strain is found to decrease performance and innovation (de Dreu, 2006). The orientation of the conflict should be task-based, instead of (personal) relationship-based, because only task-based or cognitive conflict is found to be beneficial for team performance (Jehn, 1995). Task performance and relationships are yet never fully separable in teamwork, making it important to guard for affective conflict. Conflict stimulation is only advisable if team members are positively interdependent in relation to the collective outcomes, as conflicts will take a destructive turn when one person's gain is the other's loss (Deutsch, 2006). This is not beneficial for team performance in the long run.

Conflicts can be handled either in cooperation or in competition, by pursuing either one's own *and* the other's goals, or one's own *or* the other's goals (Rahim, 2002). The respective values of cooperative styles and competitive styles of conflict management can be different for different situations. Cooperation is more appropriate for enhancing complex cognitive and behavioral changes (e.g. organizational learning), whereas competition is more appropriate for simpler changes where underlying policies, assumptions and goals don't need to be changed (Rahim, 2002). Ideally, team members use the right strategies at the right moment. In daily practice however, once a team has adopted a particular style, they tend to stick with it.

26.2.3 Compete or Cooperate

Teams can be steered to work in a cooperative or competitive style. The need for choosing to compete or cooperate arises when people are interdependent in relation to their goals and tasks. Interdependence between two or more individuals occurs when a change in the state of one causes a change in the state of others. With shared goals, and collective recourses in teams, its members are by nature interdependent. In Red teams for example, team members depend on each other's expertise in generating good advice for a project proposal. Moreover, they depend on each other's time and motivation for composing a team that finishes the proposal.

In organization psychology several forms of interdependence have been identified. Its most prominent forms are *task interdependence* and *outcome interdependence*. Task interdependence is defined as the distribution of skills and resources within a team, and the processes by which members execute the work together (Wageman, 1995). This is the strongest type of interdependence, because highly interdependent tasks not only result in experiencing significantly more task interdependence, they also influence people's perception on outcome interdependence, independent of the actual outcome condition. Outcome interdependence relates to the way that goals are achieved and how performance is rewarded (Wageman, 1995). The manipulation of outcome interdependence has much less effect on the overall intensity of experienced interdependence. However, outcome conditions do affect the type of interdependence that team members perceive. The structure of goals that people have in a particular situation determines how they interact and this interaction determines the outcomes of the situation. If a furniture maker puts safety above productivity he will work slower to avoid injuries and therefore produce less chairs. However, if he also wants his chairs to be powder coated (which he can't do himself) and the powder coater has a tight schedule, he may speed up and set aside his safety concerns.

Goal structures specify the type of outcome interdependence among individuals (i.e. personal safety against staying on schedule) and this, in turn, determines how individuals must interact to achieve their goals. "If the amount of probability of a person's goal attainment is negatively correlated with the amount of probability of the other's goal attainment" (Deutsch, 2006) people are negatively interdependent and this leads to competitive behavior. The most basic type of a competitive goal structure is where one person's gain is the other's loss (in game theory this is called the zero-sum game). In such situations one is more likely to obstruct or block, rather than promote or facilitate the goal attainment of others (Johnson & Johnson, 2006). In contrast, during cooperative situations the correlation between the players' chances of goal attainment is positive and people will be more likely to promote or facilitate the goal attainment of others. Teams that work under the circumstances of positive outcome interdependence are "more open minded regarding others' arguments and desires, more concerned about each other's outcomes, and more inclined to search for solutions and compromises"(van den Bossche, Gijselaers, Segers, & Kirschner, 2006). So by formalizing the goal structure, the way that people collaborate in teams can be influenced in order to achieve a more optimal collective outcome (Fig. 26.3).

By designing the rules for goal attainment teamwork can be structured towards competition or cooperation. Positive outcome interdependence induces cooperative behavior and negative outcome interdependence induces competitive behavior. By defining the task characteristics (e.g. sharing a space, distributing information, or influencing each other's movements), task interdependence can be influenced and thereby the intensity of the teamwork.

Gamification is particularly useful for enhancing teamwork. Firstly, because it can structure the process with explicit goals and guide players with game rules towards competitive or cooperative behavior. Secondly, it addresses other factors for good team performance, such as feedback and meaningful outcomes. Thirdly, the preconditions for positive conflict stimulation (i.e. moderate tension level, task-based conflict, and positive outcome interdependence) are addressed in a game design process by nature, cf. the explanation on games as systems of conflict by Salen and Zimmerman (2004).

26.3 Gamification and the Persuasive Game Design Model

26.3.1 Gamification

In the literature there is not much agreement on the definition of games and gamification. Currently, at least two definitions of gamification exist. Deterding et al. (2011) define gamification as "*the use of game design elements in non-game contexts*". This definition assumes a designer's perspective in which game design elements are the building blocks for a 'gameful' experience. The affordance of a 'gameful' experience is mentioned as the factor that distinguishes game design elements from other design elements. Huotari and Hamari (2012), define gamification from a user's perspective and elaborate on this latter aspect by interpreting gamification as "*a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation*".

The relation between the designer and user perspective can be explained through the MDA framework (Hunicke, LeBlanc, & Zubek, 2004), one of the most used frameworks in game design. In this framework three levels of game design elements are defined: mechanics, dynamics, and aesthetics. From the designer's perspective the game mechanics (like points, controls, and levels) are used to achieve a particular aesthetic (like challenge or fellowship). The user will first experience the aesthetics and then start to unravel the mechanics through the dynamics (like time pressure and sharing information). As a gamification designer, it is not only important to have game mechanics at one's disposal, but also to empathize with the user (Nicholson, 2012) and have a feeling for the gameful experience that one is designing (Winn, 2009).

Gamefulness was first mentioned by McGonical (2011) to relate to rule-based play ("ludus") as opposed to free-form play ("paidia") (Caillois, 1961) and *playfulness*. Role-playing is an example of free-form play. One adopts a role and the story emerges without any explicit rules defining it. Role-play is often used in business training. Learning goals are often achieved by playfulness since one can freely explore the possibilities the training offers. Most sports however, are forms of

Fig. 26.4 The use of gameful experiences

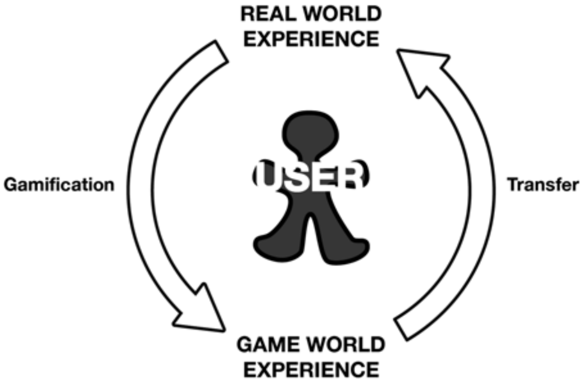


Fig. 26.5 Persuasive game design model (Visch et al., 2013)

rule-based play where conditions for winning or losing are defined and these are considered to be gameful. In business contexts 'playful' behavior is often less desirable, as its outcome is unknown. 'Gameful' behavior however, can be directed towards a particular outcome by defining goals and rules, and might therefore be useful for teamwork in business contexts (Fig. 26.4).

26.3.2 The Persuasive Game Design Model

To better understand gamification and gameful experiences we developed the persuasive game design model (Visch, Vegt, Anderiesen, & van der Kooij, 2013). In this model (see Fig. 26.5) we combine the designer's perspective and the user's perspective, by placing the designer as the facilitator of the user experience. In our view, it is the user that makes the game by experiencing and interacting with it.

However, it is the designer that designs the gamification by applying game-elements "on real-world attributes to create a user experienced game-world". Crucially, this game world experience is strongly motivating for the user since it provides *enjoyment*, *engagement* by direct feedback and *freedom* by reduced real-world consequences.

The extent to which a user is drawn into a game world experience depends on the context, behavior and the user characteristics. A holiday can be expected to be more related to a game world experience than a business meeting is. But what if the business meeting takes place in Hawaii and the holiday consists of voluntary work

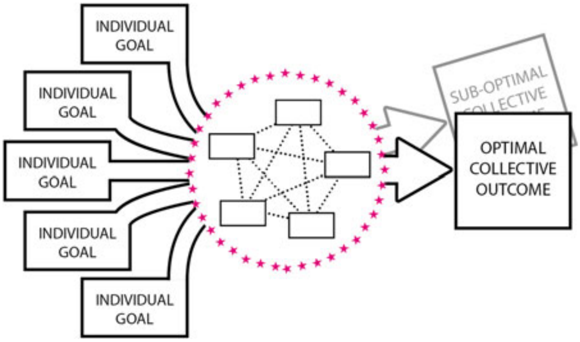


Fig. 26.6 Gamified teamwork situation

at a primary school in Bangladesh? Near to completely loosing a game might make people want to retract from the game world, while winning games might people want to stay in the game world. Moreover, parents playing games with their children will try to maintain their child in the game world by not letting him/her loose directly at the expense of not being fully engaged in the game world as a parent.

In persuasive game design, gamification is not only aimed to solely transport the user to a game world experience but also to realize real world outcomes or transfer effects: the effect of a user experienced game world on forming, altering, or reinforcing user-compliance, -behavior, or –attitude, in the real world (Visch et al., 2013).

In teamwork situations the real world goal is to improve collaboration. By implementing game design elements the participants are directed towards a more 'gameful' experience, which leads to a game world experience with increased enjoyment, freedom, and engagement. When drawn into the game world users can be directed towards cooperative or competitive behavior by defining game goals and game rules (Fig. 26.6). In the Red team meetings, explicitly stating good advice as a game goal may enhance the motivation and commitment of the participants and thereby improve the collaboration towards a good project proposal.

26.4 Game Design Elements: Rules and Goals

Game elements are the motivational building blocks for a game world experience. They may consist of rewards, challenges, phantasy world, etc. However, the game rules and goals might be the most basic and prominent elements to design a game. Rules and goals structure the player's behavior in the game and are therefore at the hearth of the "procedural rhetoric" (Bogost, 2007) of games. The behaviors of players define a game, not textual instruction or visual representation. Within a game the rules define this behavior, even if they are implicit.

To investigate the effect of rules on player behavior we conducted an experiment for which we designed two types of a multiplayer Breakout (or Arcanoid) game. The aim was to find out whether competitive or cooperative behavior could be evoked in participants by having different game rules in the two versions of the game. Participants were not informed about the rules or about them being different.

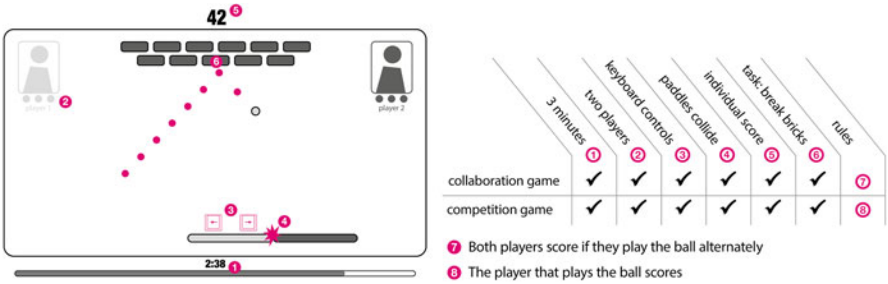


Fig. 26.7 The game mechanics of multiplayer Breakout

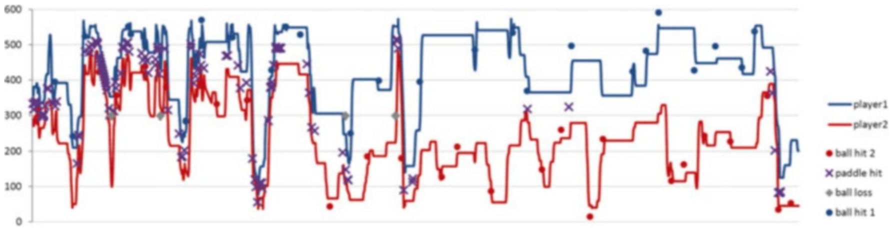


Fig. 26.8 Player behavior in multiplayer Breakout shifting from competition to cooperation

To empirically test the effect of implicit rules all other game elements were kept the same. This resulted in a competition and collaboration game where the task, controls, and visuals were identical. Only the rule for goal attainment (i.e. scoring points) was different. In the cooperative game the players had to hit the ball alternately in order to score points. In the competitive game the player that hit the ball would score points (Fig. 26.7). No instructions on these rules were given so this was only made explicit through the mechanics in the game.

Figure 26.8 shows a graph of a 3-min gameplay session where two players (top line, bottom line) initially play the game in a competitive way (indicated by the fact that the lines are close to each other: paddles try to obstruct each other). The rules of this version of the game, however, were meant to induce cooperative behavior. After approximately 1 min the players understand the rules and start to play the game cooperatively (i.e., they wait for their turn in hitting the ball). The initial competitive behavior is explained by the fact that they have played a game with competitive rules before this session. In Fig. 26.9 the reverse is happening.

We found that changing the implicit rules of the game had a significant effect on the players' experiences (measured by asking them about experiences such as the extent to which they felt helped or obstructed) and behavioral patterns (see Figs. 26.8 and 26.9). Interestingly the players' skills, knowledge, and attitudes did not seem to affect the results. The fact that they were engaged in a game made them search for the rules behind the game and eventually behave in compliance with these rules.

Our data showed that players can be expected to search for the goals and rules of a game by just playing it and may be able to infer the correct goals and rules

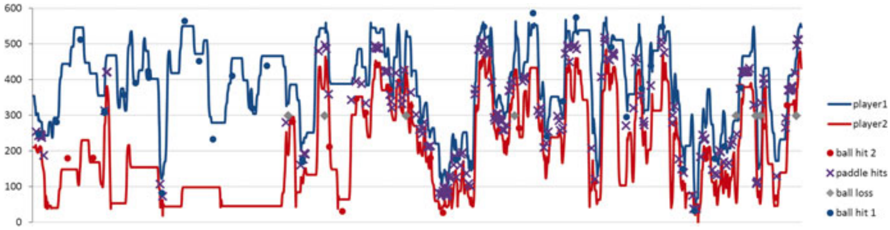


Fig. 26.9 Player behavior in multiplayer Breakout shifting from cooperation to competition

from that. We presume that this knowledge on the use of implicit rules is directly transferable to the gamification of teamwork situations in organizations. Instruction is one way to convey goals and rules, but when people are engaged in a gameful experience they will expect goals and rules and will go searching for them. The experiment showed the powerful effect of game rules on player behavior since even by hiding them in game mechanics they are strong enough to direct the user's behavior to either competition or cooperation. Moreover, the experiment showed us which player behavior might be typical for competition and cooperation.

26.5 A Framework for the Gamification of Teamwork Situations

In this section we present a framework, to assist in the analysis and gamification design of teamwork situations (Fig. 26.11). The framework is based on making a rough distinction between four types of experiences in teamwork situations (Fig. 26.10): cooperation (dependent and independent) and competition (dependent and independent).

The acrobats in Fig. 26.10 illustrate *dependent cooperation*. They heavily rely on each other (i.e. dependent) in building a human tower and the only way to achieve their collective goal is by working together (i.e. positive outcome interdependence leading to cooperation). The rugby players illustrate *dependent competition*. In this team competition game the outcome interdependence between the teams is negative. Moreover, players of each team can directly promote or obstruct each other in possessing the ball by passing it through or stealing it. In the example of darts (i.e. *independent competition*), the players interact independently since they compete for the highest score independently of the other player. The competition is in the point system rather than in the activity itself. This is also the case in the Olympic medal table. Individual athletes contribute to the overall amount of medals won by their country, but they cannot directly help each other in achieving this medal. So this is an example of *independent cooperation*.

For analyzing teamwork the framework (Fig. 26.11) can be read from left to right, first focusing on an analysis of the interdependency of goals as well as of interactions and gradually deducing from that an expectation about the user experience

Fig. 26.10 Examples of the four types of user experience in teamwork situations

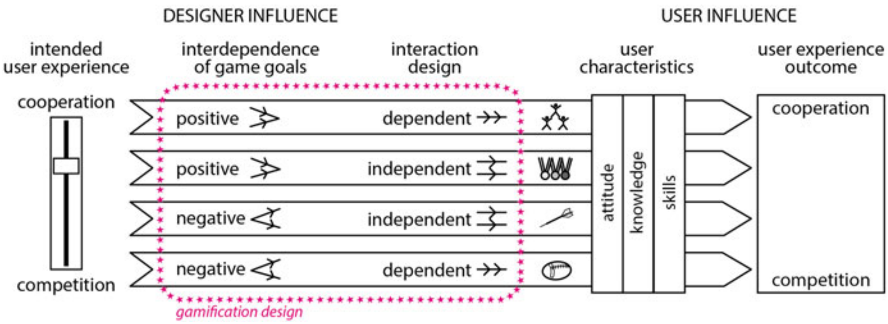


Fig. 26.11 Framework for the gamification of teamwork situations

outcome. In case the framework is used as a starting point for gamification design the first step is to set a user experience to aim for (represented by the slider on the left). E.g., should it be a dependent competitive experience, like the rugby players in Fig. 26.10? Or should it rather be an independent cooperative experience, like athletes contributing to the medal ranking of their country? Having decided on the intended user experience, the framework explains how to deal with interdependency of goals and interactions for achieving that user experience. The characteristics of the user influence the eventual user experience outcome by the way they choose to behave. In the next section the framework and how this can be used is explained in more detail.

26.5.1 Game Goals

As explained earlier, it is the correlation between user's goal attainment that directs users towards competitive or cooperative behavior. In most ball games, for example, this correlation is negative as there is just one ball available. If one team possesses the ball the other doesn't. This results in negative correlation of attaining the goal of ball possession and therefore in a competitive game. Whether players want to posses the ball themselves or keep ball possession in the team doesn't make a difference in the overall competitive nature of the game. However, in team sports it is in general not beneficial when the goal of ball possession is not only a team goal but also an individual goal, since such individual concerns might weaken the collective goal attainment of the team.

Cooperation within teams is therefore important: teammates should focus on positively correlated goals, like keeping the ball within the team, or in the case of the acrobats by behaving according to team rules. If several acrobats would be determined to be on top of the human tower, they will never achieve building a proper tower and the individual acrobats will probably also not achieve their individual competitive goal. In certain specific situations, however, the collective goal of the team might actually benefit from competing goals of individuals within the team. This could, for example, be the case when one player is much more skilled or knowledgeable than the other.

The motivational strength of games is that players can determine their own goals in a restricted but complex game system (Salen & Zimmerman, 2004). In order to keep the game motivating it is important to preserve this feature within the design of gamification. This means that a gamified situation should always provide a choice between different goals for each player. Our framework can provide the guidelines for a proper set of game goals, resulting in the intended type of competition or cooperation. The drawback is that users might choose to focus on goals that are not most beneficial for team performance. A team leader or game manager could control this on the fly.

26.5.2 Interaction Design

When the goal is set; the player can decide to obstruct or promote the other's goal attainment. However, this decision is not only influenced by the structure of the goal but also by the provided interaction possibilities. The gamification designer can steer and guide the user experience by defining the interaction possibilities, for example by the distribution of resources or by specifying rules that structure and define the degrees of freedom that users have. This determines the boundaries within which the players can achieve their individual or collective goals and to what extent they depend on the actions of other players.

Research on the effect of certain interaction possibilities within computer games shows a significant effect in the game experience. One study showed that playing against a human-controlled opponent intensified the game experience as opposed to playing against a computer-controlled opponent (Weibel, Wissmath, Habegger, Steiner, & Groner, 2007). However, for certain types of social interaction, playing against a human- or computer-controlled opponent doesn't matter for the intensity of the game experience. In a study on social exclusion in computer games, players had a negative experience while playing with a human as well as computer opponent (Zadro, Williams, & Richardson, 2004). A study on the distribution of players over different locations showed that players that are in the same room experience more fun and challenge (Kort de, Ijsselsteijn, & Poels, 2007). And the effect appeared to be even stronger when players are more familiar with each other (Gajadhar, de Kort, & Ijselsteijn, 2008). The distribution of interaction possibilities doesn't seem to have such a linear effect. Increasing the distribution of controls on moving, shooting, and switching color resulted in an increase of the level of experienced sociality and a reduction of the level of experienced control. Partly distributing the controls (e.g. just distributing the color switching) resulted in the most intense game experience (Rozendaal, Braat, & Wensveen, 2010).

Often games do not limit themselves to one type of user experience or interaction design. For instance, TeamUp is a good example of a computer game where task interdependence gradually increases and thereby the intensity of the cooperative experience. TeamUp is a teamwork training game, originally developed by the Delft University of Technology in cooperation with Accenture, and now further developed by The Barn (Signature Games, 2009). In this game teams get gradually introduced with the interaction possibilities that increase the interdependence among the players.

The game starts with sharing the same virtual space (Fig. 26.12). With each level a new game mechanic is introduced that makes players more dependent to each other's performance. Buttons that are scattered over the area generate a distribution of resources and force team members to coordinate their actions and assign roles. Leadership is enforced by unequal distribution of information such as providing one player with more overview than the other. Combinations of a particular distribution of tasks and resources result in complex and challenging puzzles for the players. Within each puzzle players are always positively interdependent in relation to the outcome, so the core of the game has a purely cooperative character. But team performance is eventually ranked in relation to the performance of other teams. This independent competitive experience may motivate teams to perform even better.

26.5.3 User Characteristics and User Experience

Designing for a particular user experience always ends up with a fuzzy result, as you never know exactly how particular users react to the game elements that you have designed. Designers can only *afford* a certain experience, which means that it is more likely that users will feel how they are intended to feel. So by defining the rules for goal attainment in such a way that players are negatively interdependent, it is more likely that they will get in a competitive mood and consider other players to be opponents.

Fig. 26.12 TeamUp (Signature Games, 2009)

For game designers it is important to take into account the players' previous knowledge, skills, and attitude (Winn, 2009). Specific game design elements affect each player differently since the players possess different knowledge and skills. Such differences can be leveled through handicapping or providing practice before actually starting the game. The attitude of players is hard to influence, some players are just more competitive or cooperative than others.

26.5.4 Applying the Framework

Our gamification framework can be used to analyze or design for teamwork situations. The goal of the framework is to predict whether the user experience is (or will be) competitive or cooperative, and to what extent. One should analyze each possible goal that a player can focus on separately and determine its resulting user experience. This kind of approach is also mentioned in literature on games (Schell, 2008), such as "skill atoms as a design lens", where games are segmented in small steps of a goal, an activity, and feedback, resulting in learning a new skill (Deterding, 2013). We propose to segment gamified teamwork situations into *goal atoms*, where the correlation between the players' goal attainment is dichotomous; being either positive or negative. Moreover, one should be either dependent or independent from others in attaining the goal. In this way the framework can be used to analyze and understand existing business games aiming at teamwork collaboration such as the leadership game of RANJ.

26.6 Illustrative Design Cases

26.6.1 Leadership game RANJ

In the Leadership game, developed by RANJ serious games, a variety of goals can be identified. The game is a 1-week simulation to train leadership. Teams compete to come up with the best project proposal. Only one team can win this challenge in the end while during the week the teams are not depending on each other. So the teams are negatively interdependent *between* each other in terms of winning the assignment that may lead to an independent competitive experience. The interaction *within* the teams is more diverse though, since each team is divided over two locations, making the team members more dependent on each other's actions. They are positively interdependent in relation to achieving the best project proposal.

The overall game structure provides independent competition, independent cooperation, and dependent cooperation, resulting in an overall game experience that inclines towards cooperation (Fig. 26.13). During the week the teams also receive several sub-tasks. Puppet masters can regulate the challenges for a team by introducing additional tasks, distributing information, introducing conflicting interests, or rescheduling deadlines. Increasing time pressure and creating a task- or information-overload increases the stress level and therefore the need to cooperate, by distributing tasks among team members. The distribution of information and introduction of conflicting interests can direct and enhance outcome interdependence. Teammates might actually become negatively interdependent and therefore be put in a competitive situation within the team. So these sub-tasks can direct the overall teamwork experience towards the competitive or cooperative side.

In general it can be seen that distribution of resources, time constraints and distribution over space are important factors that influence the user experience outcome. It affects the level of challenge and also the way that people play and experience the game (competitive or cooperative).

26.6.2 Red Team Game

Returning to our initial case of the Red Team, our framework can be used to analyze the current situation and design gamification interventions to direct the teamwork process. For instance, by designing a Red team game in which all types of competition and cooperation are included, from which a facilitator may employ the appropriate game design elements for a specific situation. Or the whole team may negotiate on the use of particular game elements. Another way to gamify Red team meetings would be to analyze the meetings as how they are now and add the proper game design elements that direct the overall experience towards cooperation or competition. If for example a team needs to brainstorm in order to generate ideas, an independent competitive experience may be introduced. Each individual

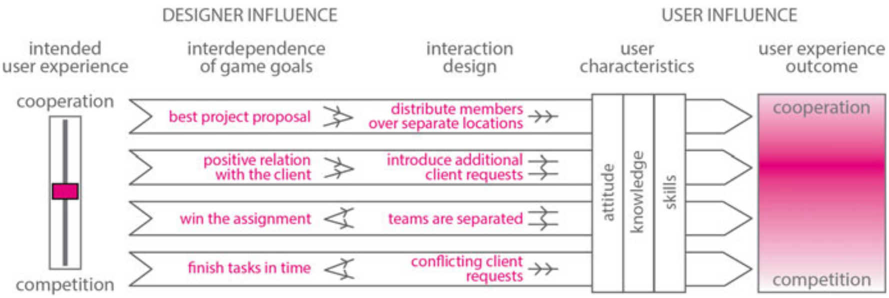


Fig. 26.13 Goals and interaction design elements from the leadership game

participant would get the goal to come up with more ideas than the other participants without interacting with them during the process. This most likely improves the quantity of ideas, however not necessarily the variation. In order to achieve a good variety of ideas the participants should become more dependent, by for example coming up with ideas in rounds where authenticity is a criterion for getting it counted to your personal score.

26.7 Future Research on Transfer Effects

26.7.1 Direct Effects

Although game design and gamification literature increased over the past decade, to our knowledge there is only scarce and recent literature on the effectiveness of game design elements in a work environment. Hamari (2013) studied the effect of badges on usage activity and Mollick & Rothbard (2013) studied the effect of leaderboards on positive affect and performance at work. Interestingly both studies come to a similar conclusion: gamification doesn't automatically lead to more engagement and enjoyment, and consequently not to increased performance. In the study with badges it was shown that "interest" in the game elements mediates their effect on engagement. And in the leaderboard study it was found that "consent to the game" plays an important role in increasing or decreasing positive affect and performance at work. In our framework this is covered by the user characteristics, and it is worth investigating to what extent these different characteristics influence the user experience and its effect on real world outcomes, like team performance.

Aside from investigating transfer effects of gamification, the knowledge on the contextual real-world preconditions influencing the game world experience and behavior could be investigated. Such knowledge would improve the reliability of the aimed transfer effects. For instance, it seems that equality is an important precondition for competition to motivate for better performance. It is said that Usain Bolt would have achieved a better 100 m world record (estimated at 9s55) at the Olympics of 2008, had he not started to celebrate his win after 60 m. In other words, the competitive aspect reduced his performance because there were no equal competitors. The eventual world record (9s58) did originate from competition with opponents that kept up during the race. Are there more preconditions for competitive and cooperative experience to have an effect on performance? And can designers influence them? Equality for example can be accounted for by selection procedures, or handicapping. We do, however, need to know possible drawbacks of handicapping. It might level the goal attainment between the players but it might also demotivate the players socially and individually to play the game.

26.7.2 Transfer Effects

Games, just as any other type of media, are found to have a transfer effect in the real world. But how specific elements contribute to emotional, cognitive, or behavioral transfer is not well known. For instance, violent game content has been said to cause for violent behavior in the real world, but recent investigations indicate that other game elements have a greater impact on real world behavior. It seems that competition, not violence, is the video game characteristic that has the greatest influence on aggressive behavior. There is at least a short-term effect, most likely due to the increased physiological arousal that was measured in competitive games (Adachi & Willoughby, 2011).

Following this study, the effect of playing violent video games cooperatively or competitively on subsequent cooperative behavior was investigated. The conclusion of this study was that cooperative gameplay (as opposed to competitive gameplay) induced significantly more cooperative behavior in a non-game situation (Edwoldsen et al., 2012). A study about the connection between competitive game play and aggressive cognition showed that cooperative play modes prompt less aggressive cognition (Schmierbach, 2010). Moreover, in a study on altruistic behavior, test subjects were given Superman-like flight in a virtual reality simulator. This increased participant's helping behavior, which suggests that "heroic behavior in a virtual environment can transfer to altruistic behavior in the real world" (Carey, 2013).

So behavior in experienced game worlds affects behavior in the real world and this is as well likely to be the case within the context of team meetings. If we implement a competitive game design element in the Red team meetings, for example, employees might become more competitive within the organization in general. Investigation of such long-term transfer effects is not only interesting but also needed from an ethical perspective.

26.8 Conclusion

By designing gamification for teamwork we can structure how teams work together and improve collaboration within the team. Game design elements are used to transport users towards a game world experience, and within this game world we steer them towards competitive or cooperative behavior. By addressing factors that affect team performance in non-game contexts we can actually improve the real world collaboration and thereby achieve more optimal team outcomes.

Our study on the use of implicit rules in a multiplayer Breakout game showed that implicit rules influence users in behaving cooperatively or competitively. Based on these results and on insights from organizational psychology, we developed a gamification framework for teamwork in order to analyze and design gamified teamwork situations. We are confident that this is a fruitful starting point for further research and design projects, as illustrated by the leadership game from RANJ and the Red team case at Berenschot that is in fact closer to gamification.

Acknowledgments We would like to thank Ludwig Hoeksema and Tim Krechting from Berenschot for providing us the Red team case and critically reviewing this chapter. We thank Michael Bas and Dennis Haak from RANJ serious games for sharing their expertise with us, and Linda van Veen and Bas van Nuland from TU Delft Signature Games for providing extensive information about the game TeamUp. This research is funded within the Creative Industry Scientific Program (CRISP). CRISP is supported by the Dutch Ministry of Education.

References

Adachi, P. J. C., & Willoughby, T. (2011). The effect of video game competition and violence on aggressive behavior: Which characteristic has the greatest influence? *Psychology of Violence, 1*(4), 259–274.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117–148.

Bogost, I. (2007). *Persuasive games: The expressive power of videogames*. Cambridge: MIT Press.

Caillois, R. (1961). Man, play, and games. University of Illinois Press.

Carey, B. (2013) Stanford experiment shows that virtual superpowers encourage real-world empathy. *Standford report.* Retrieved February 22, 2013 from http://news.stanford.edu/news/2013/january/virtual-reality-altruism-013013.html

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management, 23*(3), 239–290.

de Dreu, C. K. W. (2006). When too little or too much hurts: Evidence for a curvilinear relationship between task conflict and innovation in teams. *Journal of Management, 32*(1), 83–107.

Deterding, S. (2013). Skill atoms as design lenses for user-centered gameful design. *CHI'13*. Paris, France: ACM.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification. *MindTrek'11.* Tampere, Finland: ACM.

Deutsch, M. (2006). Cooperation and competition. In M. Deutsch & P. T. Coleman (Eds.), *The handbook of conflict resolution: Theory and practice*. San Francisco, CA: Jossey-Bass.

Edwoldsen, D. R., Eno, C. A., Okdie, B. M., Velez, J. A., Guadagno, R. E., & DeCoster, J. (2012). Effect of playing violent video games cooperatively or competitively on subsequent cooperative behavior. *Cyberpsychology, Behavior and Social Networking, 15*(5), 277–280.

Gajadhar, B. J., de Kort, Y. A. W., & Ijselsteijn, W. A. (2008). Shared fun is doubled fun: Player enjoyment as a function of social setting. *Fun and Games*.

Hackman, R. J. (1969). Toward understanding the role of tasks in behavioral research. *Acta Psychologica, 31*, 97–128.

Hackman, R. J. (1987). The design of work teams. In J. Lorsch (Ed.), *Handbook of organizational behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Hamari, J. (2013). Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service. *Electronic Commerce Research and Applications, 12*, 236–245.

Hunicke, R., LeBlanc, M., & Zubek, R. (2004) MDA: A formal approach to game design and game research. *Proceeding of the AAAI Workshop on Challenges in Game*. San Jose, CA: AAAI Press.

Huotari, K., & Hamari, J. (2012). Defining gamification—A service marketing perspective. *MindTrek 2012*. Tampere, Finland: ACM.

Jehn, K. A. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative Science Quarterly, 40*, 256–282.

Johnson, D. W., & Johnson, R. T. (2006). New developments in social interdependence theory. *Genetic, Social, and General Psychology Monographs, 131*(4), 285–358.

Kort de, Y. A. W., Ijsselsteijn, W. A., & Poels, K. (2007). Digital games a social presence technology: Development of the social presence in gaming questionnaire (SPGQ). *Proceedings of Presence 2007, Barcelona*.

Kozlowski, W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7*(3), 77–124.

McGonigal, J. (2011). *Reality is broken*. London: Jonathan Cape.

Mitchell, T. R., & Daniels, D. (2003). Motivation. In W. Borman, D. Ilgen, & R. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology*. Hoboken, NJ: Wiley.

Mollick, E. R., & Rothbard, N. (2013). Mandatory fun: Gamification and the impact of games at work. *The Wharton School research paper series*.

Nicholson, S. (2012). A user-centered theoretical framework for meaningful gamification. *Games + Learning + Society 8.0, Madison.*

Rahim, M. A. (2002). Toward a theory of managing organizational conflict. *The International Journal of Conflict Management, 13*(3), 206–235.

Reeves, B., & Read, J. L. (2009). *Total engagement: Using games and virtual worlds to change the way people work and businesses compete*. Cambridge, MA: Harvard Business Press.

Rozendaal, M. C., Braat, B. A. L., & Wensveen, S. A. G. (2010). Exploring sociality and engagement in play through game-control distribution. *AI & Society, 25*(2), 193–201.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human Factors, 50*(3), 540–547.

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.

Salen, K., & Zimmerman, E. (2005). *The game design reader: A rules of play anthology*. Cambridge, MA: Massachusetts Institute of Technology.

Schell, J. (2008). *The art of game design: A book of lenses*. Boca Raton, FL: CRC Press Taylor & Francis Group.

Schmierbach, M. (2010). "Killing spree": Exploring the connection between competitive game play and aggressive cognition. *Communication Research, 37*(2), 256–274.

Signature Games. (2009). 'TeamUp', *TU Delft signature games*. Retrieved October 17, 2013, from http://signaturegames.nl/gamelab/game/teamup/

van de Vliert, E., & de Dreu, C. K. W. (1994). Optimizing performance by conflict stimulation. *The International Journal of Conflict Management, 5*(3), 211–222.

van den Bossche, P., Gijselaers, W. H., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521.

Visch, V., Vegt, N. J. H., Anderiesen, H., & van der Kooij, K. (2013). Persuasive game design: A model and it definitions. CHI 2013 Workshop Designing Gamification. Paris: ACM.

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly, 40*, 145–180.

Weibel, D., Wissmath, B., Habegger, S., Steiner, Y., & Groner, R. (2007). Playing online games against computer- vs. human-controlled opponents: Effects on presence, flow, and enjoyment. *Computers in Human Behavior, 24*, 2274–2291.

Winn, B. M. (2009). The design, play, and experience framework. In R. E. Ferdig (Ed.), *Handbook of research on effective electronic gaming in education*. Hershey, PA: IGI Global.

Winters, D., & Latham, G. (1996). The effects of learning versus outcome goals on a simple versus a complex task. *Group and Organization Management, 21*, 236–250.

Zadro, L., Williams, K. D., & Richardson, R. (2004). How low can you go? Ostracism by a computer is sufficient to lower self-reported levels of belonging, control, self-esteem, and meaningful existence. *Journal of Experimental Social Psychology, 40*, 560–567.

Chapter 27
Gamification and Law

On the Legal Implications of Using Gamified Elements

Kai Erenli

27.1 General Information About This Chapter and Introduction

When it comes to social media, online interactions and gamification, many people often overlook how the law factors in[1].

Parlor games were a big thing in my family when I was little. Every Christmas one family member would get a new game which was then played excessively over the holidays. But every time before we could start we had to learn the rules. That was by far the most annoying part of the whole process. As no one really liked to read them, this always had to be done by my grandfather, who was a patient man and a former teacher. The latter certainly helped a lot to convey the rules to the waiting crowd effectively. Nevertheless most often in the end no one was listening and instead everyone demanded, "Let's play already, we will learn the rules along the way."

Even though this "learning by doing" approach was already validated as expedient by Aristotle in his Nicomachean Ethics[2] some 300 years before the common era started, it can be stated that while this method is valid for games it is certainly not for law. The legal sphere recognizes "learning by doing" only in small areas concerning actions of good faith (in some countries, for instance, you can keep a stolen car that you bought unaware of the fact that it legally belonged to someone else), but as we all know it typically punishes misbehavior by sanctions (if you park the same car in a "no-parking zone" you will have to pay the respective fine and odds are against you that you will be able to talk yourself out of it).

[1] http://www.gamification.co/2011/02/11/gamification-law-ftc-guidelines/

[2] for a Translation, with Interpretive Essay see Bartlett et al. 2011.

K. Erenli (✉)
Fachhochschule des bfi Wien Ges. m.b.H.,
Maria Jacobi Gasse 1/3.4/Media Quarter Marx, Vienna 1030, Austria
e-mail: kai.erenli@fh-vie.ac.at

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_27

Lawyers are killjoys. Period. Every time you ask one, you get the answer: "It depends." Therefore, no one likes to talk to a lawyer while motivation in a (gamification) project team is still high and things are rolling smoothly. In fact, however, that might be a bad idea. As soon as the project goes "live", it has to comply with innumerable laws or it might be "Game Over" before the project really gets started. Therefore, on with the lawyer talk before you keep on reading: the information in this chapter does not constitute legal advice or a legal opinion as to any particular matter. This chapter is intended for general information purposes only!

The answer "It depends" derives from the fact that each project is different and therefore has to be judged individually. So many aspects have to be taken into consideration that a definitive answer is hard to give. Gamification does not only represent one specific game system or a specific set of game design elements, it is developed further every day, thus constantly creating new scenarios. Gamification is used in a wide variety of fields, such as marketing, customer relationship management, education, gambling, etc., and each field is itself governed by a whole set of rules making gamification and law a huge cross-matter topic (which exists to protect users, developers and business owners alike.)

Moreover, gamification exists around the world[3] and thus many different regulations–global, european, nationwide or local rules (which are also in a constant process of evolution)–have to be checked and applied to each gamification project, adding a cross-border aspect to it. Still not enough, in countries with a case law system legal certainty is based on the fact that a preceding judgment has been made. Regarding gamification, only few court rulings exist at the moment. Even though there might be many legal disputes regarding gamification, not many have been litigated to the end yet, thus staying disclosed. This chapter therefore might not fulfill all expectations, for "the answer" does not exist; so be warned. Nevertheless it tries to demonstrate cases common to gamification and legal risks related to it so that these can be avoided or addressed accordingly.

Having wagged the finger, let's take a short look at gamification and numbers from a legal perspective:

1. **There is no legal definition of "Gamification" or "Games"!** Games can happen anywhere, and everywhere and always (Castranova 2006: 71). Lawyers (and especially judges) love definitions they can rely on. If there is none, they have to interpret gamification on their own. This may result in a different assessment of what gamification is and what it is not, followed by applying different regulations.
2. **32 % of gamers in the US are under the age of 18**.[4] It is generally acknowledged that "gamers" and people engaged by gamification are not coactively the same, but many gamified elements have a young target group in mind as it is widely known that this target group has a high affinity towards gaming. This fact might be of interest to consumer protection law authorities.

[3] See http://www.google.com/trends/explore#q=gamification.

[4] http://www.theesa.com/facts/pdfs/ESA_EF_2013.pdf.

3. **100 % of 6- to 10-year-olds in the UK[5] play games**. If you plan to conclude a contract with this target group, it might be wise to talk to their parents first.
4. **Total consumer spending on games in the US in 2012: $ 20.77 billion**.[6] This figure might not have any direct legal impact but it tells a few stories. First of all, there is a *market*. And when there is a market, there is a playing field for lawyers! Gamification may generate additional business for law firms able to understand the topic (helping to establish legal certainty for gamification in the process). Second there is *money*. And when there is money, there are banks and tax authorities. The European Central Bank has already recognized the impact of Virtual Currency,[7] so has the IRS[8] (and we all know what one is in for once the IRS has spotted something). In contrast to traditional payment systems, the use of virtual currencies is not regulated, which might attract criminals, thus giving virtual currencies a bad reputation in general. Such a bad reputation on a fundamental item of a gamified system can poison the entire product even if it was designed with the best of intentions. In such a case, demanding compensation will be tough if not impossible.

Finally there is a big difference between acting in a game and acting in real life (Erenli, 2009: 266). Games are places where people only act as if something mattered (Castranova: 71). When you "eliminate" a player in a board (or video) game this player might get grounded for a round while you are able to advance (Lastowka & Hunter, 2006: 127). When you "eliminate" someone in real life, however, you will face a long prison term. This dilemma has already been heard in court many times, with one case making its way into the first-semester classes at law school.

On September 16, 1973, the professional football team Denver Broncos played the Cincinnati Bengals in Denver, Colorado. Dale Hackbart was under contract for the Denver Broncos. He was playing free safety on the Broncos' defensive team when he was struck by Bengals fullback Charles Clark and suffered a neck injury that caused him to end his career. The case that was controlled by the laws of Colorado was tried in court afterwards and set a precedent. The court ruled "*that in the course of a professional football game an intentional infliction of an injury by one player upon another might constitute a tort*."[9] In 2012 a German court ruled that a soccer player "*cannot be held liable for inflicting an injury on another player while following the rules of the game and of fairness*." But if the player violates these rules—in this case Regulation #14 of the German Football Association (DFB)—he can be held liable and has to compensate the damage.[10]

---

[5] http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/05/entertainment_gaming_in_the_uk/html/3.stm.

[6] http://www.theesa.com/facts/pdfs/ESA_EF_2013.pdf.

[7] http://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf.

[8] http://www.irs.gov/Businesses/Small-Businesses-&-Self-Employed/Tax-Consequences-of-Virtual-World-Transactions.

[9] *Hackbart v. Cincinnati Bengals, Inc*., 601F.2d 516 (10th Cir. 1979).

[10] Urt. v. 22.10.2012, Az. I-6 U 241/11 (Judgement).

The norms of game play supersede the standard rules of society and "*the magic circle of game play will only be broken when a player violates the game rules*" (Huizinga, 1971: 13). Hence both systems are different but sometimes end up overlapping. This is especially true for location-based games. In 2012 many players of the popular location-based game *Ingress* got into trouble with law enforcement officials while playing the game next to "high-interest targets" such as airports, police stations or embassies.[11]

27.2 Laws and Regulations, Selected Cases and Best Practices

Since it has now been shown that games and the law have already established some kind of relationship we need to find out what this means for gamification. To this end, selected fields of law will be described briefly and possible legal risks will be identified. Finally the identified risks will be evaluated. As stated before the legal risks are within a cross-sectional area, thus an in-depth analysis cannot be carried out. The identification of potential risk should aid to balance possible legal risks and avoid cases of liability. Let us now first take a look at common areas of law and their impact on gamification.

27.3 Civil Law: Contract Law (Terms of Service)

Contracts are the core of our modern society. Whether you buy a car, subscribe to an online service or start a new job, there is always a contract (even when you have nothing in writing!). The common elements of a contract are offer ("I want to buy this car from you"), acceptance ("You are allowed to buy the car from me") and the intention to create legal relations ("I will wash your new car every Tuesday from now on"). Contracts shall protect both parties and isolate the subject matter of the contract from those that are outside of the agreement ("The new car will get cleaned every Tuesday, not a bike, and not on Wednesday or Friday"). Contracts have to comply with legal rules and regulations as they are on a lower level in the system of law. (At the top are the Constitution, federal laws and state laws or, in the EU, the Treaties establishing the European Union (primary law) and the regulations and directives which are based on the Treaties (Secondary Law). There are many regulations that put contracts within certain limits: 2-year-old children cannot negotiate a contract to buy a car, you are not allowed to fire your boss (regardless of how much you want to) or buy real estate on Mars. Although many of these protective regulations can be found in contracts where one party is a consumer (B2C), many exceptions exist for B2B contracts. Let's take a look at a popular game-related case in which a contract was in dispute:

[11] http://readwrite.com/2012/12/11/augmented-reality-game-gets-player-arrested-the-first-of-many#awesm=~ogDVhQMCyxL1cI.

27.3.1 Bragg vs. Linden Lab

In 2006 Marc Bragg, a Pennsylvania lawyer, brought a lawsuit against Linden Lab, the developer of Second Life, when his account was unilaterally disabled by Second Life administrators. Linden Lab claimed that Marc Bragg had violated their Terms of Service by URL hacking to gain access to otherwise unavailable auctions. As a result, Bragg was able to purchase virtual land in Second Life valued at $ 1,000 for approximately $ 300. Bragg's account was suspended and later closed completely. Bragg argued that by closing his account, Linden Lab had also dissolved his virtual assets, which he valued at between $ 4,000 and $ 6,000.[12] The case was settled before a final decision was reached. However, the District Court did decide on two issues[13]:

1. Second Life Terms of Service's mandatory arbitration provision was unenforceable; and
2. interaction with a person in a virtual world can satisfy a state's "minimum contacts" requirement for personal jurisdiction.

For many years businesses and especially providers have been playing their own game of contracts. It is called "**Terms of Use Game**" and works like this: the provider promises to offer his service if the user agrees to a contract most often named "Terms of Use/Service" (ToU or ToS) or "End User License Agreement" (EULA). If the user declines, the offer is rescinded, negotiation is not an option. To spice up the game, this underlying agreement has been prepared by a person who is fluent in "legalese" and is therefore confusing for the user, who most often does not speak this language. Additionally it challenges the user to stay alert for a very long time, since these contracts can go on for many, many pages. Here we can point to the first regulation that has a direct impact on gamification service providing. According to many rulings, Terms of Use have to be designed in a "reasonable way"[14] and have to comply with consumer protection rules.[15] This can be seen in the District Court ruling in Bragg vs. Linden Lab, where the mandatory arbitration provision was declared unenforceable.

From the provider perspective, Terms of Service are a powerful tool, since many specific aspects of the service/project can be addressed, but providers have to take into account that complex or unilateral clauses may be challenged by a user and stand the risk of being waived by a court. Moreover, a handy hint should be given to gamification provider start-ups: do not simply copy Terms of Use found on the web and deemed suitable for the service/project. First of all, this may be an infringement of copyright, but more importantly it can also be considered unfair commercial practice (which will be addressed later in this chapter). Being confronted with a

[12] http://en.wikipedia.org/wiki/Bragg_v._Linden_Lab.

[13] *Bragg v. Linden Research*, *Inc*., 487 F.Supp.2d 593 (E.D. Pa. 2007).

[14] e.g. § 305 German BGB (Civil Law Code), § 6 Austrian KSchG (Consumer Protection Law),

[15] LG Bielefeld (Regional Court), 30.10.1991 - 1S 174/90.

takedown notice or lawsuit in a gamification start phase might not only damage the budget or reputation!

From the user perspective, the following statement seems very true: "'*I have read and agree to the Terms' is the biggest lie on the web. We aim to fix that*."[16] Many ToS are annoying to read—those who have tried to read all of Apple's ToS for their iTunes service on their iPhone may be inclined to agree—and difficult to understand.[17] The "length aspect" is particularly true for services provided in the USA. This derives from the fact that every time a business makes a rule, someone figures out a way to stretch the limits (as mentioned above). Businesses therefore try to cover every conceivable aspect important to them so as not to potentially expose themselves to legal action.

Nevertheless there are some archetypes which may inspire the gamification community. Luckily one of these positive examples is in fact a gamification project. The ToS of the popular science gamification project "foldit"[18] are easy to read and understand as well as explanatory in character. All important aspects seem to be covered, and even the event of a scientific breakthrough is handled in one tiny clause. Section g) states that "*Scientific discoveries will be made publicly available and the University of Washington will handle ownership of discoveries. All significant scientific discoveries* (*such as structures*, *algorithms*, *etc.*) *made in game will be made publicly available. In the event that some discoveries may warrant patent protection*, *University of Washington will handle the patent application process. US patent law will govern IP attribution for each discovery. Individual players who contributed to the discovery will be considered co-inventors for any discovery produced through play. Data logs of player activity will assist in determination of attribution*."[19] Players engaging in the game and contributing valuable data will get recognized by the project and have legal certainty through foldit's ToS. This clause is especially interesting for gamification projects where the "wisdom of crowds" is used or a community approach has been chosen to solve problems (see Kapp, 2012: 108). The question to whom the intellectual property gained or developed by the community belongs should be addressed beforehand.[20]

Regarding the work force of a community, taxation is a relevant topic. When a "Mechanical Turk Worker"[21] delivers work, he or she gets paid a certain amount and thus taxation laws may apply. Since "workers" can be sitting anywhere in the world, the provider of the service delegates responsibility to obtain all relevant information regarding taxation to the worker. The ToS called "Participation Agreement" mandates that "*it is your responsibility to determine any and all taxes and duties*, *including without limitation*, *sales*, *use*, *transfer*, *value added*, *withholding and other taxes and/or duties assessed*, *incurred or required to be collected*, *paid or*

[16] http://tosdr.org.

[17] http://edition.cnn.com/2011/TECH/web/05/06/itunes.terms/ .

[18] http://fold.it/portal/communityrules .

[19] http://fold.it/portal/legal.

[20] for more details see "Copyright".

[21] https://www.mturk.com/mturk/welcome .

withheld for any reason in connection with any request for, or performance of Services, or your use of the Site, or otherwise in connection with any action, inaction or omission of you or any affiliate of yours, or any of your or their respective employees, agents, contractors or representatives ("*Taxes*") *and to collect, withhold, report, and remit correct taxes to the appropriate tax authority, and to otherwise be responsible for the collection and payment of any and all Taxes. YOU ALSO AGREE THAT AMAZON MECHANICAL TURK AND ITS AFFILIATES ARE NOT OBLIGATED TO DETERMINE WHETHER TAXES APPLY AND ARE NOT RESPONSIBLE TO COLLECT, REPORT, OR REMIT ANY TAXES ARISING FROM ANY TRANSACTION.*"[22]

This regulation makes sense if we take a look at the relationship between "Worker" and "Requester" from the perspective of labor law. In section 3b the Participation Agreement states that the work relationship qualifies as "work made for hire". Whether this is true has to be ascertained by each respective law worldwide. In many nations there are regulations governing "contracts for service". Most of them have clear definitions to separate "contract for service" and "contract for employment". This is of great importance since the legal consequences and effects are very different. While in most "contracts for employment" taxation lies within the responsibility of the employer, the opposite is true for "contracts for service" as in the latter the employer has no knowledge of the contractor's turnover. Nevertheless, the legal system does not go by a (virtual) sheet of paper but by the facts of reality. Whether or not a contract labels the "Worker" and "Requester" relationship "work made for hire", this relationship is not bound by contract but legally obligated. If a "Worker" earns his or her living solely out of "Mechanical Turks" contracts, this may be considered "contract for employment" with all corresponding legal consequences and effects. Regarding taxation, for instance, if such a "Worker" is a US citizen these earnings generate a tax liability to the US government. ToS lay out a path but they are not carved in stone. It might be a good idea after all to check the ToS of other gamification providers to see which aspects seem to be crucial for them.

27.3.2 Peter Ludlow vs. Electronic Arts

Let's finish this topic with a statement by Jeff Brown, (then) vice president for communications at Electronic Arts: "No law was violated. It's a game."[23] He made this statement after Electronic Arts, provider of the Virtual World "The Sims Online", terminated the account of Peter Ludlow, who had repeatedly reported misbehavior by other users (e.g. accusing 13-year-olds of running a prostitution ring). This case is important to consider because it has a money value to it. Inside The Sims Online,

[22] https://www.mturk.com/mturk/conditionsofuse.

[23] http://www.nytimes.com/2004/01/15/business/technology-a-real-life-debate-on-free-expression-in-a-cyberspace-city.html?pagewanted=3&src=pm.

avatars could[24] pay their debts with the virtual currency "Simoleans", which could be exchanged with real dollars. And as demonstrated above, where there is real money involved games have to go by "real" rules, aka laws. Ironically Ludlow's account was terminated by Electronic Arts because they accused him of violating the ToS. Ludlow had reached out to the community and had blogged about his findings on his website "The Alphaville Herald".[25] Many critics (Belkin & Noveck, 2006: 97, Pearce, 2011: 41) have argued that this action by Electronic Arts would have been a First Amendment case because Ludlow's right of free speech was violated, but since "The Sims Online" was only a virtual world, the constitution of this world was Electronic Arts' ToS. Gamification providers may want to take into consideration that this now-seemingly-established fact might change in future cases since real and virtual worlds increasingly tend to merge.

27.4 Civil Law: Liability and Measurability

Finally this part shall be concluded with the following thoughts on the liability and measurability of gamification. Since many people are skeptical of gamification, taking care of these issues is a good idea. Many gamification projects, such as exergames etc., concern the field of healthcare (see Zichermann & Linder, 2013: 7) and are designed to engage people to stick to their fitness plans, help them recover from a surgery or to promote a higher-quality work life. But users might overdo the fitness activities or do the exercises wrong and in the end the project might be responsible for causing harm to their health. The tricky part about liability cases is that many end in "bet the company" litigation (especially when the gamification provider is a small or medium enterprise) because they can be individual suits or consolidated mass tort cases. Next to that the success of gamification is hard to determine. Therefore it is crucial that measurable goals (e.g. using the "SMART" criteria (Doran, 1981)) are set at the beginning and are also integrated in the contract. Integrating such measurable goals will help to identify the end of the contract. A contract for service terminates when the deed is done. As long as the customer is not satisfied the contract is alive and work (still) has to be delivered. Most of the time these aspects are forgotten at the time of conclusion of the contract as no one wants to becloud the usually young relationship with such little discomforts. Nevertheless, this negligence frequently results in a mood swing when the gamification provider thinks the work is done and wants to collect his money. Without clear criteria it might be hard to prove that the contract has been fulfilled. This will create a dominant position for the client, who is able to blackmail the provider especially if the latter is a small or medium-sized enterprise because this might create a cash-flow problem. Bringing in a legal expert will cost much money and therefore might not

[24] Electronic Arts shut down service of "The Sims Online" in August 1, 2008 (http://news.cnet.com/8301-17938_105-9931757-1.html).

[25] http://alphavilleherald.com/.

be an option for the provider. Hence, he will try to satisfy the client at all cost. To avoid this scenario it is strongly recommended to insert measurable criteria at the beginning.

But the provider is not only in a weak position. Especially in a contract for service he has a powerful tool: copyright (and in the U.S.: patent) law.

27.5 Copyright Law

"Because you pay for something does not mean you own it," a gamification lawyer told the audience at a gamification conference. This might sound confusing as this is the essential attribute of a purchase. As soon as you hand over the money you gain ownership and the right to control the purchased good. While this is very true for material goods, it is not so true for immaterial goods like intellectual property rights. Most important to mention here are copyright and patent laws. Intellectual property laws are crucial for gamification since applying gamified elements demands a lot of creativity and brainwork. Unfortunately copyright law does not protect ideas. Copyright law only protects the expression of these ideas. The general understanding is that ideas are part of the public domain and therefore no one can have a monopoly on an idea regardless of how great the idea is. Section 102 of the U.S. Copyright Act clearly states that "*in no case does copyright protection for an original work of authorship extend to any idea*, *procedure*, *process*, *system*, *method of operation*, *concept*, *principle*, *or discovery*, *regardless of the form in which it is described*, *explained*, *illustrated*, *or embodied in such work*". As early as 1879 a U.S. court decided that "the foundation of federal copyright law is that open expressions of ideas, not the ideas themselves give rise to protected interests."[26] This is also recognized by other legislations throughout the world. Even the Berne Convention does not specifically address the term "idea" within the convention and merely describes works that can be protected as expressions.[27] This is sad news for the protection of gamification business models—BUT only from the point of view of copyright law. There are many other laws like the Unfair Commercial Practice Law that keep these ideas safe. Nevertheless, it is always a good idea to sign another contract on this behalf: a Non-Disclosure Agreement (NDA). Even though this will not keep you or your ideas safe at all times, it does draw attention to the fact that whistleblowing or acts of negligence will not be regarded as trivial offenses. NDAs should be signed before a project team sits down together and starts exchanging ideas to prevent someone on the team suddenly choosing to leave and play the game solo (or with someone else).

[26] *Baker* v. *Selden*, 101 U.S. 99 (1879).

[27] see also *Harris*, The Legal Protection of Ideas, http://www.copyrightlaws.com/wp-content/uploads/2010/04/Protecting-Ideas1.pdf.

To return our focus to the topic we need to take a closer look at legislative acts. The "Digital Millennium Copyright Act–DMCA"[28] and its European sister, the "European Union Copyright Directive–EUCD",[29] are powerful tools which have led to long controversies.[30] Moreover, U.S. American law recognizes the doctrine of fair use,[31] which is unknown to European law even though some limitations and exceptions to copyright exist in Europe as well.

27.5.1 Betamax Case[32]

When Sony developed the Betamax videotape recording format in the 1970s, Universal Studios and the Walt Disney Company were among the film industry members who were not too happy about that development. Both companies therefore opted to sue Sony and its distributors in California District Court in 1976, alleging that because Sony was manufacturing a device that could be used for copyright infringement, they were thus liable for any infringement committed by its purchasers. In 1978 the District Court ruled in favor of Sony on the basis that noncommercial home use recording was considered fair use and that access to free public information was a First Amendment public interest served by this use.

The concept of fair use is a limitation and exception to the exclusive right granted by copyright law to the author of a creative work. In United States copyright law, fair use is a doctrine that permits limited use of copyrighted material without acquiring permission from the rights holders. Commentary, search engines, criticism, news reporting, research, teaching, library archiving and scholarship are considered fair use. It provides for the legal, unlicensed citation or incorporation of copyrighted material in another author's work under a four-factor balancing test.

Fair use is crucial for gamification, for every project that has a story in it might be infringing the copyright of another author (because someone just copied & pasted it, because he or she did not care/was not aware of the infringement/both) or be at risk itself of getting copied by someone (who does not care/is not aware of the infringement/both). Many successful stories suffer this fate. It is called "Fan Fiction" (remember when many people just could not wait to read the last Harry Potter and some fans wrote their own end to the story?[33]).

Since many gamification projects deal with virtual assets, goods or more important currency the story is about Ownership vs Licencing. This story is about

[28] PUBLIC LAW 105–304—OCT. 28, 1998 (retrievable under: http://www.gpo.gov/fdsys/pkg/PLAW-105publ304/pdf/PLAW-105publ304.pdf).

[29] ABl. EG Nr. L 167/10,22.06.2001.

[30] see https://www.eff.org/issues/dmca or http://eucd.info/index16ea.html?English-readers.

[31] 17 U.S.C. § 107.

[32] *Sony Corp. of America v. Universal City Studios, Inc.*, 464 U.S. 417 (1984).

[33] http://news.bbc.co.uk/2/hi/entertainment/3753001.stm or see what happened with the game "Uru" in *Pearce*, Communities of Play 174.

to be written right now and has led to an ongoing discussion within the community. For better understanding the most important thoughts are presented hereafter. Be warned that since no judgment has yet been arrived at this section is somehow esoteric, but therefore the matter is still open for new ideas. This is the current state of opinions:

Wu classifies virtual goods as a "Service."[34] Buying a certain amount of virtual currency saves the user time he otherwise would have to spend in the virtual world to gain this amount of virtual currency. Fairfield describes virtual goods as "rivaling source code" and opts to subsume them as material goods since virtual goods are controlled by a single person just like real goods (Fairfield, 2005: 1049). Fairfield criticizes that virtual items are classified under copyright law because they are thereby substantially excluded from the protection of property law. He deems protection by ToS totally inadequate and thinks that only a legally protected good is sufficiently attractive for the economic market. Since source code as such does not possess the same exclusivity as things, one should ascribe this exclusivity to virtual items. Merrill asserts that "rivalrousness, in the physical world, lets the owner exclude other people from using owned objects." (Merrill, 1998: 77). In addition to this, Fairfield also looks to persistence, i.e. permanent existence in the virtual world and interconnectivity, as a key factor. In this context, interconnectivity describes the fact that the user can use the objects created by the developer to interact with them. This establishes a yaw interconnection, such as when dealing with real objects. Lastowka and Hunter in turn choose a utilitarian approach to the legal classification (Lastowka & Hunter, 2003, Virtual Worlds 57). They see copyright law as an incentive. People would only create virtual items if they simultaneously establish an exclusive claim on the created asset. This hypothesis is supported by Castranova. Exclusive protection justifies the time and effort invested by users to create their virtual items (Castranova, 2001 Virtual Worlds 10).

So, who owns the virtual good? American courts have had to deal with this question repeatedly. (Erenli, 2009: 268) The first major case was Black Snow Interactive (BSI) vs. Mythic Entertainment.[35] Mythic Entertainment prevented the sale of virtual objects by BSI in the virtual world "Dark Age of Camelot" since Mythic Entertainment was of the opinion that BSI had produced these virtual objects by exploiting vulnerabilities in the source code (which, moreover, was a violation of the ToS). BSI sued, aiming to have the ToS declared invalid. Ultimately, this goal was not reached as the competent court decided the case by arbitration. Had this case been finally decided by a court of law, this would have significantly contributed to answering the question of ownership. Currently, therefore, the (mostly restrictive) ToS apply, putting the developer or provider in a strong position. This is widely criticized but does not change the fact that in the U.S. virtual goods are mainly owned by the developers. Excepted are those projects in which the ToS contain other provisions.

---

[34] *Wu*, Virtual Goods: the next big business model, http://techcrunch.com/2007/06/20/virtual-goods-thenext-big-business-model.

[35] http://virtual-economy.org/blog/blacksnow_interactive_the_docu.

Now what about Europe? The current situation in Germany, where the discussion how to evaluate virtual items in legal terms began in 2005, can be regarded as representative. Since then, the classification of virtual objects as interest of property has regularly been rejected with reference to the sub-physicality of the virtual object. (Klickermann, 2007, Koch, 2006, Lober & Weber, 2005) Similar to the U.S., most often reference is made to the ToS (Lober & Weber, 2005: 656). Independent protection for virtual goods in favor of the user is rejected because "the player cannot use the individual items detached from the game." (Koch, 2006). In accordance with the motto "All rights reserved", like in the U.S. the virtual good belongs to the developer (unless stated otherwise in the ToS).

The current state of opinions implies relevant steps for gamification providers, which unfortunately apply only to providers in the U.S.[36] Every work created on or after January 1, 1978, has copyright protection for that work from the moment when the author of an original creates it and fixes it in a tangible medium. Moreover (and this is true for Europe as well): These rights exist even when no copyright application is filed. Unlike other laws, such as patenting or trademarks, copyright exists automatically as soon as the work has been created. Nevertheless, registration may be done at any time (as long as the work is still protected by copyright). However (and this is important for gamification providers in the U.S.), additional benefits result from timely filing a copyright application with the United States Copyright Office. The registration procedure is neither time-consuming nor complex or costly. There is a $ 35 fee for each copyright application for online submissions ($ 50–$ 65 for mail-in submissions). Once the Copyright Office has approved the application it will reward a certificate of registration. The process usually takes from 6 months to 1 year, but an expedited registration process, which requires special fees, can be utilized to obtain a registration within about 1 week. This is strongly advised if the project is urgent or there is an emergency, such as contract negotiations or pending litigation. Benefitting from a timely copyright registration, the copyright owner can file a lawsuit immediately if necessary. Additionally, the copyright owner is able to send a "cease and desist letter" to the infringer, meaningfully threatening immediate legal action. Moreover, the copyright owner is also entitled to statutory damages instead of having to prove actual damages. Currently, statutory damages lie within a set range of $ 750–$ 30,000 per infringement. These are useful for a provider when virtual goods are distributed for free or the profits of the infringer are very small. The more deliberate and damaging the infringement, the greater the award (up to $ 150,000 per infringement). Finally, the copyright owner may be entitled to legal costs and attorneys' fees, which may be extremely expensive in a copyright infringement lawsuit (also true for Europe).

Copyright serves a great purpose for protecting a gamification project and connected goods. Using ToS protects this cause. But there are limits controlling how far

[36] Gatto/Leavitt/Duranske, *Copyright Registration for Virtual Goods*: *The Benefits of Timely Filing* (http://www.pillsburylaw.com/siteFiles/Publications/29FA2776F2E9C643EC6CDCF8462D7FD4.pdf).

ToS can go. These rules described hereafter address foul gameplay between gamification businesses and consumers and put sanctions on them.

27.6 Unfair Competition and Consumer Protection Law

Even though these two fields of law address or deal with different contexts (competition law mainly B2B competition, consumer protection law primarily the weak consumer position), they have many things in common. Competition law promotes or maintains market competition by regulating anti-competitive conduct by companies (Taylor, 2009: 1). It is also known as antitrust law in the United States and anti-monopoly law in China and Russia. Its roots reach back to the Roman Empire.[37] As there is no "Gamification Empire" yet, we need not deal with competition law as such but can focus on unfair competition.

Unfair competition laws come into play when copyright law cannot protect the gamification project. As stated, ideas are not protected by copyright law, but they may well be by unfair competition law (and unjust enrichment, of course). Unfair competition law governs foul play within an industry sector or branch of economy. These laws are the rules of the (economic) game, so to speak, and since this is about money, unfair behavior will not result in a "player" having to skip a turn but in criminal charges or punitive damages. This game actually is a race because the forms of competition change continually and new forms may arise at any moment. As a certain kind of competition may be unfair but not illegal until a rule is explicitly made to prohibit it, the referee aka the state has to keep up with the speed of the race to ensure a level playing field. Since it may be difficult to define what it means to compete on equal terms (often referred to as "equal opportunity" or "equal chance" to compete), looking at cases that have already been decided is crucial, especially so in Europe.

One aspect of unfair practice is the misuse of a company's characteristics (which is also covered by trademark law). Whoever acts in a way that is likely to cause confusion with a company's protected trade name or -mark may face legal charges. Another highly relevant aspect for gamification providers is the above-mentioned protection of game design. Game design is the Holy Grail (main asset) of a gamification project. Unfortunately game design can easily fall victim to a copycat attack. Therefore it is strongly advised to protect the transfer of ideas—"know-how transfer"—with a corresponding contract or agreement (NDA). These know-how transfers or communication agreements generally contain confidentiality clauses that prohibit filing a patent request or any similar request that would protect the idea solely for the filer. Nevertheless, gamification providers may have a contractual relationship with partners, subcontractors, etc., but they have none with potential competitors. In a situation where a competitor exploits the game design of another project or offers a similar service parasitically, it is strongly advised to ask for legal counseling. To apply unfair

[37] Lex Julia de Annona.

competition rules it is necessary to be in competition (sounds logical, doesn't it?). The law will only recognize the case if the project has reached a certain level of recognition (mostly measured in sales figures, but the amount spent on marketing, media coverage or a Wikipedia article will serve as proof as well). Besides the recognition requirement, the quality of the idea is also evaluated. The more a certain gamification characteristic is likely to be a part of competition, the lower are the requirements for adoption by someone else (resulting in a ruling of unfair practice). It does not make any difference whether the target of the attack is a good or a service. A German court ruled in the 1980s that the characters of the epic videogame Donkey Kong had exceeded the level of recognition and therefore had to be protected by law,[38] BUT the same court made the mistake to rule that protection of a game should only last between 6 months and a year,[39] since games would lose their audience appeal within this timeframe [sic!]. Fortunately game history has told us otherwise. Nowadays time is not as critical an indicator as it was back in the 1980s; assumed constitutive criteria, exploitation of reputation (called "*slavish imitation*" in patent law) or imitation due to unrighteous gain of knowledge have taken its place instead—another reason why an NDA is not a bad idea.

As stated above, the law does not only regulate competition between businesses but also protects consumers. Consumer protection law or consumer law is the area of law regulating private law relationships between individual consumers and the businesses selling them goods and/or services (in this case gamification providers). It covers a wide range of topics, such as product liability, privacy rights, unfair business practices, fraud, misrepresentation, and other consumer/business interactions. Its main function is to prevent fraud and scams resulting from service and sales contracts. Let's look at the topic from a consumer's vantage point:

27.6.1 Example: Picknplay

In Sweden, a fast food franchise revived the classic game Pong by installing an interactive billboard setup.[40] The billboard invited pedestrians to engage with it through a mobile website. Upon visiting the website, the GPS feature of the user's smartphone verified the location and the player had to "survive" for 30 s to win a prize. The coupon could then be redeemed at a nearby fast food restaurant.

Many gamification projects are trying to engage customers in order to connect with them and improve the business-customer relationship (Zichermann & Linder, 2013: 8). Classical marketing tools do not seem to work well enough anymore, so sophisticated tools and methods like gamification have to get the word out. "*Behind every successful consumer app, there is a thoughtful, well-designed engagement*

[38] *OLG Frankfurt* GRUR 1983, 757 "*Donkey Kong* Junior I"; *OLG Frankfurt* WRP 1984, 79 "*Donkey Kong* Junior.

[39] *OLG Frankfurt* GRUR 1983, 758.

[40] http://picknplay.se/

loop." (Zichermann & Linder, 2013: 176). As soon as the app or project has gone viral, the gamification project is likely to be on the road to success. That is the moment when consumer protection law is overlooked most of the time, maybe because all resources on the provider side have to ensure the project keeps going or the monetary return makes the provider look at legal aspects somehow differently. The German Federal Court of Justice ruled just recently that advertising messages within a (free) game aimed at children with a link to paid offers to buy accessories for the game are unlawful.[41]

Gamification wants to engage the player in order to create a stronger relationship with the subject or company. Engagement is achieved when a player does something out of his own motivation. In many gamification projects this Engagement results in "user generated content". Since gamification addresses cognitive abilities in the subconscious, it is likely to be manipulated to facilitate unfair commercial practices. "*Efficiency is not illegal itself, but it may, depending on the nature of the business' involvement and encouragement, be an unfair commercial practice to exploit private individuals to carry out invasive marketing that the business could not legally do on its own*." (Trzaskowski, 2011: 350). To learn about the legal barriers in Europe one has to take a look at two directives: the Unfair Commercial Practices Directive (2005/29/EC) and the Misleading and Comparative Advertising Directive (2006/114/EC). Unfortunately these are simply too voluminous to discuss the related issues in this chapter, but it is strongly advised to look at best-practice cases already out. Moreover, the question to what extent businesses can be held liable for activities carried out by consumers remains yet unsolved (Trzaskowski, 2011: 350).

In the US, the Competition and Consumer Act 2010 addresses similar topics as the European Directives. It includes misleading and deceptive conduct (Section 18), unconscionable conduct in connection with goods or services (Sections 20–21), unfair contract terms (Sections 23–28), false or misleading representation about goods or services (Section 29), offering rebates, gifts or prizes (Section 32 and very important for gamification!), misleading conduct as to the nature of goods or services (Sections 33–34), bait advertising (Section 35), pyramid schemes (Section 44) and referral selling and multiple pricing (Section 47). Purchased hits, for instance, are among the topics covered in the Consumer Protection Act.

27.7 Conclusion and Final Remarks

This chapter was not intended to help you get a law degree, but to raise your awareness enough to address the most common aspects of law related to gamification and to aid you in communicating with your legal expert.

As we have seen, the **Terms of Use** serve as a powerful tool. For a provider, they form a "line of defense" which ensures that the risk of getting sued is minimized. Moreover, they can shift the balance of the contract in favor of the provider. As this

[41] (German) BGH, 17.7.2013 – I ZR 34/12.

is a fine line, an expert or counsel should be approached before launching the project. Most often a provider can (or at least should) get this service free of charge from a local Economic Chamber of Trade, Commerce and/or Industry. The information given by such institutions can then be used to design the project within the legal boundaries. From the consumer's perspective, the corresponding information can be obtained from consumer protection authorities. They will check Terms of Use for illegal or misleading content and are able to take action if they think a certain line has been crossed or enough consumers are affected. As stated, however, Terms of Use are not evil by nature; there are some good examples out there that may serve as a role model. Establishing a fair balance between consumer and provider interests can also help you to gain a good reputation throughout the community (and therefore have one "shitstorm" less to deal with).

Regarding the **development process** of a gamification project a lot can be adopted from classic contract law. If the project is related to software development the entire range of IT law (starting at NDAs) can be applied. This field is well covered and documented, and therefore a high level of legal certainty already exists. Instead of trying to reinvent the wheel, this expertise should be used. In short: do not try to label your gamification project with new terms if it is just a simple app development project.

Copyright issues might not be among the questions to address first, but they should be observed. Every time something is "in motion" or "user-generated" within a gamification project, copyright laws will help to govern these parts. Since copyright goes hand in hand with licensing, this can (and should) be included in the terms of use. Although Virtual Goods are a playing field for lawyers momentarily, it seems that they can be handled using copyright laws already in existence. Despite the fact that the protection of know-how and ideas is not covered by copyright, every country tries to build higher walls around these matters identified as the "gold of the information age". At the end of 2013 the European Union started a consideration process on a Directive on the protection of undisclosed **know-how** and business information (trade secrets) against their unlawful acquisition, use and disclosure.[42] For the moment (as this chapter is being written) we have to stay tuned on this.

Unfair Competition is a more sophisticated game between businesses—a game you simply cannot win without an internal or external legal expert.

Finally, let's take a look at the (not all-encompassing) short **checklist** that intends to help prevent failure on a massive scale:

- for **gamification providers**
  - use NDAs, ToSs and related contracts to support communication vis-à-vis the project staff and users to protect the project against possible lawsuits resulting from unfulfilled expectations. **Hint**: Talk to an expert, many documents can be developed only once but used many times (such as NDAs and ToSs).

[42] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52013PC0813:DE:NOT.

  - using **ToSs** you will have to identify minefields for your project, get help from experts or trade chambers. You can take a look at competitors' Terms of Use BUT DO NOT COPY THEM!
  - **Virtual Goods** should be governed by ToS and, as stated, copyright issues can burn money fast (also keep fair use in mind). Talk to an expert to get "insurance"!
  - **Unfair competition** can help to get rid of unwanted competitors, but first you will have to identify these competitors and second you will need to consult an expert on competition law, which will help to decide if any action should be taken (not every smart move by a competitor against your project is unlawful)
  - If you aim your project at consumers, **consumer protection** is an issue. To avoid a shitstorm you should change sides and take a look at the project from the customer's point of view before installing "*you-are-less-than-nothing-in-my-eyes*"-clauses.

- for **gamification users**

  - when you see ToSs you might want to read them first. In a recent case a dissatisfied customer posted a negative review about the service of an online retailer. However, the retailer's ToSs stated that "*your acceptance of this sales contract prohibits you from taking any action that negatively impacts* [*the retailer*], *its reputation*, *products*, *services*, *management or employees*."[43] Check with consumer protection authorities if you think ToUs are unfair or violate consumer rights. They often serve as an FAQ service and support legal actions against those who cross the line.

Whether you are a gamification provider, a developer, a consultant or a consumer interested in the matter you have to admit that gamification addresses a whole set of topics throughout the field of law. To cover this all it would be necessary to understand each and every gamification project in every detail, specify each and every corresponding field of law (including laws and provisions as well as judicature) and double check the result to make sure to be up-to-date (laws may have been revoked or renewed, or a new ruling may have been made in the meantime). Still, you would not know everything, since many settlements that would tell you the current "market price" of cases are not tried in court or not making it to a final verdict are confidential. BUT: you do not need to panic, there is hope. The killjoys we were talking about at the beginning of the chapter have a purpose: to cover all these questions and come up with an up-to-date answer. Moreover they will serve as insurance and assume responsibility if legal issues arise that could have been foreseen. Downside: This insurance will cost you something (but nothing is free, right). Benefit: You will be able to focus on the project and not worry about legal risks (for now). Finally, do not be alarmed because you did not get "the answer"; and, most important, do not lose your motivation for a hopefully fun and successful gamification project.

---

[43] http://www.kutv.com/news/features/gephardt/stories/vid_474.shtml.

References

Bartlett, R. C., & Collins, S. D. (2011). *Nicomachean ethics*. Chicago: University of Chicago Press.

Belkin, J., & Noveck, B. (2006). *The state of play: Law, games, and virtual worlds*. New York: New York University Press.

Castranova, E. (2001). Virtual worlds: A first-hand account of market and society on the Cyberian Frontier. *CESIfo Working paper, 618*, 10.

Castranova, E. (2006). The right to play. In J. Belkin & B. Noveck (Eds.), *The state of play: Law, games, and virtual worlds*. New York: New York University Press.

Doran, G. T. (1981). There's a S.M.A.R.T. way to write management's goals and objectives. *Management Review, 70*(11), 35–36 (AMA FORUM).

Erenli, K. (2009). Virtual persons + virtual goods = real problems in Daras. *Petros; Mayora, Oscar UCMedia, 2009*, 265–270.

Fairfield, J. (2005). Virtual property. *Boston University Law Review, 85*, 1047; Indiana Legal Studies Research Paper No. 35.

Huizinga, J. (1971). *Homo ludens: A study of the play-element in culture*. Boston: Beacon.

Kapp, K., (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*

Klickermann, P. H. (2007). Virtuelle Welten ohne Rechtsansprüche? *MMR, 766*.

Koch, P., (2006). Die rechtliche Bewertung virtueller Gegenstände auf Online-Plattformen, JurPC Webdok 57/2006.

Lastowka, G. F., Hunter, D. (2003). The laws of the virtual worlds, *Public Law and Legal Theory Research Paper Series 03-10 (2003)* p. 57.

Lastowka, G. F., & Hunter, D. (2006). Virtual crime. In J. Belkin & B. Noveck (Eds.), *The state of play: Law, games, and virtual worlds*. New York: New York University Press.

Lober, A., & Weber, O. (2005). Money for nothing, Der Handel mit virtuellen Gegenständen und Charakteren. *MMR, 653*.

Merrill, T. (1998). Property and the right to exclude. *Nebraska Law Review, 1998*, 730–755.

Pearce, C. (2011). *Communities of play: Emergent cultures in multiplayer games and virtual worlds*. Cambridge, MA: MIT Press.

Salen, K., & Zimmermann, E. (2003). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.

Taylor, M. (2009). *International competition law: A new dimension for the WTO?* New York: Cambridge University Press.

Trzaskowski, J. (2011). User-generated marketing: Legal implications when word-of-mouth goes viral. *International Journal of Law and Information Technology, 20*, 1–33. http://dx.doi.org/10.1093/ijlit/ear012.

Zichermann, G., & Linder, J. (2013). *The gamification revolution*. Berkeley, CA: Mcgraw-Hill Professional.

Chapter 28
How to Avoid the Dark Side of Gamification: Ten Business Scenarios and Their Unintended Consequences

Rachel C. Callan, Kristina N. Bauer, and Richard N. Landers

28.1 Introduction

Gamified interventions have become increasingly popular, but there has been a dearth of discussion about potential problems that may come along with these tools. Gamification can be described as using elements from video games in a non-gaming application to enhance user engagement and experience (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). From this definition, we can imagine an almost infinite number of possible applications of gamification in the workplace. Any process that impacts employees could be gamified to improve engagement or experience, from selection and recruitment to training and performance.

It appears that organizations are doing just that as M2 Research has projected that $522 million will be spent on gamification solutions in 2013 (Meloni & Gruener, 2012). Further, the use of these tools is expected to continue to grow with Gartner predicting that 40 % of Global 1,000 organizations will be using gamification to transform business operations by 2015 (Pettey, 2012, October 24). Although to many it seems gamification may be a panacea to organizations plagued by employee apathy toward training programs and performance systems, researchers have recently begun discussing the dark side to these interventions.

This "dark side" is the negative impact that these interventions may have due to unanticipated consequences or side effects that render them less effective or, in the worst case, counterproductive. Gartner has suggested that by 2014, 80 % of gamification applications will fail to meet business objectives due to poor design (Pettey & van der Meulen, 2012, November 27). Given the $522 million projected to be spent in

R.C. Callan (✉) • R.N. Landers
Old Dominion University, Norfolk, VA, USA
e-mail: rjohn104@odu.edu

K.N. Bauer
University of West Florida, Pensacola, FL, USA

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_28

2013 on gamification interventions (Pettey, 2012, October 24), one can easily imagine the amount of money that is wasted on poorly designed interventions.

Since the demand for gamified interventions does not appear to be slowing down in the near future, we need to turn our attention to why these interventions fail. Gartner has offered some suggestions for why an intervention may fail to meet expectations (Burke, 2013, January 21). The first is that rewards may not be seen as desirable to the employees, which is reflected in the common approach of simply adding badges or points to an activity or process to gamify it. The second is that organizations sometimes decide to adopt gamification before they actually know how it will be used, which causes the intervention to misalign with business objectives. This results in adding gaming elements that may not make sense or may be ineffective because the organization was in a rush to be part of the trend. The final issue is that the motivations of the employees need to align with the goals of the organization within the gamified intervention.

In the remainder of this chapter, we will touch upon these broad issues as well as how gamification failures can be explained by psychological research. This chapter contains ten scenarios that will be used to illustrate some of the ways an organization may include gamification within an intervention. These scenarios cover four broad topics from the personnel psychology literature: recruitment of applicants, onboarding new hires, training employees, and employee performance management. For each scenario, we will discuss why the intervention may fail, how this relates to the psychological literature, and how the intervention may be improved upon in order to avoid these potential pitfalls. It is our hope that by highlighting areas for concern within interventions, we help practitioners utilize gamification more effectively and reduce the risk of an unsuccessful intervention.

28.2 Recruitment

28.2.1 Scenario One

Organizational leadership wants to motivate job applicants to explore their recruitment website to learn more about the organization's history, values, and vision before finally applying. To do so, they decided to add gamification elements to the recruitment website. Applicants sign in to the site and earn points and badges for visiting the different areas of the site and completing the application. These points do not factor into employment decisions, but they are displayed so that the applicants can keep track of their own progress.

28.2.1.1 Potential Problems

One of the biggest issues of this approach is that the rewards do not match the organization's goal of learning more about the organization. Instead, visiting the areas of the site alone is rewarded. Presumably, the organization wants applicants to view these areas of the site so that they are more familiar with the organization before they even begin the application process. The end goal in this case could be to entice people to apply who would have been strong candidates but would not have applied due to a lack of knowledge about the organization. Another possible goal could be to give applicants a realistic job preview to ensure that those who apply understand the organization, which has been found to have a small correlation with outcomes such as turnover (Phillips, 1998). Thus, those who would not fit well with organizational values and vision would self-select out of the hiring process. In both cases, the underlying goal is to motivate applicants to learn about the organization via the materials provided on the company website.

The primary concern when dealing with motivation in this case is that attempts to shape behavior through rewards without ensuring that behavior and rewards are linked is risky. At its core, we could say that this organization is attempting to use operant conditioning to shape behavior such that applicants will see that learning about the organization is linked to these rewards (positive reinforcement), which then encourage the applicants to continue learning in order to earn more rewards (Skinner, 1953). However, the organization is committing a common fallacy by assuming that applicants will see the learning as the target behavior, rather than just clicking on as many links as possible. As the intervention is described now, the target behavior is not learning. In order to motivate learning about the organization, knowledge would have to be rewarded. This could be accomplished by giving applicants points for scoring high on a knowledge test about the company after viewing the website.

An additional problem in this context is that scoring points for an applicant could ultimately deliver contradictory information to applicants. The organization is rewarding job seekers for viewing the website, but the rewards do not factor into hiring decisions. This could be confusing to many applicants as they are visiting the site with the hope of earning a job, the ultimate positive reinforcement for job seekers. Without a tie to this desired outcome, points really mean nothing. This issue also taps into Vroom's (1964) expectancy theory of motivation. Specifically, one of the key components to behavioral change is that the actor values the reward. In this case, points and badges offered may be of little value to a job seeker. With any gamification intervention, one should consider what the desired outcome is and whether that behavior is actually being motivated by the proposed intervention. If the intervention fails to change the behavior, which must be measured, another approach should be taken.

28.2.2 Scenario Two

An organization wants to make applicants feel more excited when applying for their positions and wants to make their job offers seem more enticing once they are received. To do this, the CEO has suggested applicants compete with one another during the application process. She argues this will make the application process more interesting for applicants and the competitive atmosphere will encourage those who receive offers to accept them immediately. A system is designed in which applicants sign in with an anonymous username, which is then linked to their scores on the measures included in the selection battery. These measures could include scores on application blanks, knowledge tests, personality tests, and other selection devices. For each measure, the applicant receives points based on his or her performance and his or her total score is posted on a leaderboard that all applicants are able to see. The CEO sees this as a promising program and is very enthusiastic about applicants completing the measures and following the leaderboard as they go through the application process.

28.2.2.1 Potential Problems

The first major problem with this scenario is the motivational issues discussed in Scenario One. The organization should want those in the application process to provide truthful responses to selection measures, not to simply move up a leaderboard based on their performance. This issue is additionally relevant to the applicant faking literature, which considers the conditions under which applicants give untruthful responses and the effects on the predictive abilities of the selection measure. A recent meta-analysis found that other-rating of personality had significantly greater predictive validities than self-ratings of personality (Connelly & Ones, 2010). The researchers suggested this may have occurred because people (intentionally or unintentionally) often misrepresent themselves to appear more socially desirable, which can decrease the effectiveness of selection measures. Although faking is generally considered a given for measures such as personality (Hough & Johnson, 2013), it is likely unwise to create an intervention that explicitly motivates applicants to fake as we know that people are very capable of distorting ratings when they are told to do so (Viswesvaran & Ones, 1999).

A second issue that we could anticipate from the intervention described is that applicants would actually use the leaderboard to their advantage when making salary negotiations. The literature has shown that the best applicants are fickle and drop out of the selection process during recruiting delays (Rynes, Bretz, & Gerhart, 1991) or when they receive negative information about the job (Bretz & Judge, 1998). Although no studies have yet investigated gamification of recruitment, it is easy to imagine how job seekers may believe that if they are at the top of the leaderboard, they are the organization's best choice and deserve premium treatment as a result. Thus, applicants could expect not only higher pay or better benefits but also faster contact for interviews and a guarantee of a job offer. If the top applicants find that the organization is not able to meet these expectations, the organization could quickly find itself driving away the top of its applicant pool. In short, this intervention would likely not produce the effects the CEO had hoped for because undesired behaviors are being motivated and the applicants are given more information than is standard in a selection setting, which could then be used as leverage against the organization in the selection process.

28.2.3 Scenario Three

The Director of Human Resources at an organization has recently learned that applicants recruited through employee referrals may be better employees than those recruited through more traditional means, such as job ads. As a result, he has decided to incentivize employees to refer prospective employees through a gamification intervention. In the proposed intervention, an employee earns one point for each applicant who lists the employee as referring him or her to the organization and ten extra points for every referred applicant who is hired. A leaderboard will be created based on the point totals and distributed to all of the employees so they can see how they are doing compared to their coworkers. The director believes this leaderboard will create the motivation needed to boost the number of employee referrals and anticipates this will have long-term effects on the productivity of the workforce as these referrals are hired.

28.2.3.1 Potential Problems

This system again suffers from the issue of whether the desired behavior is actually being motivated by the intervention. The work of Skinner (1953) suggests that in order to change behavior, the reinforcer needs to be directly related to the desired behavior. If the behavior desired by the organization is for employees to recommend people for employment who are subsequently hired, this needs to be rewarded explicitly. Although it appears on the surface that this is the case, consider how easy it would be for an employee to have people who are unqualified apply for a position compared to how difficult it is to identify a friend or acquaintance who would actually be likely to be hired for the position. This suggests that perhaps only having referred a qualified applicant should be rewarded, rather than simply referring a large number of unqualified applicants.

A related issue is that creating a leaderboard such as this could distract employees from job duties. Although leveraging employees to improve recruiting can be a valuable technique (Moser, 2005), it is generally not the employee's primary responsibility. Care should be taken to ensure it does not become a distraction. In this case, the points really only have a social reward of appearing higher on the leaderboard, rather than a tangible reward such as monetary compensation. If the employee finds achieving job-related goals to be more motivating, this should not distract from the employee's duties. However, this should be a consideration when motivating employees to perform tasks outside of their job duties—the rewards should be weighted such that it reflects the amount of effort the organization wants the employee to put toward the task. This goes back to Vroom's (1964) theory, which suggests that if the employee sees the reward as valuable and linked to his or her effort of referring applicants, he or she will be motivated to participate. Again, the key issue to consider when attempting to motivate employees is identifying the behavior that is desired and reinforcing that behavior specifically while considering the unintended effects of the intervention on behavior.

A final issue here is that the literature linking employee referrals to job performance is mixed (Rynes & Cable, 2003), with the relationship between turnover and referral source showing a stronger relationship such that employee referrals are less likely to turn over than other applicants, once hired. Rynes and Cable (2003) identified two possible theories in the literature for these effects: (1) employee referrals are likely to have more realistic information about the position and (2) employee referrals serve as a sort of prescreen because employees may be more likely to know other people with similar qualifications and attributes. These theories have both been supported to some degree in the literature; applicants with employee referrals have more realistic job information than walk-ins (Blau, 1990) and employee characteristics are related to referral characteristics (Kirnan, Farley, & Geisinger, 1989). However, the positive effect of employee referral (versus walk-ins) appears to diminish post-hire (Kirnan et al., 1989), which suggests any claims that promoting one recruiting source over another will have a dramatic effect on productivity are unfounded.

28.3 Onboarding

28.3.1 Scenario Four

A tech company utilizes a voluntary web-based onboarding process to acclimate new hires to the organization. This process includes training on topics such as the organization's core values, the organization's history, and the functions of the organization's different departments. The organization has noticed that participation on the website has dropped off in recent years. The leaders of the organization believe that forcing employees to complete the process goes against the company's free-spirited culture, but they hope that making the website more engaging will increase the likelihood that employees will participate. To do this, the leaders decided to frame progression through the onboarding website as the adventures of a knight, played by the employee. The "knight" needs to complete "quests", which are the various onboarding modules on the website. When the employee completes a quest, he or she receives an award from the "king and queen" (the company itself) for a job well done.

28.3.1.1 Potential Problems

There are two potential issues with this kind of intervention. The first is that the final goal is for employees to learn about the organization, but this is not being measured or motivated directly by the intervention. The reward structure in the onboarding process only rewards completing the modules (which may just require a few clicks of a mouse), rather than actually learning about the organization and applying this information on the job. The issue is not only that of reinforcing the desired behavior (Skinner, 1953) but also that learning outcomes should be measured in order to determine the effects of an instructional program (Kraiger, Ford, & Salas, 1993). If learning is not measured, it cannot be rewarded. Perhaps more importantly, without a measure of learning, the organization cannot determine if the onboarding process effectively teaches new hires about the organization. To improve this intervention, learning measures should be included at a minimum, and post-tests should follow each module. Post-test performance could then be the reinforced behavior, which would serve to encourage employees to study and retain the information in the training materials.

The second problem is that this kind of widespread use of strong game fiction may not be accepted well by the employees. In the virtual worlds' literature, researchers have suggested that poor trainee attitudes toward virtual worlds due to their novelty may indirectly and negatively affect both trainee reactions and learning outcomes when learning in virtual worlds (Landers & Callan, 2012). Gamification is similarly novel in organizations, and as such, employees may not welcome gamification interventions, potentially resulting in poorer outcomes. Organizational representatives should be sensitive to this issue when applying gamification to the workplace. Computer-based testing research suggests that computer privacy concerns are related to age, procedural justice, and test taking motivation (Bauer et al., 2006). Although research on gamification in the workplace is limited, gamification collects a great deal of personal information as well, and attitudes may be similar. One change that may ameliorate this effect would be to make the intervention more directly related to the workplace. For example, the game fiction could require employees to collect parts for the company's best-selling piece of hardware by performing well on the post-tests with the goal of "assembling" the product once training is complete. This job-related story may make the gaming elements more appealing to employees than the unrelated story of the knight.

28.3.2 Scenario Five

An organization has new employees complete an online week-long orientation program before beginning their new jobs. Feedback from the orientation reveals that new hires find the program to be tedious and boring. To make the process more interesting, the organization decided to gamify orientation. Employees create a fictional 3D character to represent themselves in the online orientation on the first day and subsequently participate in the orientation as this avatar who earns points for completing "challenges" (e.g., completing modules, filling out profile details, setting up accounts) and correctly answering questions about the orientation materials. Employees with the top scores are recognized at the end of orientation.

28.3.2.1 Potential Problems

This attempt at gamification represents an improvement over the previous attempt to gamify a web-based, new hire training because learning assessments are included as part of the challenges employees are expected the complete. Thus, the organization has a mechanism to monitor whether employees are acquiring the appropriate level of knowledge and skills. However, there is still a concern that the gaming elements could pull focus from the task at hand. Kanfer and Ackerman (1989) theorized that individuals have a limited pool of attentional resources that can be devoted to on-task, off-task, and self-regulatory behaviors. If the addition of gamified design elements pulls attentional resources to the elements themselves (i.e., resources are devoted to off-task behaviors), new employees will not learn as much from the assessments. Furthermore, similar to the way massed practice (or "cramming") has a detrimental effect on retention (Donovan & Radosevich, 1999), a new employee that becomes so engrossed in the gamified system that he or she goes through all content in a short amount of time may retain less information than if gamification had not been used.

Another issue that an organization may face is whether the motivation gained from using the avatar offsets the time spent making them on the first day, particularly for older workers who may not be as technology savvy as younger workers. An important avenue for future research is identification of the types of employee that are motivated by gamified systems. If some employees are demotivated by the use of avatars, it would be wise for organizations with such employees to invest resources in an alternate strategy for creating a more engaging orientation.

28.4 Training

28.4.1 Scenario Six

An organization has implemented mandatory online sexual harassment training. The organization's leaders recently learned that one of the most common problems faced by organizations implementing such training programs is compliance, and found this to be the case in their organization as well: only 35 % of employees have completed the online training program by the deadline imposed by Human Resources. To improve employee motivation, the training designer decides to gamify the training by incorporating a game element: game fiction. Training modules are presented as "quests" with "monsters" to defeat in the format of post-training knowledge tests. With successful defeat of a sufficient number of monsters, each quest is complete, and the trainee gains a "level".

28.4.1.1 Potential Problems

One of the most common early application areas for gamification is education (e.g. Landers & Callan, 2011; Tay, 2010, March 18), which is likely one of the reasons the designer would choose this approach. Instructors take any of a variety of game elements theorized to improve learning or motivation to learn (Bedwell, Pavlas, Heyne, Lazzara, & Salas, 2012) and apply them to the classroom. In the business environment, this application of gamification to student learning shifts to that of employee training and development. However, just as gamification can result in negative outcomes in child instruction, it can also produce negative results in adult instruction.

Although the spirit of this training designer's idea is appreciated—to make training more fun and thus increase compliance—extant theory suggests that it may bring substantial risks. Organizational justice theory describes three general perceptions related to how people perceive the way they are treated: (1) distributive justice, the perceived fairness of the treatment itself, (2) procedural justice, the perceived fairness of the process leading to that treatment, and (3) interactional justice, the perceived appropriateness of the way information about the treatment was delivered (Greenberg, 1990). When employees believe they have been treated unfairly, they are more likely to engage in counterproductive work behaviors (like theft), reduce their organizational citizenship, and place less trust in their organization (Cohen-Charash & Spector, 2001). By adding additional impositions upon employees to complete training that they are already reluctant to complete, fairness perceptions may be negatively affected, ultimately leading to such negative organizational outcomes. Instead, the organization would likely be better served by implementing traditional training compliance techniques, like improving organizational and supervisor support (Noe & Schmitt, 1986). Thus, we contend that gamification is best restricted to training contexts in which both the training itself and participation in the gamification component of training is completely voluntary.

28.4.2 Scenario Seven

An organization has a substantial catalog of online courses available to employees, the purpose of which is to encourage employees to engage in self-directed learning as their time and interests allow. A training designer notices that usage of the self-development website is low; few employees ever log in to complete one of the optional courses. To improve the website's attractiveness, this designer implements a gamification platform, assigning badges for a variety of activities which appear on user profiles. This includes reading descriptions of course offerings, participating in practice activities, posting on the website's discussion boards, and completing course knowledge tests, among others. Rankings are developed based upon badges earned to encourage employees to compete with each other.

28.4.2.1 Potential Problems

Operant conditioning is frequently cited as the basis for gamification efforts, and yet this perspective suggests potential harm in the case study above. According to behavioral psychology, when psychological rewards follow a target behavior, engagement in that behavior will increase (Skinner, 1938). Gamification is often implemented using this strategy, awarding points and badges for engaging in some target behavior. However, nearly a century of research on operant conditioning has been quite clear: only the target behavior is increased, and other behaviors may decrease in favor of the target behavior. In the case above, rewards are provided for reading descriptions, completing activities, posting on discussion boards and completing tests. This does not imply that employees will enjoy the courses more, learn more from the activities, participate meaningfully on discussion boards, or learn more in courses. Because these activities are not rewarded, they are unlikely to be increased by the system described above. The challenge for gamification designers is that the behaviors they *want* to reward (e.g., motivation, meaningful participation, learning) are difficult to measure accurately and automatically. For example, deep understanding of learned material (e.g., as demonstrated in writing), quality of discussion board posts, and motivation to learn cannot currently be judged by a computer automatically and accurately, and thus cannot be rewarded in any current gamification system. Rewarding proxy behaviors will only encourage those proxy behaviors. More explicitly, the learner with the highest score is not likely to be the user that has learned the most. Training designers implementing gamification must be careful to reward *precisely* the target behavior they wish to encourage; if this precise behavior cannot be rewarded, gamification should not be used.

28.5 Performance

28.5.1 Scenario Eight

An organization is having trouble getting managers to complete performance appraisals on time and with enough detail to be useful for improving employee performance. To improve participation, the organization awards managers points based on timeliness of their reviews and how much detail they include in the evaluation. The point totals are published during the performance appraisal season to encourage managers to compete to turn in their appraisals quickly.

28.5.1.1 Potential Problems

One initial problem an organization will face is developing a system to assign points. It is fairly straightforward to assign points for the speed with which a manager submits his or her performance evaluations. A simple example might be: ten points for early submission, five points for on time submission, and negative points for late submission. However, it is more difficult to assign a point value for quality as there are relatively few good measures available (Murphy & Cleveland, 1995). Although the length of a submission would be a quick way to assign points, using length as a metric can reward managers who are wordy but not necessarily accurate. Having human resources personnel code responses will be subjective and time consuming, and immediate feedback is integral to gamification.

Related to the difficulties developing a point system, another potential problem is that quick appraisals do not necessarily lead to accurate appraisals. Organizations need to be careful about what, specifically, is being rewarded. If an organization rewards speed more so than accuracy, quick appraisals may translate to an incomplete assessment of subordinate performance, the use of biases or heuristics to make performance judgments, and generally inaccurate performance evaluations. Research suggests that accurate ratings are a product of spending more time observing behavior (e.g., Favero & Ilgen, 1989; Heneman & Wexley, 1983), and it is ill advised to create a system that introduces biases into the rating process.

Performance appraisals also provide extremely sensitive information to the subordinate or rate and have been the basis for employment discrimination lawsuits (Werner & Bolino, 1997). Currently, there is no known research or case law on the gamification of a performance evaluation system. An organization should be mindful about gamifying a performance evaluation system that may inadvertently introduce bias or reduce accuracy as such a practice has not been empirically or judicially supported.

28.5.2 Scenario Nine

An organization wants to use gamification to enhance employee motivation for completing the performance appraisal process. Employees create avatars that move through the performance appraisal process all year long as the employee completes his or her job duties. The job itself is framed as a game with each job duty the employee completes being framed as a "quest". Using the general premise of Call of Duty (a popular first-person perspective game) as an example, a job might become a game where a soldier is tasked with helping his country win the Cold War. Each job duty would then be a quest to eliminate enemy soldiers or gather intelligence information. As quests are completed, the character moves up in levels. The organization believes this will allow employees to be involved in performance appraisal year-round and provides motivation without the need for bonuses.

28.5.2.1 Potential Problems

One of the major problems an organization would face when attempting to gamify the performance appraisal process in this manner is developing the game fiction. The development of appropriate game fiction would require a considerable amount of resources and time. For example, an organization must decide what level of game fiction is appropriate. A well-developed story line may be costly, in terms of paying a writer, and may also detract from the work itself as employees become invested in the story. On the other hand, an under-developed storyline may not be believable or motivating. Another key decision an organization would face is what kind of story line to apply. In the example provided in the scenario, there is a masculine undertone, which could dissuade female employees from becoming fully invested in the game system. The use of employee focus groups would be required to develop a storyline that is motivating to all employees.

Regardless of how well developed the storyline is, another potential problem is that some employees will just dislike having gaming elements added to required work systems. As mentioned in previous scenarios, there are employees who would prefer to keep work and play separate. In this specific case, the entire evaluative component of the job is gamified, which potentially increases alienation of employees who are opposed to making a game out of work.

Furthermore, in this attempt at gamification, completion is being rewarded, not the quality of the work. As described above, we need to tie the behaviors being rewarded to the actual desired behaviors. Before implementing a gamified performance appraisal system in this manner, an organization would be wise to do a thorough cost benefit analysis as the payoff may not outweigh the time it takes to design and participate in this system.

28.5.3 Scenario Ten

A sales manager has implemented a leaderboard to help motivate the sales team to improve their performance. The leaderboard rank orders all employees on the team according to the dollars in sales for the week. The manager posts the leaderboard in the office so that everyone can see who is bringing in the most sales and try to improve their standing.

28.5.3.1 Potential Problems

One problem that an organization faces when implementing a leaderboard is determining the metric on which the leaderboard should be based. Basing the leaderboard strictly on the dollar amount of sales could be perceived as unfair and would be an inaccurate measure of job performance. Campbell, Gasser, and Oswald (1996) make the distinction between job performance (organizationally relevant behaviors that an individual performs) and performance results (outcomes of performance not entirely under each employee's control). Sales can be considered a performance result. For example, an employee may happen to have a territory that easily nets many sales while another employee has a more difficult territory. This would result in the former employee easily beating out the latter employee on the leaderboard not because of different sales techniques, but solely because the assigned territory is difficult. In this case, adjusting the dollar amount by the size of the territory would be paramount for the success of the motivational influence of the leaderboard.

Additionally, dollar amount in sales is just one aspect of job performance. Other aspects of job performance, like customer satisfaction or working with other departments to ship products quickly, are also important for organizational success. The leaderboard is a sign to employees that the organization values sales, which could send the message that other aspects of job performance are less important. Without proper monitoring or reward mechanisms in place for these other aspects of job performance, employees' overall performance, and hence organizational success, may suffer.

Another problem is that the leaderboard could potentially have negative motivational consequences. If an employee is consistently at the bottom of the leaderboard, this would be a sign of negative feedback. Repeated negative feedback leads to downward goal revision and decreased effort among other negative outcomes (Mikulincer, 1988, 1989). Thus, employees who perceive that they will never be at the top of the leaderboard may disengage from their work, ultimately negatively impacting organizational performance.

Leaderboards typically demonstrate individual performance. An interesting caveat to the ease with which a leaderboard can be implemented is the case of a team-based sales environment. In an advertising agency, for example, a team works together to develop a product for a client. A large advertising agency will have multiple teams and potentially employees on multiple teams. In team-based environments, the organization would need to determine how to represent performance on the leaderboard. Research suggests that the level of feedback has an effect on the relationship between team goals and performance (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). Team members who receive team-level feedback tend to see improvements in team-oriented performance while those who receive individual-level feedback tend to have higher individual performance. However, performance is best when team members receive just one form of feedback, which suggests the level of the leaderboard feedback should depend upon the type of performance the designer is attempting to enhance.

28.6 Conclusions

The scenarios described above highlight many of the concerns expressed by Gartner (Burke, 2013, January 21). The fictitious organizations often adopted gamification without linking it to organizational goals and/or employee motivations. Although these scenarios were all fictional, it is important to emphasize that these kinds of design errors appear to be common in gamified interventions. According to Gartner, this is the rule, rather than the exception (Pettey & van der Meulen, 2012, November 27). Since organizations are becoming more eager to adopt gamification (Pettey, 2012, October 24), the warnings included in this chapter are timely.

Many of the recommendations above focus on linking gamified interventions back to basic psychological research literatures and their "best practices". One area of research that was brought up repeatedly is motivation. Organizations who wish to improve employee engagement may be quick to assume that gamified interventions will motivate employees, but this is not necessarily the case. Human motivation is complex and as a result a number of theories are used to explain how motivation affects behavior across situations, including but not limited to goal setting theory (Locke & Latham, 2002), operant conditioning (Skinner, 1953), and expectancy theory (Vroom, 1964). Whenever an organization is seeking to motivate employees, one of the first decisions to be made is which motivational theory will best inform the designer in this situation, given the intervention's goals. From there, gaming elements that work with the theory can be identified, such as utilizing a leaderboard to activate goal-setting. By relying upon literature to inform design decisions, rather than choosing the "latest and greatest" technology and then deciding how to use it, practitioners can improve the likelihood that an intervention will have the desired effect.

This issue is echoed in the training literature, which suggests that the training needs assessment should guide training design (Brown, 2002). Here, the training literature informs the needs assessment, which then informs the design. It is important to note that in a rush to embrace new technologies, many organizations are applying this process in reverse: allowing the design to inform the needs (Burke, 2013, January 21). This backwards thinking is not only bad for the organization, but could make gamification the next Second Life, which experienced a similar faddism before being abandoned by many organizations (Semuels, 2007, July 14). By following best practices from the literature, not only can practitioners inform the gamification literature, but also ensure that gamification is viewed as a useful tool, rather than a passing trend.

References

Bauer, T. N., Truxillo, D. M., Tucker, J. S., Weathers, V., Bertolino, M., Erdogan, B., et al. (2006). Selection in the information age: The impact of privacy concerns and computer experience on applicant reactions. *Journal of Management, 32*, 601–621. doi:10.1177/0149206306289829.

Bedwell, W. L., Pavlas, D., Heyne, K., Lazzara, E. H., & Salas, E. (2012). Toward a taxonomy linking game attributes to learning: An empirical study. *Simulation & Gaming, 43*, 729–760. doi:10.1177/1046878112439444.

Blau, G. (1990). Exploring the mediating mechanisms affecting the relationship of recruitment source to employee performance. *Journal of Vocational Behavior, 37*, 303–320. doi:10.1016/0001-8791(90)90047-6.

Bretz, R. D., & Judge, T. A. (1998). Realistic job previews: A test of the adverse self-selection hypothesis. *Journal of Applied Psychology, 83*, 330–337. doi:10.1037/0021-9010.83.2.330.

Brown, J. (2002). Training needs assessment: A must for developing an effective training program. *Public Personnel Management, 31*, 569–578.

Burke, B., (2013). The gamification of business. *Forbes*. Retrieved January 21, from, http://www.forbes.com/sites/gartnergroup/2013/01/21/the-gamification-of-business/

Campbell, J. P., Gasser, M. B., & Oswald, F. L. (1996). The substantive nature of job performance variability. In K. R. Murphy (Ed.), *Individual differences and behavior in organizations* (pp. 258–299). San Francisco: Jossey-Bass.

Cohen-Charash, Y., & Spector, P. E. (2001). The role of justice in organizations: A meta-analysis. *Organizational Behavior and Human Decision Processes, 86*, 278–321. doi:10.1006/obhd.2001.2958.

Connelly, B. S., & Ones, D. S. (2010). Another perspective on personality: Meta-analytic integration of observers' accuracy and predictive validity. *Psychological Bulletin, 136*, 1092–1122. doi:10.1037/a0021212.

DeShon, R. P., Kozlowski, S. W. J., Schmidt, A. M., Milner, K. R., & Wiechmann, D. (2004). A multiple-goal, multilevel model of feedback effects on the regulation of individual and team performance. *Journal of Applied Psychology, 89*, 1035–1056. doi:10.1037/0021-9010.89.6.1035.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification: Using game-design elements in non-gaming contexts. *CHI'11 Extended Abstracts on Human Factors in Computing Systems*. New York, pp. 2425–2428. doi: 10.1145/1979742

Donovan, J. J., & Radosevich, D. J. (1999). A meta-analytic review of the distribution of practice effect: Now you see it, now you don't. *Journal of Applied Psychology, 84*, 795–805. doi:10.1037/0021-9010.84.5.795.

Favero, J. L., & Ilgen, D. R. (1989). The effects of ratee prototypicality on rater observation and accuracy. *Journal of Applied Social Psychology, 19*, 932–946. doi:10.1111/j.1559-1816.1989.tb01230.x.

Greenberg, J. (1990). Organizational justice: Yesterday, today, and tomorrow. *Journal of Management, 16*, 399–432. doi:10.1177/014920639001600208.

Heneman, R. L., & Wexley, K. N. (1983). The effects of time delay in rating and amount of information observed on performance rating accuracy. *Academy of Management Journal, 26*, 677–686. doi:10.2307/255915.

Hough, L. M., & Johnson, J. W. (2013). Use and importance of personality variables in work settings. In N. W. Schmitt & S. Highhouse IB Weiner (Eds.), *Handbook of psychology* (Industrial and organizational psychology 2nd ed., Vol. 12, pp. 211–243). Hoboken, NJ: John Wiley & Sons Inc.

Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology, 74*, 657–690. doi:10.1037/0021-9010.74.4.657.

Kirnan, J. P., Farley, J. A., & Geisinger, K. F. (1989). The relationship between recruiting source, applicant quality, and hire performance: An analysis by sex, ethnicity, and age. *Personnel Psychology, 42*, 293–308. doi:10.1111/j.1744-6570.1989.tb00659.x.

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology, 78*, 311–328. doi:10.1037/0021-9010.78.2.311.

Landers, R. N., & Callan, R. C. (2011). The seriousness of casual games: The psychology of gameification in undergraduate education and employee training. In M. Ma, A. Oikonomou, & L. C. Jain (Eds.), *Serious games and edutainment applications* (pp. 399–424). Surrey, UK: Springer.

Landers, R. N., & Callan, R. C. (2012). Training evaluation in virtual worlds: Development of a model. *Journal of Virtual Worlds Research, 5*(3), 1–20.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*, 705–717. doi:10.1037/0003-066x.57.9.705.

Meloni, W., & Gruener, W. (2012). *Gamification in 2012: Market update*. Encinitas, CA: M2 Research.

Mikulincer, M. (1988). Reactance and helplessness following exposure to unsolvable problems: The effects of attributional style. *Journal of Personality and Social Psychology, 54*, 679–686. doi:10.1037/0022-3514.54.4.679.

Mikulincer, M. (1989). Cognitive interference and learned helplessness: The effects of off-task cognitions on performance following unsolvable problems. *Journal of Personality and Social Psychology, 57*, 129–135. doi:10.1037/0022-3514.57.1.129.

Moser, K. (2005). Recruitment sources and post-hire outcomes: The mediating role of unmet expectations. *International Journal of Selection and Assessment, 13*, 188–197. doi:10.1111/j.1468-2389.2005.00314.x.

Murphy, K. R., & Cleveland, J. (1995). *Understanding performance appraisal: Social, organizational, and goal-based perspectives*. Thousand Oaks, CA: Sage.

Noe, R. A., & Schmitt, N. (1986). The influence of trainee attitudes on training effectiveness: Test of a model. *Personnel Psychology, 39*, 497–523. doi:10.1111/j.1744-6570.1986.tb00950.x.

Pettey, C. (2012). Gartner reveals top predictions for IT organizations and users for 2013 and beyond [Press release]. Retrieved October 24, 2012, from http://www.gartner.com/newsroom/id/2211115

Pettey, C., & van der Meulen, R. (2012). Gartner says by 2014, 80 percent of current gamified applications will fail to meet business objectives primarily due to poor design [Press Release]. Retrieved November 27, 2012, from http://www.gartner.com/newsroom/id/2251015

Phillips, J. M. (1998). Effects of realistic job previews on multiple organizational outcomes: A meta-analysis. *Academy of Management Journal, 41*, 673–690. doi:10.2307/256964.

Rynes, S. L., Bretz, R. D., & Gerhart, B. (1991). The importance of recruitment in job choice: A different way of looking. *Personnel Psychology, 44*, 487–521. doi:10.1111/j.1744-6570.1991.tb02402.x.

Rynes, S. L., & Cable, D. M. (2003). Recruitment research in the twenty-first century. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology* (Vol. 12, pp. 55–76). Hoboken, NJ: John Wiley.

Semuels, A., (2007). Virtual marketers have second thoughts about Second Life. *Los Angeles Times*. Retrieved July 14, 2007, from http://articles.latimes.com/2007/jul/14/business/fi-secondlife14

Skinner, B. F. (1938). *The behavior of organisms*. New York: Appleton.

Skinner, B. F. (1953). *Science and human behavior*. Oxford, UK: Macmillan.

Tay, L. (2010). Employers: Look to gaming to motivate staff. *itnews for Australian Business*. Retrieved March 18, 2010, from http://www.itnews.com.au/News/169862,employers-look-to-gaming-to-motivate-staff.aspx

Viswesvaran, C., & Ones, D. S. (1999). Meta-analyses of fakability estimates: Implications for personality measurement. *Educational and Psychological Measurement, 59*, 197–210. doi:10.1177/00131649921969802.

Vroom, V. H. (1964). *Work and motivation*. New York: Wiley.

Werner, J. M., & Bolino, M. C. (1997). Explaining U.S. courts of appeals decisions involving performance appraisal: Accuracy, fairness, and validation. *Personnel Psychology, 50*, 1–24. doi:10.1111/j.1744-6570.1997.tb00898.x.

Chapter 29
Gamification of Survey Research: Empirical Results from Gamifying a Conjoint Experiment

Briana Brownell, Jared Cechanowicz, and Carl Gutwin

29.1 Introduction

29.1.1 Background and Motivation

One of the most important tools utilized by the marketing research industry is the consumer survey. This self-reported data is the foundation of many currently applied methodologies for measuring the success of marketing campaigns and strategies (Evans & Mathur 2005). As such, suppliers in the marketing research industry rely on the engagement and attentiveness of the individuals who participate in their research and respond to their surveys. Keeping these respondents engaged is important for reducing the drop-off rate (the rate at which respondents quit before completing a survey), increasing time spent on surveys (which is linked to the quality and quantity of responses), and improving respondents' subjective enjoyment (since a happy respondent is more likely to complete future surveys). There is evidence to suggest that engagement has an influence on data quality as well, since bored or inattentive respondents produce lower quality data (Cape, 2009). Keeping respondents engaged and willing to participate in research is critical both to industry providers and to clients who use the results of the research for their decision making.

Recently, gamification has become a popular way to increase engagement and participation in tasks that would otherwise be considered work (Deterding, Dixon, Nacke, O'Hara, & Sicart, 2011; Von Ahn & Dabbish, 2008). Researchers have

B. Brownell (✉)
Insightrix Research, Saskatoon, SK, Canada

University of Saskatchewan, Saskatoon, SK, Canada
e-mail: Briana.Brownell@insightrix.com; bri.brownell@gmail.com

J. Cechanowicz • C. Gutwin
University of Saskatchewan, Saskatoon, SK, Canada
e-mail: jcechanowicz@gmail.com; gutwin@cs.usask.ca

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_29

successfully utilized gamification in a wide range of subject areas (Deterding et al., 2011; Dignan, 2011; Von Ahn & Dabbish, 2008), demonstrating that a gamified design can result in improved user motivation, subjective preference, and data quality. Because all of these improvements would be desirable in the area of marketing research, some research suppliers and academic researchers have already attempted to integrate gamification into surveys (Adamou, n.d.a, n.d.b; Guin, Baker, Mechling, & Ruylea, 2012; Puleston & Sleep, 2011). The majority of their results demonstrate an increase in engagement, subjective preference, or data quality. While these results are promising, research into gamified surveys is still relatively new and only a small number of survey types have been gamified.

To help address these gaps in the literature, we applied gamification to a survey containing a choice-based conjoint experiment. Specifically, we investigated the effect of scenario realism, points and feedback for correct responses, and level of gamification as compared to a benchmark survey. To our surprise, the game elements had either no effect or a negative effect on engagement. Our results provide evidence that improved engagement is not a certain outcome of gamification. Further, it seems likely that the success of a gamified design depends greatly on the numerous design decisions made during the process, up to and including the nature of the task being gamified. There also appears to be a strong expectation component to a user's experience: the perception of participating in surveys is that it is useful and helpful, while the perception of participating in games is that it is entertaining.

In this chapter, we first discuss the previous research related to our study. We then provide a detailed analysis of our results as they relate to user engagement and data quality. Finally, we discuss the implications of our findings to gameful designers. In particular, we highlight the design decisions, gamification choices, and experiential factors at play in an outcome that seems contrary to much of the research into gamification.

29.1.2 Application of Gamification

Gamification, "the use of game elements in non-gaming contexts" (Deterding et al., 2011), has never been more popular, as evidenced by the multitude of design guides (Dignan, 2011; Hunicke, LeBlanc, & Zubek, 2004; Lewis, Wardrip-Fruin, & Whitehead, 2012; Puleston & Sleep, 2011; Reeves & Read, 2009) that have been published on the topic. Although gamification is still a new area for researchers, many preliminary works have already been published; psychological research has shown that the motivational roots of gamification are already well understood (Ryan, Rigby, & Przybylski, 2006; Sweetser & Wyeth, 2005), and many successful implementations of gamified designs have been tested and studied (Chrons & Sundell, 2011; Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011; Korn, 2012; Puleston & Sleep, 2011; Von Ahn & Dabbish, 2008). While this research indicates that gamification can work, there is an element missing: the demonstration of an empirical link between the amount of gamification and the level of user motivation.

Researchers have only just begun to approach this problem (Guin et al., 2012; Jung, Schneider, & Valacich, 2010; Mekler, Brühlmann, Opwis, & Tuch, 2013) leaving much future work to be done.

29.1.3 Gamification of Work

The "non-gaming context" for gamification has often been work- and task-related; indeed, some of the earliest work in the area of gamification has been with systems designed to increase user motivation and performance in tasks that would otherwise be considered work (Deterding et al., 2011; Dignan, 2011; Reeves & Read, 2009; Shneiderman, 2004; Von Ahn & Dabbish, 2008). The process of gamification has made office and industrial assembly jobs more motivating (Korn, 2012; Nikkila, Byrne, Sundaram, Kelliher, & Linn, 2013), has made annoying computer tasks more fun (Chao, 2001; Flatla et al., 2011), and has enabled citizen-scientists to participate in conservational and bio-chemical research (http://www.fold.it; Mason, Michalakidis, & Krause, 2012).

But what game elements actually lead to improved motivation and performance? Some researchers have sought to answer this question by empirically comparing game elements. For instance, Mekler et al. (2013) demonstrated that giving participants points increases motivation in an image tagging application, as measured by the number of tags users gave to images. However, the quality of the tags they entered increased when the users were told that their tags would help scientific research into image recognition; this "meaningful framing" of the task, along with points, resulted in the best overall performance from users.

Testing another pair of game elements in a distributed "idea generation" system, Jung et al. (2010) found that feedback on the ideas was far more important than providing set goals. Providing only feedback resulted in increased quality and quantity of responses, but providing only set goals actually resulted in a small decrease in the quality and quantity of responses. It was the combination of set goals and feedback that resulted in the highest level of user response quality and quantity.

29.1.4 Gamification of Surveys

The marketing research industry has empirically studied many of the factors that affect engagement and data quality in traditional and online surveys, including the effect of survey length (Brown, 2003), the effect of answering device (slider, text-box, etc.) (Guin et al., 2012; Malinoff, 2010), and the effect of social motivation (Thomas, Bremer, Terhanian, & Couper, 2007). However, there has been little research into the effects of gamification in the context of surveys.

In a study comparing four different versions of a survey, Guin et al. (2012) included one gamified version. This version included a narrative "quest" as a motivating element, a customizable in-game avatar, and collectable items that were required to progress through the survey. The empirical results were inconclusive, but respondents seemed to prefer the gamified version over the others.

Much of the publicly released research into gamified survey design has been performed by Puleston and Sleep (Puleston & Sleep, 2011), and Adamou (Adamou, n.d.a, n.d.b) respectively. Over a number of studies they have tested gamified survey designs that include 3D environments (Puleston & Sleep, 2011; http://www.researchthroughgaming.com/), in-game story and narratives (Korn, 2012; http://www.youtube.com/watch?v=2s63gLuO-W0), response feedback such as point scoring systems (Guin et al., 2012; Puleston & Sleep, 2011), game timers (Puleston & Sleep, 2011), and in-game avatars (Adamou, n.d.a; Guin et al., 2012). In most cases, their results show that the addition of these game elements increases the length and quantity of responses, and respondents typically prefer the gamified version to the standard survey version. However, their research does not compare the effectiveness of game elements in gamified surveys. They have also found that that some gamified survey designs can lead to compromised respondent data (Puleston & Sleep, 2011).

As we have identified, there is a significant gap in the literature with regards to the effectiveness of using games as a way to gather marketing research data these in two key areas. First, it is unknown whether gamified data-gathering tools really work to provide greater engagement or participation among research participants. Some of the case studies discussed above have suggested value in the approach, but there is still little empirical evidence that directly compares gamified and non-gamified results. There is also little understanding about what aspects of gamification may be the source of any effect. Second, it is unknown whether the data gathered from gamified marketing research instruments is statistically reliable and reconcilable with traditional research methods.

29.1.5 Respondent Engagement in Survey Research

Presently, the most common method of data collection in the marketing research industry is through online surveys (Greenbook Industry Trends, 2013). Researchers conducting data collection by way of an online survey often rely on a participant pool recruited from the population of interest. Within the past decade, response rates have declined considerably (Cape, 2009), presenting an issue for researchers whose main objective is to collect accurate data. Interest in the subject matter of the survey, short survey length and relevance are commonly cited as motivating factors that encourage respondents to complete surveys (Ray & Tabor, 2003). However, individuals may not be passionate about subjects on which researchers would like to collect data.

Various strategies for increasing response rates and respondent engagement have been considered in survey research, such as incenting respondents to complete by providing a small monetary honorarium or entry into a prize draw. However, the effectiveness of these methods has been debated (Porter & Whitcomb, 2003). It has been suggested that barriers due to disinterest cannot necessarily be overcome by monetary incentives: "Response will be improved if the survey is short, relevant and of interest to the respondent. Failure to meet these criteria cannot be compensated by incentives" (Ray & Tabor, 2003, pp. 35).

Comparisons in the respondent data to short and long surveys have shown that individuals are willing to participate in fairly long questionnaires; however, it has been noted that maintaining the respondents' engagement is a key factor in ensuring the data quality does not suffer: "It appears that even a surprisingly long questionnaire can be administered without large-scale and pervasive deterioration of the quality of the data, particularly if efforts are made to maintain respondent motivation." (Herzog & Bachman, 1981, pp. 559).

29.1.6 Conjoint Experiments

Conjoint experiments are commonly used methods for gathering information about the relative value of different product attributes. The method, developed by Luce and Tukey (1964), has been in use since the 1960s and has produced a wide body of literature.

The principal advantage to the methodology is that it allows researchers to collect information that is very difficult to gather accurately in other ways. Choice-based-conjoint (CBC) style experiments are the most common type of conjoint method used in marketing research (Carson et al., 1994), as it allows the direct calculation of preference share and most directly mirrors the real choice process (Carson et al., 1994; Orme, 2010). In this type of conjoint experiment, the respondent is asked to choose his or her most preferred product from several alternatives rather than to rate the products. Although easier for respondents, the choice-based approach requires each respondent to complete more choice sets in order to achieve the same level of accuracy (Orme, 2010). Therefore, utilizing this methodology means that respondents must complete a longer survey.

Researchers have focused on experimental designs that reduce the required number of choices respondents must make (Chrzan & Terry, 1995) rather than improving the overall experience of completing the task. Survey fatigue may negatively affect responses, and some researchers have found that respondents may be using artificial simplification strategies in their later choice sets (Johnson & Orme, 1996). At present, there is no universally accepted measure for how many choice sets are too many. It is difficult to estimate the number of choice sets that respondents would typically be asked to perform, as products vary widely in their complexity; however, Johnson and Orme's (1996) analysis of 21 datasets to assess the reliability of CBC data contained between eight and 20 choice sets per respondent.

Because of its usefulness for researchers but its difficulty for respondents, a conjoint experiment was chosen as a survey style for which respondents are in great need of increased motivation, and thus used in the empirical research presented herein.

29.2 Methodology

29.2.1 Conjoint Experiment Design

Conjoint experiments can handle a wide variety of product trade-offs. We selected a product for which the respondents would be familiar: a wireless cell phone package. Products of this type have many directly comparable features which have a definite ranking order. For instance, a cell phone package which includes 200 calling minutes is at least as good as the package which includes 100 min for the same price. For this reason, this type of product is ideal for use in a conjoint analysis. The only attribute for which there was no clear ranking order between attributes was the wireless provider. Table 29.1 shows the attributes and levels that were used in the conjoint experiment.

Because of the nature of the game (described below), we elected to use a CBC method rather than a traditional conjoint method. This approach corresponded nicely with the game scenario which asked respondents to choose the best of several options.

A randomized design was used to determine the choice sets. This method allowed us to use all of the data collected from respondents and also allows the estimation of the relevant parameters in an efficient way (Orme, 2010), despite the necessity to have each individual complete more choice sets as compared with a block design. Respondents could select one out of three different options, or they could select "none". This design was used to add to the realism of the choice task (Carson et al., 1994).

29.2.2 Measurement of Engagement

Two common measures of engagement in surveys are drop-off rates and self-reported enjoyment. Both have been used as the primary measure in a number of research studies involving gamification as well as other survey attributes such as length and complexity (Deutskens, de Ruyter, Wetzels, & Oosterveld, 2004; Guin

Table 29.1 Attributes and levels used in the conjoint experiment

Attribute	Number of levels	Levels
Brand	3	SaskTel/Telus/Rogers
Price	4	\$30/\$40/\$50/\$60
Minutes	3	100/200/400
Data	4	None/250 MB/1GB/2GB
Long distance	2	25¢ per minute/unlimited
Calling features	2	None/Call waiting, call transfer, three-way calling

Table 29.2 Self-reported engagement questions

Question	Scale
How enjoyable was this survey game?	(1—not enjoyable) to (7—highly enjoyable)
How motivated were you to complete the survey game?	(1—not motivated) to (7—highly motivated)
How interested were you in the subject matter of the questions?	(1—not interested) to (7—highly interested)

et al., 2012). Presumably, respondents who become bored are more likely to drop off part-way through the survey. However, some researchers have found a remarkable resilience to survey length and, despite declining response rates to online surveys, have found little effect on participation rates (Cape, 2009). For this reason, we did not wish to rely on participation and completion rates as our only measure of engagement. Time spent has also been used to measure engagement (O'Brien & Toms, 2010) in gamification research. We chose to include time spent as well in an attempt to quantify the degree of engagement of participants.

Because our main goal was to determine whether gamification would increase the quantity of data we were able to collect in a conjoint experiment, we directly used the number of choice tasks completed as the ultimate measure of the success the gamification of the research. The quantity of data collected has been used as a measure of success in gamification (Jung et al., 2010; Mekler et al., 2013) but to our knowledge, it has not been assessed in the context of survey research.

Following (Guin et al., 2012), we also included survey questions so that the respondents could self-report their engagement levels. A seven-point scale was used for three semantic-anchor questions. Table 29.2 lists the questions used.

We were interested to see whether an increased enjoyment of the survey games would also lead to a higher measured engagement in the subject matter. In other words, we were interested to know whether the way in which the subject was presented, within a game or within a survey, affects the subjective evaluation of how interesting it was perceived to be.

Finally, we collected qualitative data on the participants' subjective experience by allowing them the option to provide comments about the games in which they participated.

29.2.3 Applicability of Gamification to Conjoint Analysis

The gamification of the survey needed to ensure that the core tasks of the process remained the same. A CBC experiment consists of a series of choice tasks in which the respondent must evaluate and choose the most preferred alternative from several choices (Sawtooth Software Inc.,1993), and so we created a game where the goal mimicked this decision: a salesperson scenario. Respondents were situated in a store and customers came in wanting to purchase a product. They were asked to serve the customer by choosing the best product from several alternatives (the choice task) for the customer.

Several elements of a gamification framework were included:

- **Fantastical scenario and immersive experience**: Two versions of the game were developed. The first was a "realistic" scenario where customers were located in a store. The second was a completely fantastical scenario where the customers were monsters from an alien planet.
- **Autonomy of the participant**: Instead of going through a survey where the questions are displayed automatically, respondents were able to "play" by choosing which customer they wished to serve in the game.
- **Novelty**: To add an element of novelty, the instruction statements which explained the task to the respondent were different for each customer they clicked on (although the sentiment stayed the same). In the most gamified version, we added humourous elements and sound effects.
- **Feedback and scoring system**: Participants were given points for successfully serving customers. In two of the versions tested, the instruction statement from the customer had a correct and incorrect answer, and the respondent was given feedback as to whether or not the customer was successfully served.
- **Progress**: The game was divided into rounds of six questions each. Although there was no increase in difficulty as the rounds progressed, participants would receive higher point rewards in the higher rounds of the game.
- **Time pressure**: We included a time element in the more fully gamified versions to determine whether adding a time pressure would have any effect on the engagement in the task.

Several gamification elements were considered for inclusion but ultimately were not included because of their potentially negative effects on the data quality:

- **Increasing challenge**: We did not include any change to the level of challenge throughout the game as the choice task requires the data to be collected in the same format.
- **Reputation or ranking**: No out-of-game implications such as a leader board was included as we felt that respondents may cease to pay attention to the task at hand in an attempt to make it to the top of the list, resulting in compromised data.

29.2.4 Experimental Design

In our research, we sought to answer four key questions in two areas. First, we wanted to determine the effect of gamification on the accuracy of the data collected, as determined by the similarity of the results between a survey version and a gamified version. Second, we sought to explore the effect of gamification on participant engagement. Our experimental design strived to answer the following questions:

- Does the act of completing a conjoint experiment in a game setting affect the results? Further, does the realism of the game scenario affect the results?
- Does providing responses in a game setting allow us to collect more data from each participant? Further, does the possibility of correct and incorrect answers improve respondents' engagement with the series of choice tasks?

29.2.5 Effect of the Game Setting on Engagement

We hoped that adding a gamification element to the conjoint experiment would encourage research participants to be more engaged in the research process. The five measures of engagement used were

- drop-off rates
- time spent participating in the research
- self-reported enjoyment, motivation and interest
- the proportion of minimum efforts
- the number of choice tasks done by each respondent

Drop-off rates were calculated by determining the number of respondents who dropped out of the survey part-way through and dividing it by the total number of respondents who started the survey, excluding those who were disqualified from participation due to demographic quotas.

When the respondent clicked into the survey, the time was recorded. The time was again recorded when they submitted their completed responses. Because the respondents could have opened the link in their browser and then left it open to complete later, the accuracy of this measure is somewhat ambiguous. Attempts were made to exclude outliers from the results: any time greater than 5 h were excluded from calculations.

After participating in the game, respondents were routed to an online survey system and asked to rate their enjoyment, motivation and interest on a seven-point semantic-anchor question. Since a conjoint experiment is tedious for the respondent, we expected low levels of engagement for the survey overall.

The proportion of minimum efforts and the total number of rounds completed were used to measure the extent to which respondents were willing to provide more data to researchers. Participants were told that they only needed to complete a single round (six questions) in order to receive their honorarium and they were able to continue playing as long as they wished. Therefore, the honorarium provided no additional incentive to continue participation. We measured the proportion of respondents who completed only the minimum number of choice tasks to receive their incentive.

We also directly used the number of rounds that the participants completed as a measure of their ongoing engagement in the various versions of the games. This allowed us to see whether those incented by the gamified versions had increased motivation to *continue* providing data.

Table 29.3 In-game statements used in the salesperson scenario game

In-game statement from the customer	Correct response
I need your help! Which is the best value?	No correct response
I'm not sure… Which should I pick?	No correct response
Can you do me a favour? Choose for me!!	No correct response
I've narrowed it down to these… Which do you think is best?	No correct response
"I don't want to spend much! I want the cheapest price!"	Least expensive
"I make a lot of work calls to cities across the country."	Must contain long distance
"I don't know what I'd do without internet on the bus!"	Must contain data
"I don't know how much I talk on the phone - but it's a LOT!"	Large amount of calling minutes

29.2.6 Additional Motivating Factors

As designed, a conjoint experiment does not have correct or incorrect answers since the purpose is to solicit an individual's subjective opinion of which is the best option. However, in a game setting, feedback is an important motivating mechanism. All of the gamified versions featured points that respondents would receive upon answering each question.

Incorporating the possibility of getting incorrect answers had the potential to motivate respondents by providing more challenging gameplay (Mekler et al., 2013; Reeves & Read, 2009). From a data collection standpoint, the effect on engagement would have to be substantial in order for it to be worthwhile to include these planted choice sets since they do not provide the researcher with data that is usable for the conjoint experiment results.

To measure the effect of correct and incorrect answers on engagement, we added planted choice sets. The respondent was asked to choose the best plan for the customer. The questions were phrased so that there were clear correct answers among the choices. Several examples of in-game statements used are summarized in Table 29.3.

The appearance of the planted choice sets was random and the ratio of planted choice sets to real choice sets was set to 50/50. We hypothesized that providing feedback to respondents would provide a more immersive experience and encourage them to continue playing.

29.3 Description of Game Versions

29.3.1 Version 1.0: Simple Choice Sets

The first version was as close as possible to a basic survey version. The respondent would click a "Next Question" button to reveal each conjoint question in the round. Respondents were instructed to select the best plan from the options presented. A screenshot of the survey-style version is contained in Fig. 29.1.

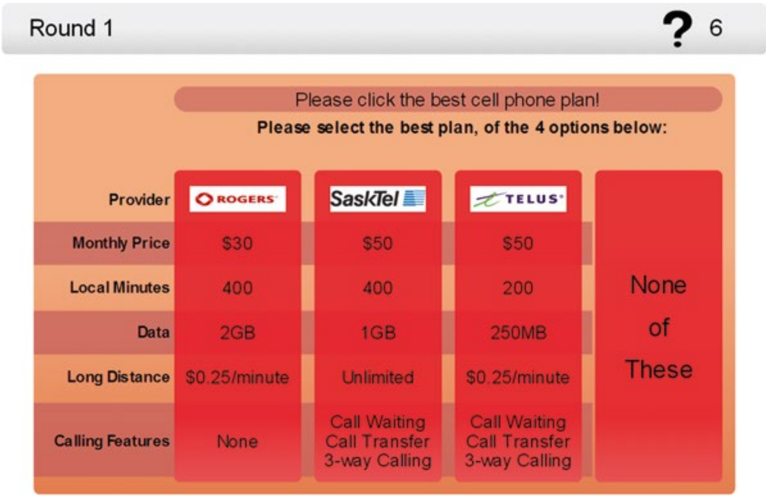


Fig. 29.1 Version 1.0 Survey-style Choice Sets

29.3.2 Version 2.1: Salesperson: No Correct Answers

The next, more gamified version of the game included animated human characters that represented each new question. Respondents were asked to pretend that they were the cell phone shop owner, and each conjoint question was revealed by clicking on the customer characters that walked onto the screen. The game story had basic sounds and graphics, and a simple story where the respondent was asked to help customers in the virtual store decide on their cell phone purchase. Figure 29.2 illustrates version 2.1 of the game.

29.3.3 Version 2.2: Salesperson: With Correct Answers

As in version 2.1, the respondents who played version 2.2 were asked to act as the cell phone shop owner and to recommend cell phone plans to customers. This version differed from 2.1 in several ways. Version 2.2, illustrated in Fig. 29.3, included planted cards with correct and incorrect responses, a point scoring system, and a game timer.

29.3.4 Version 3: Monsters: With Correct Answers

The final game version was intended to push the boundaries of our gamified design; we selected a fantastical game story and setting as a contrast to the more grounded and realistic game story from the other versions tested. The human characters were

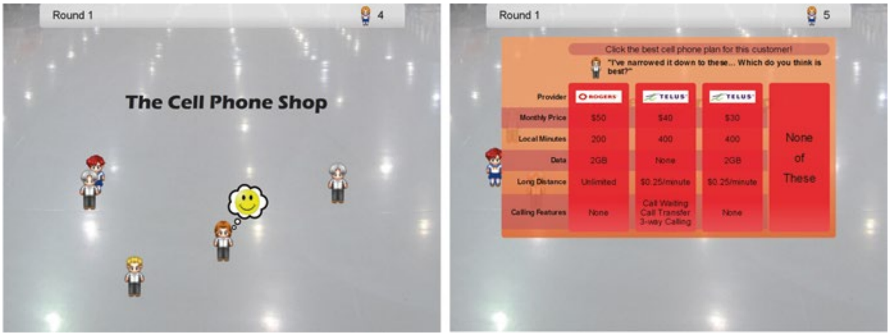


Fig. 29.2 Salesperson Scenario Game with No Correct Answers

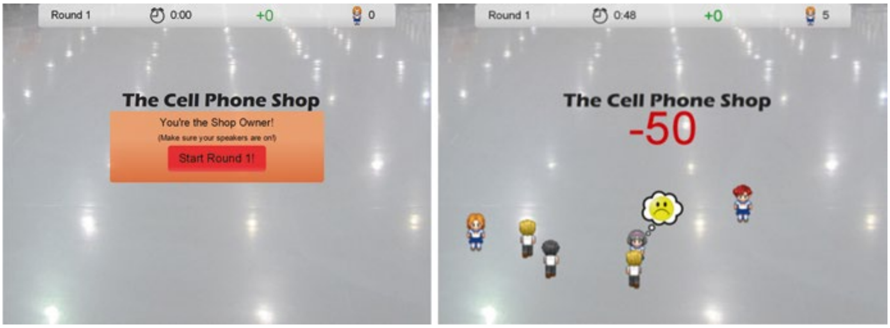


Fig. 29.3 Salesperson Scenario Game with Correct and Incorrect Answers

Fig. 29.4 Monster Scenario Game

Table 29.4 In-game statements used in the monster scenario game

In-game statement from the customer	Correct response
Monster stubbed toe—Ouch! Best phone plan will fix!	No correct response
Eee a rowr! (Translation: Help me pick out the best one.)	No correct response
ROAR!!!… Sorry… Habit. You help me pick?	No correct response
ARHR! Monster hate shopping!!! (Maybe just pick the best one for him)	No correct response
Me like stay up to date on news! Monster on Twitter! #ROOOOOAR	Must have data plan
Monster want browse internet on bus! No internet?? Monster EAT BUS!!	Must have data plan
What's WhoTube? My face-look? Monster don't need that! Monster just want PHONE!	No data plan
Monster like spend least possible! ME WANT FREE!	Lowest cost

replaced with monsters and the store environment background image was replaced with an alien planet to reinforce the fantasy setting. The task descriptions for each conjoint question were intended to be humorous, and we used additional audio and video elements (such as random talk and speech bubbles) to increase interest. Figure 29.4 illustrates the Monster Scenario Game used.

Table 29.4 shows a selection of the in-game statements used for the categorization of correct and incorrect answers.

29.4 Experimental Results

29.4.1 The Research Setting

Respondents who had previously consented to participate in research through Insightrix Research's proprietary online panel were invited to participate in the experiment. The sample was drawn from approximately 12,000 individuals and was balanced by age and gender. Each potential participant was sent an email inviting him or her to participate in the research and then randomly assigned to one of the four versions tested. Quotas were set to ensure that an appropriate demographic mixture of respondents participated in the research, as interest in games varies by these variables. Once a quota group was full, the respondent was disqualified from the research pool and was not able to participate.

Each version was programmed to show six questions per round. There was a maximum of 192 questions per game session, which represented the respondent seeing and evaluating every possible combination of levels and attributes.

Approximately 100 respondents participated in each of the various versions of the game. The sample sizes and the demographic breakdown are given in Table 29.5.

Table 29.5 Demographic breakdown of responses

		Version 1—simple choice sets	Version 2.1—salesperson—no incorrect answers	Version 2.2—salesperson—with incorrect answers	Version 3—monsters—with incorrect answers
Age	18–34	26	20	31	31
	35–54	38	35	36	35
	55+	38	35	35	35
	Total	102	90	102	101
Gender	Male	46	43	39	48
	Female	58	47	63	53
	Total	104	90	102	101

29.4.2 Drop-Off Rate

Approximately 40 % of those who were qualified to complete the survey dropped off before completion in each of the gamified versions. Because of the greater complexity of the conjoint experiment compared to a typical survey, it was expected that the drop-off rate would be higher than for a typical survey. This was indeed the case: other researchers have found a fairly consistent drop-off rate of 25 % in online surveys (Cape, 2009). Table 29.6 details the drop-off rates of the four different games.

Gamification did not significantly reduce the survey drop-off rate at the 95 % confidence level, although the sample size may not have been powerful enough to show a difference. Respondents who participated in the regular survey-style conjoint experiment were just as likely to discontinue participating in the survey as those who played the gamified versions.

No effect was found on drop-off with regards to the inclusion of correct and incorrect answers: including questions that respondents could get wrong did not affect the drop-off rates of the survey.

Additionally, the scenario realism also had no significant effect on the drop-off rates. Respondents were just as likely to drop out of the realistic version of the game as the fantastical version.

29.4.3 Time Taken

The total time take to complete the survey was measured for each respondent to determine whether he or she would spend more time on the task in the gamified version. The time taken includes the total time participating in the research: answering the beginning demographic questions, playing the games or participating in the survey, and completing the final few survey questions where they rated their enjoyment and provided comments.

Table 29.6 Drop-off rates

	Version 1—simple choice sets	Version 2.1—salesperson—no incorrect answers	Version 2.2—salesperson—with incorrect answers	Version 3—monsters—with incorrect answers
Total completes	104	90	102	101
Total drop-offs	128	58	68	63
Total qualified to complete	232	148	170	164
Percentage of drop-offs over the total who started	55 %	39 %	40 %	38 %

Table 29.7 Time spent

	Version 1—simple choice sets	Version 2.1—salesperson—no incorrect answers	Version 2.2—salesperson—with incorrect answers	Version 3—monsters—with incorrect answers
Average time spent (minutes)	13.42[a]	10.69	11.83	12.67
Standard Deviation	*12.87*	*11.40*	*13.02*	*16.83*
Standard error	*1.27*	*1.20*	*1.29*	*1.68*

[a]One outlier with a time of more than 5 h—corresponding to a respondent who may have left his or her browser window open—was excluded

We expected respondents to spend more time, on average, taking part in the research process when they were participating in the gamified versions. However, respondents spent approximately the same amount of time or longer completing the simple choice sets as they did playing the games. The average time taken for each version of the game is given in Table 29.7.

A univariate ANOVA test of average completion times did not find a significant difference between the four versions ($F_{3,390}=0.517$, $p=0.67$). The realism of the scenario did not significantly affect the time spent participating in the research; respondents spent a similar amount of time playing the realistic game as the fantastical game. There was also no significant effect on the time spent when correct and incorrect responses were included.

29.4.4 Self-Reported Engagement

After respondents decided to stop completing choice sets, they were asked to rate the enjoyableness of the games that they played. They were also able to provide comments about their experience.

Table 29.8 Self-reported engagement

	Version 1: simple choice sets	Version 2.1: salesperson—no incorrect answers	Version 2.2: salesperson—with incorrect answers	Version 3: monsters—with incorrect answers
Enjoyment (How enjoyable was this survey game?)	2.9	3.0	3.4	3.1
Standard deviation	*1.79*	*1.69*	*1.90*	*1.83*
Standard error	*0.18*	*0.19*	*0.18*	*0.18*
Motivation (How motivated were you to complete the survey game?)	3.0	3.3	3.5	3.1
Standard deviation	*1.70*	*1.78*	*1.88*	*1.82*
Standard error	*0.18*	*0.19*	*0.18*	*0.18*
Interest (How interested were you in the subject matter of the questions?)	3.5	3.7	3.6	3.0
Standard deviation	*1.76*	*1.73*	*1.86*	*1.72*
Standard error	*0.18*	*0.19*	*0.18*	*0.18*

Table 29.8 shows the average ratings for self-reported enjoyment, motivation and interest in the subject matter. Ratings were given on a seven-point semantic-anchor scale.

Univariate ANOVA tests showed that gamification had no significant effect on respondent ratings of how enjoyable the game was ($F_{3,390}=1.12$, $p=0.34$) or how motivated they were to complete the survey ($F_{3,390}=1.95$, $p=0.12$). We did find a significant difference in respondent interest in the subject matter of the questions ($F_{3,390}=2.84$, $p=0.038$).

As there were no significant differences found between versions 2.1 and 2.2, the addition of correct and incorrect answers in the salesperson scenario does not seem to have had an effect on enjoyment, motivation or interest. However, it seems likely that some element of the design of version 3 had an effect on respondents' interest in the subject matter: the fantastical setting or the different tone and writing style of the in-game customer statements *decreased* interest in the subject, opposite to our expectations.

The comments from the four versions we deployed showed that there was a marked difference between the non-gamified and gamified versions. The general tone and types of comments we received regarding the non-gamified version were typical for any survey; generally minor complaints, with no major positives or negatives cited. Here are a few examples:

- "*This was too repetitious*."
- "*A bit too long*."
- "*Did not know when the rounds would end—got tired/bored*."

However, the tone of the comments from the gamified versions tended to two extremes. Some of the comments we received were strikingly positive, such as the following:

- "*Do more surveys in the form of games*, *it's much more fun*!"
- "*Fun*!"
- "*I love games. I was quite excited to do this one*."

On the other extreme, some respondents were clearly not pleased with various aspects of the gamified design. Here are a few of these types of comments:

- "*I am not motivated by highschool-looking characters*."
- "*The game was stupid*…"
- "*What was the point of the survey. Waste of time*."

Our gamified designs were quite divisive; it seems clear that respondent expectations and preferences must be strongly considered when designing and deploying gamified surveys. Some respondents will be more motivated by games and game elements than others, and what seems like a well-selected game mechanic may not appeal to everyone. Moreover, the positive and negative qualitative comments were spread across demographics and gaming experience. Clearly some respondents may prefer the standard survey version over even a perfectly designed gamified survey, and it would be prudent to retain this option for such respondents.

29.4.5 Number of Choice Tasks Completed

To our surprise, the game elements did not have a positive effect on the number of choice sets that respondents completed. Although a univariate ANOVA test did not show a significant difference ($F_{3,390}=1.17$, $p=0.322$), respondents who received the survey-like version completed an average of 10 *more* choice sets than in any of the game versions, completely contrary to expectations.

As there is no significant difference between the number of choice sets completed between the three gamified versions, it seems that the inclusion of correct and incorrect answers (for versions 2.2 and 3) did not have a notable effect on the average number of choice tasks completed. Table 29.9 summarizes these results.

It is also worth noting that the average number of choice sets completed by respondents was substantially higher than the eight to 20 choice task range in the data sets analysed by Johnson and Orme (O'Brien & Toms, 2010). This suggests that respondents may be willing to complete many more choice sets than are commonly employed in CBC research studies.

Table 29.9 Number of choice tasks completed

	Version 1—simple choice sets	Version 2.1——salesperson—no incorrect answers	Version 2.2—salesperson—with incorrect answers	Version 3—monsters—with incorrect answers
Average number of choice sets completed	47	37	36	37
Standard deviation	52.9	48.2	39.6	45.8
Standard error	5.08	4.73	4.32	4.21

Table 29.10 Number of choice tasks completed—percentages

	Version 1—simple choice sets	Version 2.1—salesperson—no incorrect answers	Version 2.2—salesperson—with incorrect answers	Version 3—monsters—with incorrect answers
Percentage who did at least 36 choice tasks	41 %	24 %	33 %	30 %
Percentage who completed all 192 choice tasks	7 %	3 %	0 %	3 %
Percentage who did only the minimum (*6 choice tasks*)	21 %	29 %	29 %	29 %

29.4.6 Minimum Efforts

The percentage who completed the minimum number of choice tasks to receive the incentive varied slightly across the versions; however, the difference was not statistically significant at the 95 % level. Directionally, the non-gamified version again proved to be the best.

Some respondents exhibited a remarkable willingness to complete the choice tasks and completed all (192) choice tasks possible in the entire experiment, which was much greater than expected.

The proportion who did the minimum was lowest among those who completed the simple survey. Table 29.10 summarizes the minimum efforts across all four versions.

29.4.7 Reliability of Results

The results from the five games showed a remarkable amount of consistency in the calculation of the part worth utilities from the conjoint dataset Table 29.11 summarizes these results. This result suggests that there was no negative effect on the

Table 29.11 Reliability of results

Price	Version 1—simple choice sets	Version 2.1—sales-person—no incorrect answers	Version 2.2—sales-person—with incorrect answers	Version 3—mon-sters—with incorrect answers
$30	33 %	36 %	36 %	31 %
$40	30 %	27 %	24 %	28 %
$50	22 %	22 %	23 %	20 %
$60	14 %	15 %	17 %	21 %
Provider				
Brand 1	44 %	48 %	45 %	47 %
Brand 2	28 %	24 %	27 %	24 %
Brand 3	28 %	28 %	28 %	30 %
Minutes				
100	25 %	26 %	29 %	26 %
200	36 %	35 %	33 %	32 %
400	39 %	39 %	38 %	43 %
Data				
None	15 %	14 %	17 %	15 %
250 MB	20 %	23 %	25 %	24 %
1GB	29 %	29 %	27 %	29 %
2GB	36 %	34 %	31 %	32 %
Long distance				
$0.25/min	40 %	41 %	42 %	44 %
Unlimited	60 %	59 %	58 %	56 %
Calling features				
No calling features	45 %	45 %	41 %	44 %
Call waiting, call transfer, 3-way calling	55 %	55 %	59 %	56 %

accuracy of the results despite the drastic changes in the realism of the different games. These results suggest a high degree of engagement already in the respondent population, which did not appear to be improved by gamifying the research process.

29.5 Summary and Conclusions

Our results contrast some of the results in the literature where gamification has been shown to assist in engagement in tedious tasks. None of our measures of engagement were improved by gamifying the conjoint survey, and one, interest in the subject matter, was significantly reduced. The addition of the gamification elements also had, if anything, a detrimental effect on the *amount* of data that respondents were willing to provide. This result contrasts those of Mekler et al. (2013) and Jung et al. (2010) who both found an increase in the quantity of data provided by respondents.

It is important to note that, while gamification reduced the number of questions completed, the data collected did not appear to be negatively affected. Our results on drop-off rates are also consistent with Guin et al. (2012) who also found no difference in the engagement measures of survey drop-off and completion rates in their gamified version. Guin et al. also found that gamification increased self-reported engagement. However, our results did not show a strong effect on the enjoyability of the task or motivation to complete the task, and interest in the subject matter was lower in the very fantastical scenario. As well, including questions with correct and incorrect responses did not appear to influence our engagement results significantly between versions.

Our results could have been caused by several factors. Previous researchers have highlighted the importance of carefully pairing work tasks and game elements when developing a gamified design (Von Ahn & Dabbish, 2008). It is possible that the "salesperson" game metaphor that we selected was not as appropriate for a conjoint survey as we initially thought. In a typical conjoint survey respondents are asked to select the best option with the implication that they are selecting the best option *for themselves*. In our game versions, respondents are asked to recommend the best options *for someone else* as a result of the design of the game. This changes the respondent experience in two ways. First, a respondent is being asked to pretend that the character on screen (who is "asking" them for help) is real enough to warrant giving their genuine opinion: the task might be more successful if respondents believed they were giving a recommendation to a real person instead. Second, asking the respondent to make a recommendation for someone else may actually make the task less personal and interesting: some respondents may prefer discussing and making choices for themselves rather than for others.

It is also possible that respondents were not given enough instruction and training regarding the game mechanics to make them feel comfortable with playing the game. Although the conjoint questions were administered in exactly the same manner in all four versions, the game setting may have been enough to confuse respondents, make them second guess their task, and reduce their confidence and comfort with the game version of the conjoint; some respondent comments seem to support this as a possible conclusion. Further research where some participants receive information about the game mechanic and others do not would be helpful in determining the true effect of additional instruction on engagement in a gamified survey task.

Another possible explanation for our findings could be in the framing of the task: Mekler et al. (2013) found that simply informing participants that their results would be used to improve scientific knowledge increased their motivation and willingness to complete more tasks. In the case of a survey, the very nature of the survey instrument makes it clear to the respondent that the data is being collected for a particular purpose. However, respondents may have been less clear about the purpose of the questions they were answering in the game version and how their participation in the game versions would be as helpful as in a typical survey.

Compared to the method tested by Mekler, gamifying surveys and occluding the survey instrument could actually prove to be problematic. If the obviousness of the data collection method proves to be a major motivating factor for survey participation, gamification in survey research may in fact be more of a detriment than a positive. Experiments where participants are explicitly informed of the value of the game to researchers could assist in determining whether this is indeed a factor. However, making the usefulness of the survey game explicit could also have a negative effect. Since part of the reason for using gamified data collection methods is to capture *naturalistic* data from participants, informing them prior to their participation in the survey game could have other negative effects. This is an important area for future research.

It is reassuring that there were no negative data quality implications of gamifying the conjoint experiment. This suggests that despite the relatively fantastic nature of the game terrain itself, individuals' preferences are fairly fixed: what they believe is better does not appear to strongly depend on the context in which they are asked. This remains true for a fairly realistic game scenario – a store front – as well as an extremely fantastical scenario – monsters on an alien planet.

Our use of gamification as a motivating component did not have a positive effect on any of the engagement measures that we used, suggesting that gamifying surveys is not a guaranteed way to increase respondent engagement in the survey process. The results suggest that in the context of survey research, the core task of providing opinions to a researcher is a very important motivator in itself. Therefore, meaningful framing must be a crucial consideration for researchers who wish to employ gamification as part of a data collection process and should guide future gamification strategies used in survey research.

References

Adamou, B. (n.d.a). *Using gamification in youth surveys*. Retrieved from http://rwconnect.esomar.org/2012/07/17/using-gamification-in-surveys-for-children/

Adamou, B. (n.d.b). Giving research the NOS effect. *Proceedings of 2012 Net Gain 6.0 MRIA Conference.*

Brown, J. (2003). Survey metrics ward off problems. *Marketing News, 17*, 17–20.

Cape, P. (2009). Questionnaire length, fatigue effects and response quality revisited. *SSI white paper.*

Carson, R., Louviere, J., Anderson, D., Arabie, P., Bunch, D., Hensher, D., et al. (1994). Experimental analysis of choice. *Marketing Letters, 5*(4), 351–368.

Center for Game Science at University of Washington: Foldit. Retrieved from http://www.fold.it

Chao, D. (2001). Doom as an interface for process management. *Proceedings of CHI 2001* (pp. 152–157).

Chrons, O., & Sundell, S. (2011) Digitalkoot. Making old archives accessible using crowdsourcing. *Proceedings of HCOMP.*

Chrzan, K., & Terry E. (1995). Partial profile choice experiments: A choice based approach for handling large numbers of attributes. *1995 Advanced Research Techniques Conference Proceedings*. Chicago, IL: American Marketing Association.

Deterding, S., Dixon, D., Nacke, L., O'Hara, K., & Sicart, M. (2011). Gamification: Using game design elements in non-gaming contexts. *CHI 2011 Ext. Abstracts*.

Deutskens, E., de Ruyter, K., Wetzels, M., & Oosterveld, P. (2004). Response rate and response quality of internet-based surveys: An experimental study. *Marketing Letters, 15*(1), 21–36.

Dignan, A. (2011). *Game frame: Using games as a strategy for success*. New York: Free Press.

Evans, J. R., & Mathur, A. (2005). The value of online surveys. *Internet Research, 15*(2), 195–219.

Flatla, D. R., Gutwin, C., Nacke, L. E., Bateman, S., & Mandryk, R. L. (2011). Calibration games: Making calibration tasks enjoyable by adding motivating game elements. *Proceedings of UIST 2011* (pp. 403–412).

Greenbook Industry Trends Report (2013, Winter).

Guin, T. D., Baker, R., Mechling, J., & Ruylea, E. (2012). Myths and realities of respondent engagement in online surveys. *International Journal of Market Research, 54*(5), 613–633.

Herzog, A. R., & Bachman, J. G. (1981). Effects of questionnaire length on response quality. *Public Opinion Quarterly, 45*, 549–559.

Hunicke, R., LeBlanc, M., & Zubek, R. (2004). MDA: A formal approach to game design and game research. *Proceedings of AAAI04 WS on Challenges in Game AI* (pp. 1–5).

Johnson, R., & Orme, B. (1996). How many questions should you ask in choice-based conjoint studies? *Sawtooth software research paper series*

Jung, J., Schneider, C., & Valacich, J. (2010). Enhancing the motivational affordance of information systems: The effects of real-time performance feedback and goal setting in group collaboration environments. *Management Science, 56*(4), 724–742.

Korn, O. (2012). Industrial playgrounds: How gamification helps to enrich work for elderly or impaired persons in production. *Proceedings of EICS 2012* (pp. 313–316).

Lewis, C., Wardrip-Fruin, N., & Whitehead, J. (2012). Motivational game design patterns of 'ville games. *Proceedings of FDG 2012* (pp. 172–179).

Luce, R. D., & Tukey, J. W. (1964). Simultaneous conjoint measurement: A new scale type of fundamental measurement. *Journal of Mathematical Psychology, 1*(1), 1–27. doi:10.1016/0022-2496(64)90015-X.

Malinoff, B. (2010). Sexy questions, dangerous answers. *Proceedings of CASRO 2010 Technology Conference*.

Mason, A., Michalakidis, G., & Krause, P. (2012). Tiger nation: Empowering citizen scientists. *Proceedings of IEEE DEST*.

Mekler, D., Brühlmann, F., Opwis, K., & Tuch, N. (2013). Disassembling gamification: The effects of points and meaning on user motivation and performance. *CHI 2013*.

Nikkila, S., Byrne, D., Sundaram, H., Kelliher, A., & Linn, S. (2013). Taskville: Visualizing tasks and raising awareness in the workplace. *CHI 2013 Ext. Abstracts.*

O'Brien, H. L., & Toms, E. G. (2010). The development and evaluation of a survey to measure user engagement. *Journal of the American Society for Information Science and Technology, 61*(1), 50–69.

Orme, B. (2010). *Getting started with conjoint analysis: Strategies for product design and pricing research* (2nd ed.). Glendale, CA: Research Publishers LLC.

Porter, S., & Whitcomb, M. (2003). The impact of contact type on web survey response rates. *Public Opinion Quarterly, 67*(4), 579–588.

Puleston, J., & Sleep, D. (2011). The game experiments: Researching how gaming techniques can be used to improve the quality of feedback from online research. *Proceedings of ESOMAR Congress*.

Ray, N. M., & Tabor, S. W. (2003). Cyber surveys come of age. *Marketing Research, 15*, 32–37.

Reeves, B., & Read, J. (2009). *Total engagement: Using games and virtual worlds to change the way people work and businesses compete*. Boston: Harvard Business Press.

Research through gaming: Pimple crisis. Retrieved from http://www.youtube.com/watch?v=2s63gLuO-W0

Research through gaming: The Playspondent House. Retrieved from http://www.researchthrough-gaming.com/

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion, 30*(4), 347–363.

Sawtooth Software Inc. (1993). The CBC system for choice-based conjoint analysis—Version 8. *Sawtooth software technical paper series*

Shneiderman, B. (2004). Designing for fun: How can we design user interfaces to be more fun? *Interactions, 11*(5), 48–50.

Sweetser, P., & Wyeth, P. (2005). GameFlow: A model for evaluating player enjoyment in games. *Computers in Entertainment, 3*(3), 1–24.

Thomas, R., Bremer, J., Terhanian, G., & Couper, M. P. (2007). Truth in measurement: Comparing web-based interview techniques. *Proceedings of ESOMAR Congress*.

Von Ahn, L., & Dabbish, L. (2008). Designing games with a purpose. *Communications of the ACM, 51*(8), 58–67.

Chapter 30
Project Knowledge Management While Simply Playing! Gaming Mechanics in Project Knowledge Management Systems

Silvia Schacht and Alexander Maedche

30.1 Motivation or Why Gamification is Needed in Project Knowledge Management

In addition to challenges caused by the project itself, a project manager is exposed to many questions and obstacles regarding project knowledge management (KM). Beginning with project's start, the first task of project managers is to decide which expert fits best to the team. Thus, he has to figure out who knows what. Within the project, a vast amount of knowledge is created and shared among all project participants. The individual knowledge base of each member is growing rapidly in the limited period of time until the project is finished. Furthermore, members are joining or leaving the team which also increases the heterogeneity of overall project knowledge. Finally, at project's end, the project manager is ordered by his supervisor to collect and document project's key insights. These insights are called lessons learned and aim to improve organizational learning. Often, the collection and documentation of lessons learned take place in a final team meeting.

This final step again comes along with a number of questions: Who has to be invited? Since team members join and leave the project during its duration, it is difficult to sample the group of appropriate participants. Have invitees time to join the session? Often, project team members already left the project or immediately joined another team or project. Therefore, invitees rate the benefits of participating at lessons learned sessions as being very low. Are the invitees motivated to participate and

S. Schacht (✉)
Chair of Information Systems IV, University of Mannheim, Mannheim, Germany
e-mail: schacht@es.uni-mannheim.de

A. Maedche
Chair of Information Systems IV, University of Mannheim, Mannheim, Germany

Institute for Enterprise Systems, University of Mannheim, Mannheim, Germany
e-mail: maedche@es.uni-mannheim.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_30

share their knowledge? From all questions asked in this section, it is the only one having a clear answer—No! The lacking motivation is caused by many reasons. On the one hand, team members do not see a benefit for themselves. Contributing their knowledge in order to collect insights of a project that is already closed seems to be waste of time. On the other hand, in a knowledge-based society, individuals tend to hoard their knowledge especially if they fear to depreciate themselves when sharing it. After sampling the participants, the question arises on how to conduct a lessons learned session. To put it more strongly, typical lessons learned sessions follow one of two possible ways. Either the project has failed resulting in finger pointing, or everything went well leading to hymns of praise about team members' individual work. Both alternatives are not satisfying since comments in such sessions are seldom valuable for knowledge reuse in future projects. Which insights are valuable? For project teams it is difficult to answer this question. Over the time, the team has built up a common sense on project-related topics often referred as transactive memory system (Hsu, Shih, Chiang, & Liu, 2012). Members of a transactive memory system do not need additional explanations for a certain issue, while those who are not part of the system need more detailed information in order to understand the same issue. However, project teams are often not aware that they are in an environment with such a common sense. In consequence, most lessons learned lack contextual information and thus, cannot be reused by others. Those key insights that are identified as valuable need to be documented raising the question of which way is best for documentation. Storytelling? Blogging? Both methods provide more information and are easy to read, but have the disadvantage of high documentation effort. Bullet points? Documenting knowledge in bullet points possesses at least effort, but does not provide additional information necessary to understand its context. Who is doing the work of documentation? The first answer coming into mind of most project team members is: the project manager. Since the project manager has got the mandate, he has to document the findings. However, during a project life-cycle managers are drowning in reporting and documentation work. Where to store the documented lessons learned? Some companies put their trust on document management systems or data bases in order to answer this question. Others recognize the way of the world and implement more modern knowledge management systems (KMS) like wikis or blogs. Nevertheless, beyond individuals mind, all media of knowledge storage seem to be only cemeteries of data containing knowledge that is never used again. Even if all these questions got an answer and project teams collect, document and store their insights, they are still not valuable when no one reuses them. However, the reuse of knowledge happens far less than its collection, documentation or storage. This is reasoned by the fact that the search for valuable knowledge on organization's cemetery of data becomes to a search for a needle in a haystack. Most lessons learned turn out to be only a straw instead of the searched needle. They are not relevant for knowledge seekers, often lack contextual information in order to understand the background of project insights, or are simply outdated.

All these issues are not new and pushed KM research. Especially with the advent of the digital age, researchers and practitioners came up with the idea of designing and implementing KMS. This special form of information systems aims to enable organizations to manage what they know. Over time, KMS were enriched or even substituted by Web 2.0 applications. Nevertheless, many studies reveal a low adoption rate of these systems in firms. In fact, the adoption of KMS follows the 90-9-1. This means, 90 % of users are pure consumers of content, 9 % are creating only little content, while 1 % is providing the greatest amount of content (Palmisano, 2009). The 90-9-1 rule illustrates that KMS do not motivate users to contribute their knowledge or reuse it in other projects. This situation is aggravated by the fact that most KMS generate low user experience and satisfaction. To carry this topic to extremes, KMS are no fun. In order to consolidate the mentioned issues, project KM has to cope with less motivation and engagement, and KMS do not create an enjoyable user experience or high user satisfaction. For effective and efficient KM and thus, increased knowledge reuse, engagement and motivation as well as the implementation of an appropriate KMS seem to be key success factors. Thus, a KMS needs to cover all these concepts. For many years, researchers ask themselves how this can be accomplished. One possible answer can be given by taking gamification into account as driver for motivation and engagement. Motivated by the key research question on how to increase project knowledge reuse within an organization, we designed and implemented a project KMS which also includes typical elements of gamification.

Therefore, the results of our research will be discussed in this book chapter using the gamification perspective. The remainder of this section is structured as follows: In the first part, we present our results of an intensive literature review in order to provide an overview existing research on gamification. In the second part, we present our own research including identified meta-requirements (MRs) and design principles (DPs) for an effective project KMS. We are discussing typical issues in KM and which gamification mechanics were implemented in order to provide some solutions of mentioned issues.

30.2 Research on Gamification

In order to get an overview on the current state of the art in gamification research, we conducted a literature review. We searched in data bases being most important in economics (namely Ebsco and ProQuest), information systems (AIS Digital Library) and computer science (IEEE Explore and ACM Digital Library) by using the term "gamification" mentioned in title, abstract or keywords. In total, we received 93 articles. Since all these articles contained the term gamification in their abstract, we decided to read all this papers completely. We excluded papers which only mention gamification as a trend without further details. In a second step we scanned the references of all the remaining articles. Based on the title we included 86 referenced articles, scanned them, and removed 30 papers due to missing relevance. Only full research papers are considered in our statistical analysis.

As a result, we identified 111 relevant articles which can be clustered in four main categories: More than half of identified articles present results of **realizing** gamification in various contextual backgrounds for different purposes. However, only few articles discuss benefits as well as potential pitfalls of gamification. Those researchers, who include such a discussion, make careful distinctions between gamification and related concepts. Because gamification is an emerging trend born out of previous concepts, some researchers are concerned with its **definition**. Particularly over the past 3 years, researchers intensified their attempts to study **effects and influencing factors** of gamification. Another growing research field related to gamification comprises studies on the **design and implementation** of gamified applications. For all identified topic clusters related to gamification, we will go more into detail in the following subsections.

30.2.1 Definition

Only a small proportion of identified articles aim to shed light on the concept of gamification by defining and distinguishing it from other concepts. Most of the 111 articles refer to Deterding, Khaled, Nacke, and Dixon (2011) who define gamification as "… *the use of game design elements in non-game contexts*." (Deterding, Khaled et al., 2011). Only few researchers distinguish gamification from related concepts. Rather, the term gamification is often used synonymously with terms like "serious games", "games with a purpose" or "(digital) game-based learning". All concepts behind these terms relate to game-based applications and their definitions do not create absolute dividing lines. However, all concepts follow various purposes and thus, distinguish from each other. Although, researchers like Susi, Johannesson, and Backlund (2007) or Breuer and Bente (2010) are not primarily defining gamification itself, they provide a good overview on related concepts by classifying them. Based on these classifications, Deterding, Khaled et al. (2011) categorize gamification along the two dimensions: **Completeness** refers to the amount of game elements implemented in an application. Concepts like serious games, (digital) game-based learning, edutainment or games with a purpose (GWAP) can be categorized as entire games containing a complete set of game mechanics that are designed and implemented for a particular purpose. The second dimension covers the **area of application**. Games and game-related concepts may have a wide spectrum of application fields. Edutainment or digital game-based learning, for example, primarily aim to educate, train and teach. Other concepts like GWAPs or gamification applications focus on engaging and motivating individuals to fulfill tasks that may be repetitive, boring or undesirable. Figure 30.1 provides an overview on game-related concepts and their definitions categorized according the dimensions.

30.2.2 Realization of Gamification

In literature, gamification is mainly realized in three different organizational settings: A huge amount of articles refer to game mechanics implemented in **digital communities** focusing, for example, on *environmental protection* (e.g. (Lee et al.,

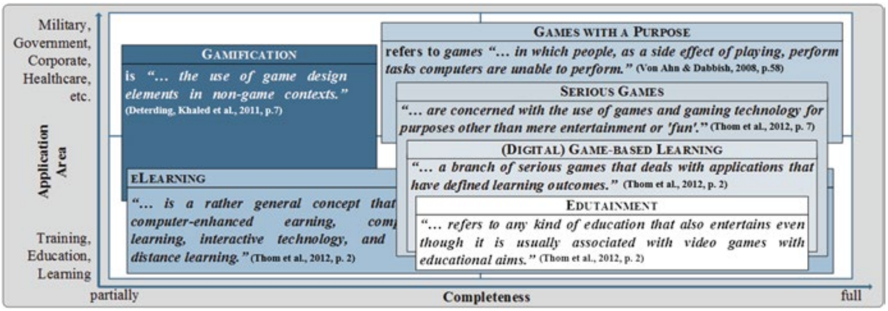


Fig. 30.1 Game-related concepts (categorization based on (Breuer & Bente, 2010) and (Deterding, Khaled et al., 2011))

2013; Mason, Michalakidis, & Krause, 2012)), *health care* (e.g. (Gerling & Masuch, 2011; De Oliveira, Cherubini, & Oliver, 2010)) *citizen science* (e.g. (Crowley, Breslin, Corcoran, & Young, 2012; Crowston & Prestopnik, 2013)) or *social networking sites* (e.g. (Hsu, Chang, & Lee, 2013; Singh & Shadbolt, 2013)). Others are using the mental power of communities in order to complete some repetitive tasks that "…*computers are unable to perform*." (Von Ahn & Dabbish, 2008, p. 58) like *image tagging* (e.g. (Von Ahn & Dabbish, 2008; Gomes, Chambel, & Langlois, 2013)). However, when looking closely at these articles and taking the definitions of game-related concepts into account, it raises the suspicion that the implemented applications are more related to GWAPs than gamification applications. Other articles like (Cohen, 2011; Hakulinen, Auvinen, & Korhonen, 2013; Muntean, 2011) present results of gamification projects in **educational settings** for training and learning. Although, learning is also a purpose of gamification applications, the research discussed in these articles focuses on schools and universities rather than companies. Thus, they seem to match more to game-related concepts like serious games, eLearning or digital game-based learning than gamification. Some articles discussing the realization of gamification applications in a **company**—the third organizational setting. According to the definition of Deterding, Khaled et al. (2011), these articles seem to be real gamification projects, since they present the results of gamification realization for purposes like improvement of onboarding processes in HR departments (e.g. (Depura & Garg, 2012)), optimization of business processes such as task or risk management (e.g. (Bajdor & Dragolea, 2011; Neeli, 2012)), team building (e.g. (Ellis, Luther, Bessiere, & Kellogg, 2008)), improvement of sales activities (e.g. (Hamari & Järvinen, 2011; Harwood & Ward, 2013)) or support of employees in the production processes (e.g. (Korn, Schmidt, & Hörz, 2012; Korn, 2012)).

Gamification is a trend that has found its way into organizations due to societal changes like blurred borders between life and work, diverse and distributed workforces, smart and connected technologies, or the emergence of social platforms (Smith, 2011). Although many researchers believe in positive effects of gamification,

Table 30.1 Benefits and critics of gamification mentioned by various researchers

Benefits	Source	Critics	Source
Direct and immediate feedback	Farzan et al. (2008)	Replacement of intrinsic rewards by extrinsic	Castellani, Hanrahan, Colombino, and Grasso (2013), Lee and Hammer (2011), Liu, Alexandrova, and Nakajima (2011)
User engagement and satisfaction	Kankanhalli, Tan, and Wei (2005), Lee and Hammer (2011), Zuk (2012)		
Room for errors	Lee and Hammer (2011)	Additional layer of control and pressure	Castellani et al. (2013), Liu et al. (2011)
Guidance	Lee and Hammer (2011)		
Deepening of Learning	Lee and Hammer (2011)	Loss of freedom (when mandatory)	Lee and Hammer (2011)
Social credibility and recognition	Lee and Hammer (2011)	Improve quantity instead of quality	Mekler et al. (2013)
Rewarding self-efficacy	Antin (2012)	Non-systemic, reward-oriented, not user-centric and pattern-bound	Deterding (2013)
Group identification and team building	Antin (2012), Ellis et al. (2008)		

some criticize its actual realization. In particular, the pure focus on rewards like achievements, badges and points is often objected. If points and badges are only created for the game without having a meaningful framework, they can be annoying rather than motivating (Cramer, Zeynep, Holmquist, & Rost, 2011). On the contrary, when gamification has a meaningful background, it can change individuals' usage behavior and thus increase contribution and participation (Laschke & Hassenzahl, 2011). The implementation of gamification applications requires design thinking and processes (Paharia, 2012) balancing its pro and contra. An overview on various critics and benefits of gamification application is summarized in Table 30.1.

30.2.3 Design and Implementation

Gamified applications in non-gaming contexts are a new area of research resulting in studies on its design and implementation. Two research groups independently designed a generic framework for implementing gamification. While Aparicio, Vela, Sánchez, and Montes (2012) focus on key activities of the implementation process, Herzig, Ameling, and Schill (2012) approach the topic from a more technical perspective. Both groups come to the result that an intensive analysis of business and user goals is necessary for a successful gamification implementation. Identified goals need to be mapped in game-related goals and rules before selecting appropriate game mechanics. Table 30.2 provides an excerpt of game-related mechanics as discussed by several researchers.

Following Aparicio et al. (2012) call for the measurement of effectiveness, Costello and Edmonds (2007) develop a framework containing 13 categories of pleasure. Using these categories, the framework enables companies to measure engagement and pleasure of employees when using gamification applications. Later on, the framework is tested and extended by Korhonen, Montola, and Arrasvuori (2009). According to the authors, the framework "… *can be used as an aesthetic tool for the design and evaluation of non-utilitarian features of the products that can make the products more engaging*, *attractive and playful for users*." (Korhonen et al., 2009, p. 284).

30.2.4 Effects and Influencing Factors of Gamification

Although gamification promises to solve issues related to technology adoption and use, some researchers and practitioners are skeptical with regards to its effects. Therefore, researchers began to study the impact of gamification on users' participation. Out of 28 articles focusing on the impact of gamification, 12 articles measure the effects of some kind of rewarding like badges or points assuming and demonstrating a positive impact on technology use due to the implementation of points and badges. However, the effect of these rewarding mechanisms is limited. While in experimental settings an increase of participation is observable directly after the introduction of points and badges, the amount of contributions decreased over time to the same degree having the control group without any rewards (Farzan, DiMicco, & Brownholtz, 2009; Mekler, Brühlmann, Opwis, & Tuch, 2013). In consequence, researchers acknowledge that the effect of such rewards is not substantially. This observation is exacerbated when studying individuals' motivation to contribute on social networking platforms after removing the rewards. In particular, Thom, Millen, and DiMicco (2012) realize that intrinsically motivation is eroded by rewards resulting in a significant lower motivation after the removal of rewards than before its introduction. Another intensively studied mechanism is the provision of feedback. The impact of feedback on individuals' motivation is not a new concept. However, when implementing as game mechanic—not triggered by humans but machines—it is important to plan and design content of feedback as well as its timing carefully (Dunwell, de Freitas, & Jarvis, 2011).

Other researchers observe the effects of gamification from a more remote perspective. Deterding et al. mention the "ludification of culture" (Deterding, Dixon, Khaled, & Nacke, 2011) as the key societal change enabling the emergence of gamification applications. The term "ludification" means 'making playing to a kind of sport'. In consequence, "ludification of culture" means that games and playful activities become to a central element of the society. Today, individuals tend to play more often resulting in an culture of ludification (Bouca, 2012). However, when

Table 30.2 Game-mechanics discussed by various researchers

	Achievements	Badges	Bonus	Challenges/ goals	Competition	Customized frontend	Envy	Epic meaning	Feedback	Leaderboards/ranks	Levels/progression	Ownership	Points	Rules	Social components	Status	Team building	Time pressure
Burke and Hiltbrand (2011)	X						X	X		X	X	X	X		X		X	X
Herzig, Strahringer, and Ameling (2012)		X	X	X	X	X			X	X	X		X	X	X		X	X
Holopainen and Björk (2008)	X		X	X	X	X					X	X			X	X		X
Kankanhalli et al. (2005)	X	X	X	X						X	X		X		X	X		

considering the trend of gamification as a cultural change, it is important to remark, that gamification applications need to be adapted to various aspects of different cultures. Only if gamified applications are consistent with individuals cultural beliefs, they are accepted and used (Khaled, 2011). In addition to culture, social influences have to be taken into account. According to Hamari and Koivisto (2013) social influences as well as reciprocal benefits are strong predictors for individuals' attitude toward gamification and for its continued use.

30.3 Gamification in Project Knowledge Management

Beyond organizational boundaries, there exist some gamified applications aiming to motivate knowledge exchange between individuals. In called Social Question and Answer (SQA) sites like Stack Overflow[1] or Yahoo Answers[2] individuals can publish their issues to a broad audience or answer to questions. Shah, Oh, and Oh (2008) define SQA as "… *a Web-based service for information seeking by asking natural language questions to other users in a network*." (Shah et al., 2008, p. 4). By including game mechanics like badges, leaderboards, ratings, or levels, individuals will be motivated to participate in such platforms and high quality of comments will be controlled. In research, there exist quite some work (e.g. (Gazan, 2011; Harper & Raban, 2008; Shah et al., 2008)) studying the effects of such SQA sites as well its included functionalities.

In contrast, we did not find any articles discussing the usage of gamification applications to improve knowledge management (KM) in organizations. Since KM activities include learning, there exists a huge amount of research in the area of eLearning. However, learning—where the internalization of knowledge and its integration into individuals' knowledge base takes place—is only one part of the entire KM spectrum. Other activities comprise the capturing of knowledge, its documentation and storage, the transfer from one knowledge source to another, or reuse and application of knowledge. Findings derived from research on eLearning, however, are not really helpful to improve efficiency and effectiveness of all KM activities. In addition to learning, individuals need to be motivated and engaged in order to manage knowledge successfully. In the following, we discuss issues of KM, briefly describe the results of our research and analyze our existing research results from a gamification perspective.

[1] http://stackoverflow.com/

[2] http://answers.yahoo.com/

30.3.1 Issues of Knowledge Management in Companies

Effective KM requires high motivation and engagement of all individuals involved in KM process. In literature, there exist quite some work discussing factors motivating individuals to exchange their knowledge. Hendriks (1999), for example, identified six main motivators for knowledge sharing: (1) sense of achievement, (2) sense of responsibility, (3) recognition of job done, (4) operational autonomy, (5) promotional opportunities, and (6) challenge of work. In an empirical investigation, he demonstrates different effects of these motivators within different settings for knowledge sharing. He also discusses the contradictious need for force and control as well as pleasure in order to motivate individuals (Hendriks, 1999). A similar work is performed by Ardichvili, Page, and Wentling (2003) who identifying the most important factors influencing individuals' willingness to share knowledge within 30 semi-structured interviews. According the researchers, organizational culture, knowledge self-efficacy and reciprocity are main motivators of knowledge sharing (Ardichvili et al., 2003). This results are confirmed by Lin (Lin, 2007) in a quantitative study within 50 companies. According the research, all three motivators have significant impact on knowledge sharing. In addition, the researcher demonstrates that expected organizational rewards seem to have no impact on individuals' motivation to share knowledge.

When considering the entire KM process as defined by Alavi and Leidner (2001), a lot of motivational hurdles become obvious. In the first process phase—**knowledge creation**—either new content is developed or existing content is replaced, refined or extended. Knowledge creation requires a lot of motivation, since individuals need to (1) communicate their knowledge and collaborate with others, (2) document knowledge which is often related with high effort, and (3) learn from retrieved knowledge by integrating into their knowledge base. Knowledge **storage and retrieval** refers to the second KM process phase. Organizational memory including culture, processes, structures, ecology, and information archives is "trained" in this phase. It contains the rule base of an organization. For effective KM, organizational members need to be motivated to behave according this rule base. The third KM process phase comprises **knowledge transfer** requiring knowledge providers being motivated to share knowledge and knowledge seekers being willing to receive knowledge. In the fourth process phase **knowledge is applied** and maintained. Individuals are using the knowledge in their work practices, updating, refining and extending it. To be motivated to search for and apply knowledge, individuals need be aware that they need support (Alavi & Leidner, 2001).

Often, researchers and practitioners try to improve KM by designing and introducing information systems (IS). There exists a vast amount of systems claiming to be effective KMS. The spectrum of KMS ranges from data bases and repositories to more modern technologies like blogs and wikis. However, the success of all the technologies highly depends on individuals' motivation to use them. Organizational wikis as representatives of modern KMS are often inferior in the fight for improvement of KM due to the 90-9-1 rule stating that only 1 % of users cause the lion's share of content (Palmisano, 2009). In addition, wikis do not connect documented knowledge and experts with each other. In order to motivate individuals to reuse existing knowledge, they need to trust the knowledge sources which only can happen if they know the sources of knowledge. Considering traditional KMS like repositories or data bases we will find other typical issues. For example, they do not provide feedback mechanisms. Of cause, users can change the content, when they are not satisfied, but praising helpful and good content is not intended. Another issue of traditional KMS is a lacking structure and thus, a limited overview on existing knowledge. The documents are stored in different locations, increasing the difficulty in findings documents. Even if the user has found the document searching for, its content can still be outdated or does not provide valuable knowledge because of missing contextual information. Summed up, documents stored in data bases or repositories are often not up-to-date, diverse, distributed over many different locations and lack contextual information. They are not useful.

Independently which KMS is considered, all existing technologies suffer from teething troubles—some more than others. Even if a KMS fulfills all requirements for sophisticated KM, it will not be successful, if the individual is not motivated to use it. In consequence, when developing a KMS, it is necessary to design the system by applying the user-centered design approach aiming to facilitate individuals' engagement. Because gamification aims to increase user engagement and user experience, we strongly believe, that gamification can increase (1) individuals' motivation to share, transfer and reuse knowledge, (2) quantity **and** quality of documented knowledge, (3) social networking between knowledge providers and seekers, and (4) the development of a transactive memory system within the entire organization.

30.3.2 Design of a Project Knowledge Management System

Why are projects struggling in reusing already existing project knowledge? In order to answer this question, we started our work in a large financial service company, because banking companies heavily rely on IS. On the one hand they need IS to manage their processes and on the other hand IS are the primary product of banks. Most of IS are so-called in-house developments designed and implemented by employees of the bank. In consequence, many projects are performed in order to develop and improve the systems, but much knowledge is lost.

The main goal of our research is to understand issues related to knowledge reuse within project and to solve these issues by designing an appropriate project KM artifact. Thus, the application of Design Science Research (DSR) as research paradigm seemed to be most appropriate for us. According to Hevner et al. (Hevner, March, Park, & Ram, 2004), DSR "…*creates and evaluates IT artifacts intended to solve identified organizational problems*." (Hevner et al., 2004, p. 77). However, some researchers criticize DSR, since the research approach often results in an imbalance between relevance and rigor. According the critics, most DSR projects follow rigor methods solving a class of problems, but miss to develop concrete interventions that can be applied by practitioners (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011). On the contrary, Action Research (AR) as a research paradigm often used in organizational science focuses on close collaboration between researchers and practitioners resulting in the development of interventions. Thus, similar to DSR, AR aims to solve practical issues and to expand scientific body of knowledge simultaneously (Baskerville & Myers, 2004). AR, however, is often criticized for focusing more on practical relevance than methodological rigor. As a combination of DSR and AR, the application of Action Design Research (ADR) seemed to be most appropriate for our research since ADR "…*conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artifact*, *intervening in the organization*, *and evaluating it concurrently*" (Baskerville & Myers, 2004, p. 37). Thus, we decided to follow the ADR approach according to Sein et al. (2011). By applying ADR, we designed a project KMS artifact consisting of two parts: (1) the social subsystem including interventions regarding processes and roles within the company, and (2) the technological subsystem including a technical implementation supporting KM activities. The results regarding the technological subsystem of our project KMS are reported in (Schacht & Mädche, 2013). Within our studies we designed the artifact based on the requirements analyses conducted in the company as well as research results discussed in recent KM literature. Originally, we did not consider gamification in our research. However, as we intensified our studies on gamification, we noticed that we had intuitively incorporated some typical elements of gamification. Based on the findings discussed in (Schacht & Mädche, 2013), we now consider the design of our project KMS under the light of gamification. We will provide some contextual information for the readers of this book section by briefly describing the results of our previous research in the following subsection. Next, we present our final design and discuss the implemented gamification elements in more detail.

30.3.2.1 Requirements and Design of our Project KMS

In order to determine the requirements of company's employees, we conducted a series of interviews. Therefore, we invited 27 employees possessing various roles to the interview sessions. With the permission of all interviewees, we recorded the semi-structured interviews enabling us to listen without taking notes. Following the interviews were transcribed and coded following an inductive coding approach (Thomas, 2006) by two researchers using a data analysis software called MaxQDA. In total, we identified 971 codes clustered in 20 categories. The research approach applied to collect requirements regarding an effective project KMS as well as the results of the explorative interview study are presented and discussed in (Schacht & Mädche, 2013).

After analyzing the interview data, we noticed that some themes continuously occurred. A central issue within the organization seemed to be the storage of project-related knowledge. Each project has an own repository where all documents—including project lessons learned—had to be stored. However, only employees being part of the project team had access to this repository. In consequence, project-related knowledge could not be accessed and reused by project-external company members. One project manager told us, that the limited access is an issue for those employees that were not part of the project. Even he experienced the situation not being able to access project-related documents, after leaving the project. Another issue related to the project repositories is the lacking overview on existing project knowledge. Even if all employees would have access to every project repository, the search for relevant project knowledge would still be wasted effort. Every project has its own structure for naming and storing their documents. There were no organizational guidelines. Moreover, the documents itself did not follow any structure. The documentation of project-related insights took place in many various forms. Some insights were documented within meetings spread among team members per Email, captured in presentations containing bullet points stored on project repositories, or exist as photo protocols stored in project manager's desk drawer. An interviewee summarized the requirements related to this issue as:

> You have to structure it in some way so that you can use it afterwards and also efficiently for future similar projects.

In addition to structured documents, the interviewees also claimed for documents that are up-to-date. Outdated information is not helpful and increases difficulties in searching for and finding relevant knowledge. In combination with this requirement, another question came up: Who will maintain the documents? At project's end it is even hard to get all project team members at one table to discuss and document project lessons learned. After project completion, it is much harder to find someone who will maintain the lessons learned regularly. A technical specialist interviewed by us summarized the issue as following:

> It is a time exposure to maintain and manage it. I mean, information important in one project can later be invalid or outdated.

Although, we had identified much more issues within our interviews, we want to conclude the list of identified requirements with interviewees demand for feedback. It is a basic desire of individuals to perform tasks in order to "… *achieve something great*, *something awe-inspiring*, *and something bigger than themselves*." (Burke & Hiltbrand, 2011, p. 14). Burke and Hiltbrand (2011) call this desire "*epic meaning dynamic*". To notice whether this desire is fulfilled, feedback mechanisms are necessary. One interviewee, therefore, suggested the implementation of asterisks in order to promote active authors of project-related lessons learned. Another interviewee focused more on intrinsically motivation of providing and sharing knowledge with others:

> … if anyone says to you: 'I read your lessons learned. Thank you for your presentation making the issue transparent for us […].' I think this kind of recognitions is incentive enough—or should be incentive enough.

In total, we identified 13 MRs covering both, social and technological subsystem of an effective project KMS. Based on the MRs we derived with the aid of existing KM literature five DPs. Eight out of 13 MRs and four out of five DPs relate to the

Suptopics	Meta-Requirements
Access	MR1: Full accessibility to project data base for all organization members
	MR2: Central storage including consistent filing and search functionalities
	MR3: Access to technology and experts possessing project insights
Structure	MR4: Structured documents by indexing, categorizing and clustering
	MR5: Pre-structured documents for easy completion
	MR6: Including sufficient free space for additional explanations
Feedback & Maintenance	MR7: Providing feedback on documented lessons learned
	MR8: Ensuring maintenance of lessons learned documents

Design Principles
DP1: Ensure access to both experts and expertise
DP2: Provide contextual & packaged information in structured documents using a terminology appropriate for novices and experts
DP3: Enable maintenance of project-related knowledge
DP4: Provide and enable feedback on documented knowledge

Fig. 30.2 MRs and DPs of an effective project KMS

technological subsystem of the project KMS. Since the focus of this article is on the design of a technological instantiation of a project KMS using gamification mechanisms, Fig. 30.2 summarizes MRs, resulting DPs and the connections between them.

30.3.2.2 Design Choices from a Gamification Perspective

In (Schacht & Mädche, 2013) we discuss our design choices derived from the DPs. Since the project is still running some design choices are already implemented, while others are still planned. Basically, the banking company has an in-house developed platform similar to Microsoft's SharePoint. Until our interventions, the company utilized the platform primarily as a document management system. Other functionalities like social components or reporting mechanisms were used only seldom. We therefore decided to reactivate these functionalities and thus, exploit the full potential of the platform. A key advantage of such a platform is the accessibility. Having an account and an internet connection, all users can access the platform and its content. In addition to storing documents, the user can create lists containing structured information, integrate social components, and design reports based on stored data within this platform. Since a central element of our project KMS is the assessment of projects, we realized a questionnaire on the platform. Basic information like project team members, stakeholders, goals, risks or duration are requested in this questionnaire and stored in a list. The questionnaire structures the characteristics of projects making a quick and easy comparison of various projects possible. Such a comparison enables employees to decide whether the project-related knowledge is valuable for them. Based on the characteristics, a so-called "project sonar" will be implemented, providing an overview on similar projects. Figure 30.3 presents two mockups of our project KMS highlighting some functionalities.

When using the gamification-tinted glasses, we also implemented some mechanisms that can be categorized in the class of game mechanics as presented in Table 30.2. Primarily, we included these design elements to the end, that employees will be more motivated to share and reuse project-related knowledge. As we started to engage ourselves more intensively in the topic of gamification, we realized that these mechanisms are often referred as instantiations of gamification. In the following we will briefly present those functionalities that are implemented in our project KMS and can be categorized as gamification mechanism:

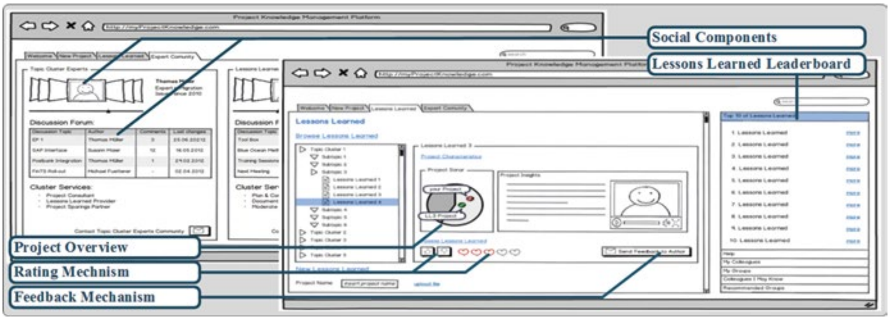


Fig. 30.3 Mockup design of project KMS from a gamification perspective

Leaderboard and rating mechanism. The easiest way—and in most cases the entry point—to introduce gamified applications in organizations, is the implementation of leaderboards. Today, individuals are surrounded by leaderboards and rating mechanisms in their private life. In context of project knowledge reuse, there are also many ways to realize leaderboards. We decided to rank the lessons learned content instead of its authors in order to emphasize project knowledge quality rather than its quantity.

During a project, each project team member is allowed to enter its own project experiences on a central storage location within the organization-wide platform on a voluntary basis. After each lessons learned session, however, the documentation of project lessons learned is mandatory. In order to ease the documentation process, the project KMS provides some pre-structured templates for project knowledge documentation. Since some interviewees called for the possibility of anonymity, we inserted an anonymity flag into the lessons learned template. When authors are activating the anonymity flag, only project's lessons learned will be published and can be retrieved by other employees. However, in order to preserve project's contextual information, authors who want to publish their insights anonymously have to provide an additional information namely the name of the Lessons Learned Expert (LLE) employed in the project as the contact person. LLE's can be classified as knowledge intermediaries and are an instantiation of the social subsystem of our project KMS. Each project has to employ at least one LLE being responsible for planning, preparing and moderating lessons learned sessions as well as gathering, documenting, storing, distributing and enabling reuse of project-related knowledge. Thus, project's lessons learned are retrievable by every employee while at the same time anonymity of knowledge providers will be ensured. Summed up, leaderboards ranking project knowledge combined with the employment of knowledge intermediaries ensure the access to both, experts and expertise (**DP1**) as well as provide some contextual information (**DP2**).

After entering and publishing project-related knowledge each employee can *rate* lessons learned by pushing the "like" or "dislike" buttons. A counter is used in order to determine the ranking of lessons learned to a "Top 10 lessons learned" leaderboard based on "likes" or "dislikes". The resulting leaderboard is displayed on the

Table 30.3 Potential benefits and critics on leaderboard and ranking in project KMS

Benefits	Critics
– Quick overview on positive rated LL	– Ranking based on primitive mechanism (like/dislike)
– Leaderboard can be used as entry point for project knowledge search and reuse	– Maybe perceived by employees as an additional layer of control
– No distortion of employee profiles due to rating of content rather than authors	
– Facilitation of LL maintenance	
– High quality of LL rather than high quantity	

LL lessons learned

starting page of the project lessons learned section as part of the company-wide platform. We decided to implement a simple rating mechanism based on "likes" and "dislikes" of employees, in opposite to a more sophisticated one, since simplicity seems to be one of key success factors for our project KMS. The implementation of the ranking mechanism enables to identify which project knowledge seemed to be more useful than others, and thus enables the maintenance of project knowledge (**DP3**). Some benefits and critics that may arise in relation to the leaderboard and rating mechanism implemented in our project KMS are summarized in Table 30.3.

Feedback mechanism. As Dunwell et al. (2011) demonstrate, feedback is one of the central design elements in effective gamified applications. When individuals receive constructive feedback on their work, they are more willing to share their knowledge. Thus, feedback related to project knowledge enables inter-project and intra-project learning as well as continuous improvement of project processes.

We therefore implemented a feedback loop for users who want to provide feedback on the lessons learned document by pushing an according button. Similar to our leaderboard and rating mechanism, feedback relates to lessons learned content not to its authors. In addition to content-related feedback, we also plan to realize a feedback loop for experts employed in projects. As already mentioned, each project has to employ at least one LLE being responsible to moderate lessons learned sessions, gather project experiences within these sessions, and document them. At the end of each project, team members will be asked to evaluate both, employed experts and documented knowledge based on a survey. Thus, project teams can provide some feedback on experts' work. The evaluation results will be statistically analyzed, prepared as a report, and presented to the expert. Based on these data, each expert can reach various "service levels" ranging from beginner level to expert level. In addition, positive feedback provided by project team members in form of open comments can be presented as testimonials in order market their service level and skills as LLE in further projects. In addition to feedback on project-knowledge provided to employees (**DP4**), this functionality also enables the maintenance of project knowledge (**DP3**). Table 30.4 presents some potential benefits and critics on the realization of feedback in our project KMS.

Table 30.4 Potential benefits and critics on feedback mechanism in project KMS

Benefits	Critics
– Identification of experts being most appropriate for project	– Evaluation of LLE may result in issues with working council
– Motivation to continue participating in project KMS due to direct feedback	– Can be misused by managers to assess their employees merely based on evaluation results

Social Components. Providing the possibility of direct, bilateral communication is one of the most important factors for effective knowledge management. Therefore, many companies promote the building of knowledge communities—often referred as Communities of Practice (CoP). In general, CoP realized in companies "…*improves knowledge sharing and helps the development of a common identity and social relationships. It is not just a matter of knowhow but also of who knows what* […]." (Bettiol & Sedita, 2011, p. 468) CoP enable the development of a common transactive memory system. We therefore reactivated the social communication features already implemented in the company-wide platform. We prepared various spaces for social interaction between different kinds of experts such as LLE or experts on a particular topic (called "Topic Experts" (TE)), which can be consulted by project teams. There are two ways to become a TE. Either one is known in the company having expertise in a particular topic, or one is actively publishing and maintaining lessons learned on the platform. Similar to LLEs, TEs can increase their service level. Each time, a TE advised a project, the team can rate the TE based on various factors such as helpfulness, experience, or currency of provided knowledge.

These social spaces for both kinds of experts are subdivided into two parts. On the upper part all experts are introduced by summarizing their name, area of experience, actual service level and—if existent—some testimonials provided by project team members in previous projects. Based on these information project teams can choose and consult the experts being most appropriate for them and their project. On the lower part experts can discuss in forums on various topics in order to exchange their experiences and increase the body of knowledge. Every employee of the company is invited to participate in one or even both communities and upgrade his or her own skills. By providing social components in the project KMS, we (1) enable access to experts via direct communication and expertise via storage of documents (**DP1**), and (2) ensure availability of contextual information of project knowledge (**DP2**). Table 30.5 provides an overview on potential benefits and critics related to the implementation of social components in our project KMS.

Whether our gamification-related interventions have an impact on individuals' motivation to engage on the platform or not remains still open. Although our primarily research does not consider any gamification-related aspects, we strongly believe that the design choices in form of gamified functionalities have a positive impact on users' intention to continue using the project KMS. One reason encouraging us in this belief is the fact that we not only placed a bet on points and achievements. Rather we concentrated our gamification-related interventions on the provision of information

Table 30.5 Potential benefits and critics on social components in project KMS

Benefits	Critics
– Direct and bilateral communication	– Requires additional effort for moderation and maintenance
– Identification of experts in certain topic areas	
– Development of transactive memory system	

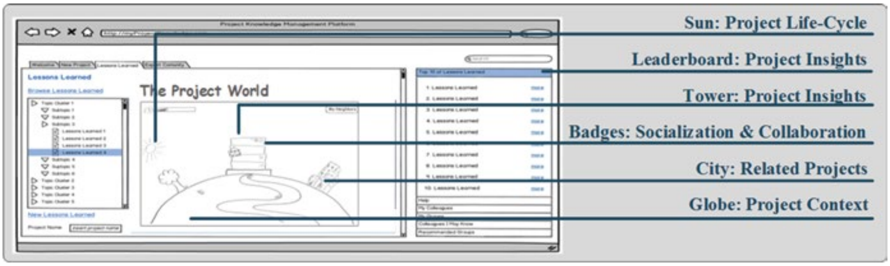


Fig. 30.4 Mockup design of *Project World*

and overview. By focusing our ranking on lessons learned documents instead of its authors we could kill two birds with one stone. On the one hand, we reward high quality instead of quantity because users like or dislike content of lessons learned with regard to their usefulness and currency. On the other hand, the feedback mechanisms enable the maintenance of project-related documents since documents containing current and important content will be higher rated.

As we are so convinced on the positive effect of gamification, we decided to implement a second instantiation of our project KMS emphasizing gamification aspects more intensively. In this instantiation—a gamified application called *Project World*—will be included in the project KMS (see Fig. 30.4). Within *Project World* projects will be sketchily visualized. On a globe different project insights can be stored in form of a tower. Hereby, each project insight forms a tier of the tower. Other users of *Project World* can connect to the project similar to a social network. Thus, users can get quick overview on projects they are interested in, its context and project knowledge. In addition, users can collect badges. One badge, for example, can be earned, when users help other projects solving certain issues. Thus, the application also supports collaboration. All data collected in *Project World* can also be accessed by the project KMS, since both applications use the same data base. Thus, we enable a voluntary participation in *Project World*. A detailed discussion on the idea of *Project World* is provided in (Schacht, Morana, & Maedche, 2014). After realizing both versions of the project KMS we plan to evaluate individuals' intention to use one of the systems. The results will be compared by analyzing the effects of our design principles as well as gamification mechanisms.

30.4 Conclusion

Managing project-related knowledge is not an easy endeavor. Many issues are hampering individuals to capture, store, transfer, and reuse knowledge. Although, IS cannot solve all KM-related issues, a project KMS can be very supportive to retrieve and reuse knowledge. At the moment many KMS suffer from low user acceptance and adoption. In order to increase the usage of our project KMS we implemented some functionalities being typical elements of gamification. While studying KMS adoption and gamification at the same time, we became aware of some guidelines for effective project KM.

Effective project KM requires a lot of motivation. Because of lacking motivation, knowledge often gets lost resulting in project teams repeating the same mistakes and reinventing the wheel. In consequence, all interventions regarding project KM need to motivate individuals to participate and engage in KM activities. Since we live in an age of ludification, where individuals are performing repetitive tasks in games like FarmVille or Bejeweled, game mechanics can be adequate motivators. However, when introducing gamified IS in organizations it is important not only to focus on points and achievements. Especially, in the field of KM gamification mechanisms, the retrieval of information, overview and feedback are more expedient than points and badges. Instead of rewarding high quantity gamified KMS need to reward high quality of documented knowledge. In addition, designers of gamified project KMS should be aware that the pure implementation of gamification elements is not sufficient. Researchers like (Laschke & Hassenzahl, 2011; Lawley, 2012) are also emphasizing the importance of a meaningful framework. Therefore, gamified project KMS requires the communication of its importance supported by top management and thus, the rewarding of both contribution of valuable knowledge and its reuse. In consequence, a careful design of project KMS following user-centered DPs is necessary. Before implementing and introducing gamified project KMS, a comprehensive analysis of business needs and user requirements is inevitable. Based on these needs appropriate gamification elements have to be selected. Finally, we suggest the measurement of all interventions regarding their effectiveness and efficiency. Thus, we recommend to follow the framework as introduced by (Aparicio et al., 2012), when organizations plan to enrich their KMS by gamification elements.

References

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual Foundations and research issues. *MIS Quarterly, 25*(1), 107–136.

Antin, J. (2012). Gamification is not a dirty word. *Interactions, 19*(4), 14–16.

Aparicio, A. F., Vela, F. L. G., Sánchez, J. L. G., & Montes, J. L. I. (2012). Analysis and application of gamification. *Proceedings of the 13th International Conference on Interacción Persona-Ordenador—INTERACCION'12* (pp. 1–2). New York: ACM Press.

Ardichvili, A., Page, V., & Wentling, T. (2003). Motivation and barriers to participation in virtual knowledge-sharing communities of practice. *Journal of Knowledge Management, 7*(1), 64–77.

Bajdor, P., & Dragolea, L. L. (2011). The gamification as a tool to improve risk management in the enterprise. *Annales Universitatis Apulensis Series Oeconomica, 2*(13), 574–583.

Baskerville, R., & Myers, M. D. (2004). Special issue on action research in information systems: Making IS research relevant to practice—Foreword. *MIS Quarterly, 28*, 229–235.

Bettiol, M., & Sedita, S. R. (2011). The role of community of practice in developing creative industry projects. *International Journal of Project Management, 29*, 468–479.

Bouca, M. (2012). Mobile communication, gamification and ludification. *Proceeding of the 16th International Academic MindTrek Conference on—MindTrek'12* (pp. 295–301). New York: ACM Press.

Breuer, J., & Bente, G. (2010). Why so serious? On the relation of serious games and learning. *Eludamos: Journal for Computer Game Culture, 4*(1), 7–24.

Burke, M., & Hiltbrand, T. (2011). How gamification will change business intelligence. *Business Intelligence Journal, 16*(2), 8–16.

Castellani, S., Hanrahan, B., Colombino, T., & Grasso, A. (2013). Game mechanics in support of production environments. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems—CHI'13* (pp. 9–12).

Cohen, A. M. (2011). The gamification of education. *The Futurist, 45*(5), 16–17.

Costello, B., & Edmonds, E. (2007). A study in play, pleasure and interaction design. *Proceedings of the 2007 Conference on Designing Pleasurable Products and Interfaces—DPPI'07* (p. 76). New York: ACM Press.

Cramer, H., Zeynep, A., Holmquist, L. E., & Rost, M. (2011). Gamification and location- sharing: Some emerging social conflicts. *CHI 2011 Workshop on Gamification* (pp. 30–33).

Crowley, D. N., Breslin, J. G., Corcoran, P., & Young, K. (2012). Gamification of citizen sensing through mobile social reporting. *2012 IEEE International Games Innovation Conference, IEEE* (pp. 1–5).

Crowston, K., & Prestopnik, N. R. (2013). Motivation and data quality in a citizen science game: A design science evaluation. *Proceedings of the 46th Hawaii International Conference on System Sciences, IEEE* (pp. 450–459).

De Oliveira, R., Cherubini, M., & Oliver, N. (2010). MoviPill: Improving medication compliance for elders using a mobile persuasive social game. *Proceedings of the 12th ACM International Conference on Ubiquitous Computing—Ubicomp'10* (pp. 251–260). New York: ACM Press.

Depura, K., & Garg, M. (2012). Application of online gamification to new hire onboarding. *Third International Conference on Services in Emerging Markets (ICSEM)* (pp. 153–156).

Deterding, S. (2013). Skill atoms as design lenses for user-centered gameful design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems—CHI'13* (pp. 18–21).

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining "gamification."*Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments—MindTrek'11* (pp. 9–15). New York: ACM Press.

Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011). Gamification: Towards a definition. *CHI 2011 Workshop on Gamification* (pp. 6–9).

Dunwell, I., de Freitas, S., & Jarvis, S. (2011). Four-dimensional consideration of feedback in serious games. In S. de Freitas & P. Maharg (Eds.), *Digital games and learning* (pp. 42–63). London: Continuum.

Ellis, J. B., Luther, K., Bessiere, K., & Kellogg, W. A. (2008). Games for virtual team building. *Proceedings of the 7th ACM Conference on Designing Interactive Systems—DIS'08* (pp. 295–304). New York: ACM Press.

Farzan, R., DiMicco, J. M., Millen, D. R., Dugan, C., Geyer, W., & Brownholtz, E. A. (2008). Results from deploying a participation incentive mechanism within the enterprise. *Proceeding of the Twenty-Sixth Annual CHI Conference on Human Factors in Computing Systems—CHI'08* (pp. 563–572). New York: ACM Press.

Farzan, R., DiMicco, J. M., & Brownholtz, B. (2009). Spreading the honey: A system for maintaining an online community. *Proceedings of the ACM 2009 International Conference on Supporting Group Work—GROUP'09* (pp. 31–40). New York: ACM Press.

Gazan, R. (2011). Social Q&A. *Journal of the American Society for Information Science and Technology, 62*(12), 2301–2312.

Gerling, K. M., & Masuch, M. (2011). Exploring the potential of gamification among frail elderly persons. *CHI 2011 Workshop on Gamification* (pp. 45–48).

Gomes, J. M. A., Chambel, T., & Langlois, T. (2013). SoundsLike: Movies soundtrack browsing and labeling based on relevance feedback and gamification. *Proceedings of the 11th European Conference on Interactive TV and Video—EuroITV'13* (pp. 59–62). New York: ACM Press.

Hakulinen, L., Auvinen, T., & Korhonen, A. (2013). Empirical study on the effect of achievement badges in TRAKLA2 online learning environment. *2013 Learning and Teaching in Computing and Engineering, IEEE* (pp. 47–54).

Hamari, J., & Järvinen, A. (2011). Building customer relationship through game mechanics in social games. In M. Cruz-Cunha, V. Carvalho, & P. Tavares (Eds.), *Business, technological and social dimensions of computer games: Multidisciplinary developments*. Hershey, PA: IGI Global.

Hamari, J., & Koivisto, J. (2013). Social motivations to use gamification: An empirical study of gamifying exercise. *Proceedings of the 21st European Conference on Information Systems*.

Harper, F., & Raban, D. (2008). Predictors of answer quality in online Q&A sites. *Proceedings of the SIGCHI*.

Harwood, T. G., & Ward, J. (2013). Market research within 3D virtual worlds: An examination of pertinent issues. *International Journal of Market Research, 55*(2), 247–266.

Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. *Knowledge and Process Management, 6*(2), 91–100.

Herzig, P., Ameling, M., & Schill, A. (2012). A generic platform for enterprise gamification. *2012 Joint Working IEEE/IFIP Conference on Software Architecture and European Conference on Software Architecture, IEEE* (pp. 219–223).

Herzig, P., Strahringer, S., & Ameling, M. (2012). Gamification of ERP systems—Exploring gamification effects on user acceptance constructs. *Proceedings of the Multikonferenz Wirtschaftsinformatik 2012*.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75–105.

Holopainen, J. & Björk, S. (2008). Gameplay design patterns for motivation. *Proceedings of ISAGA 2008*.

Hsu, S. H., Chang, J.-W., & Lee, C.-C. (2013). Designing attractive gamification features for collaborative storytelling websites. *Cyberpsychology, Behavior and Social Networking, 16*(6), 428–435.

Hsu, J. S.-C., Shih, S.-P., Chiang, J. C., & Liu, J. Y.-C. (2012). The impact of transactive memory systems on IS development teams' coordination, communication, and performance. *International Journal of Project Management, 30*(3), 329–340.

Kankanhalli, A., Tan, B. C. Y., & Wei, K.-K. (2005). Contributing knowledge to electronic knowledge repositories: An empirical investigation. *MIS Quarterly, 29*(1), 113–143.

Khaled, R. (2011). It's not just whether you win or lose: Thoughts on gamification and culture. *CHI 2011 Workshop on Gamification* (pp. 64–67).

Korhonen, H., Montola, M., & Arrasvuori, J. (2009). Understanding playful user experiences through digital games. *International Conference on Designing Pleasurable Products and Interfaces, DPPI09* (pp. 274–285).

Korn, O. (2012). Industrial playgrounds: How gamification helps to enrich work for elderly or impaired persons in production. *Proceedings of the 4th ACM SIGCHI Symposium on Engineering Interactive Computing Systems—EICS'12* (pp. 313–316). New York: ACM Press.

Korn, O., Schmidt, A., & Hörz, T. (2012). Assistive systems in production environments. *Proceedings of the 5th International Conference on PErvasive Technologies Related to Assistive Environments—PETRA'12* (p. 1). New York: ACM Press.

Laschke, M., & Hassenzahl, M. (2011). Mayor or patron? The difference between a badge and a meaningful story. *CHI 2011 Workshop on Gamification* (pp. 72–75).
Lawley, E. (2012). Games as an alternate lens for design. *Interactions, 19*(4), 16–17.
Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*(2), 1–5.
Lee, J. J., Matamoros, E., Kern, R., Marks, J., de Luna, C., & Jordan-Cooley, W. (2013). Greenify: Fostering sustainable communities via gamification. *CHI'13 Extended Abstracts on Human Factors in Computing Systems on—CHI EA'13.* New York: ACM Press (pp. 1497–1502).
Lin, H.-F. (2007). Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. *Journal of Information Science, 33*(2), 135–149.
Liu, Y., Alexandrova, T., & Nakajima, T. (2011). Gamifying intelligent environments. *Proceedings of the 2011 International ACM Workshop on Ubiquitous Meta User Interfaces—Ubi-MUI'11* (pp. 7–12). New York: ACM Press.
Mason, A. D., Michalakidis, G., & Krause, P. J. (2012). Tiger nation: Empowering citizen scientists. *2012 6th IEEE International Conference on Digital Ecosystems and Technologies (DEST), IEEE* (pp. 1–5).
Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). Disassembling gamification: Effects of points and meaning on user motivation and performance. *CHI'13 Extended Abstracts on Human Factors in Computing Systems on—CHI EA'13.* New York: ACM Press (pp. 1137–1142).
Muntean, C. (2011). Raising engagement in e-learning through gamification. *Proceedings of the 6th International Conference on Virtual Learning* (pp. 323–329).
Neeli, B. K. (2012). A method to engage employees using gamification in BPO industry. *Third International Conference on Services in Emerging Markets (ICSEM)* (pp. 142–146).
Paharia, R. (2012). Gamification means amplifying intrinsic value. *Interactions, 19*(4), 17.
Palmisano, J. (2009). Motivating knowledge contribution in virtual communities of practice: Roots, progress and needs. *AMCIS 2009 Proceedings* (Paper 198).
Schacht, S., & Mädche, A. (2013). How to prevent reinventing the wheel?—Design principles for project knowledge management systems. In J. Brocke, R. Hekkala, S. Ram, & M. Rossi (Eds.), *Design science at the intersection of physical and virtual design SE—1* (pp. 1–17). Berlin: Springer.
Schacht, S., Morana, S., & Maedche, A. (2014, June 9–11). The Project World—Gamification in Project Knowledge Management. *Proceedings of the 22nd European Conference on Information Systems* (*ECIS*) *2014*, Tel Aviv, Israel. Track 04, Paper 10.
Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action design research. *MIS Quarterly, 35*, 37–56.
Shah, C., Oh, J. S., & Oh, S. (2008). Exploring characteristics and effects of user participation in online social Q&A sites. *First Monday, 13*(9), 18.
Singh, P., & Shadbolt, N. (2013). Linked data in crowdsourcing purposive social network. *Proceedings of the 22nd International Conference on World Wide Web Companion* (pp. 913–918).
Smith, R. (2011). The future of work is play: Global shifts suggest rise in productivity games. *2011 IEEE International Games Innovation Conference (IGIC), IEEE* (pp. 40–43).
Susi, T., Johannesson, M., & Backlund, P. (2007). Serious games: An overview. *Elearning, 73*, 28.
Thom, J., Millen, D., & DiMicco, J. (2012). Removing gamification from an enterprise SNS. *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work—CSCW'12* (pp. 1067–1070). New York: ACM Press.
Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27*, 237–246.
Von Ahn, L., & Dabbish, L. (2008). Designing games with a purpose. *Communications of the ACM, 51*(8), 57–67.
Zuk, R. (2012). Get in the game: How communicators can leverage gamification. *Public Relations Tactics, 19*(2), 7.

Chapter 31
How Gamification Can Help Companies to Become More Sustainable: A Case Study on Ride Sharing

Stefanie Huber and Konrad Röpke

31.1 Introduction

How do we get people to share a ride if there are more convenient, comfortable, and easier ways to commute? A lot has already been said about serving the unappealing "broccoli" with either cheese sauce (Zichermann & Cunningham, 2011) or under a chocolate coating (Kumar & Herger, 2013). However, simply adding chocolate—or in a broader sense game mechanics to a system, often also called "pointsification" (Kumar & Herger, 2013, p. 9)—does not trigger a permanent behavior change in the long run.

In an enterprise context "behavior-change gamification seeks to form beneficial new habits among a population" (Werbach & Hunter, 2012, p. 21), with this population being a corporate community. This behavior change can apply to anything from eating more healthy food or participating in sports programs, through to a more sustainable or environmentally-friendly lifestyle—like the sharing of rides when commuting to and from work. However, some doubt has been raised about the effectiveness of gamification with regard to producing environmentally-friendly behavior (see, for example, Chorney, 2012; Zichermann, 2011). Research has shown that it already requires an environmentally-friendly mindset from the users of the system to use a gamified system for encouraging environmentally-friendly behavior at all (Yefeng, Alexandrova, & Najima, 2011). This, of course, contradicts the idea of behavior change and it needs a deeper understanding of human motivation and behavioral dynamics to make a gamified system successful. This holds particularly

S. Huber (✉) • K. Röpke
SAP AG, Rosenthaler Straße 30, 10178 Berlin, Germany
e-mail: stef.huber@sap.com; konrad.roepke@sap.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_31

true for the area of sustainability in order to avoid the trap of exclusively building a system for people who already show the desired mindset.

Even if the "best practices in gamification are still emerging" (Kumar & Herger, 2013, p. 9), the simple application of game mechanics does not help encourage the behavior one wants to evoke. In contrast, it needs a systematic approach where underlying behavioral dynamics are considered, target behavior is understood, player characteristics are known, and where gamification has to provide a real value for the players, or as Nicholson (2012) put it:

> Rather than using a point system, meaningful gamification encourages a deeper integration of game mechanisms into non-game contexts. Meaningful gamification techniques focus on the consideration of aspects of the underlying activity to understand where an integration of game elements makes sense. (p. 6)

To perform such a systematic approach and not forget about key aspects to be covered, it is possible to use gamification frameworks that successively guide through the process of building a meaningful gamified system. We will present two such frameworks in the next section and also follow the steps of one of those for building a gamified ride sharing system.

31.2 Gamification Framework

There are several frameworks available for gamifying systems, which have broad overlaps with regard to content and differ mainly in the chronology of the specific phases. Two prominent examples are the gamification design framework introduced by Werbach and Hunter (2012) "that is customized for developing gamified systems" (p. 86) and the player-centered design framework provided by Kumar and Herger (2013). A comparison easily shows the aspects they have in common: Even if the framework by Werbach and Hunter (2012) consists of six steps and the one by Kumar and Herger (2013) of five steps—all of the steps can be assigned to an even more general framework such as goal definition for the gamification project, player analysis, and the application of game mechanics (see Fig. 31.1). Werbach and Hunter (2012) start with defining business objectives and delineating target behaviors (goal definition), followed by a description of players (player analysis). The last steps of the framework include devising activity cycles, while at the same time not forgetting about fun and deployment of appropriate tools (application of game mechanics). Kumar and Herger (2013), though, focus on knowing the player as the first step (player analysis), then continue with: Identifying the mission (goal definition), understanding human motivation (player analysis), applying mechanics (application of game mechanics), and, lastly, managing, monitoring, and measuring (goal definition). As they introduced their concept as "Player Centered Design that puts the player at the center of the design and development process" (p. 29) it is clear that they start with player analysis in the first phase.

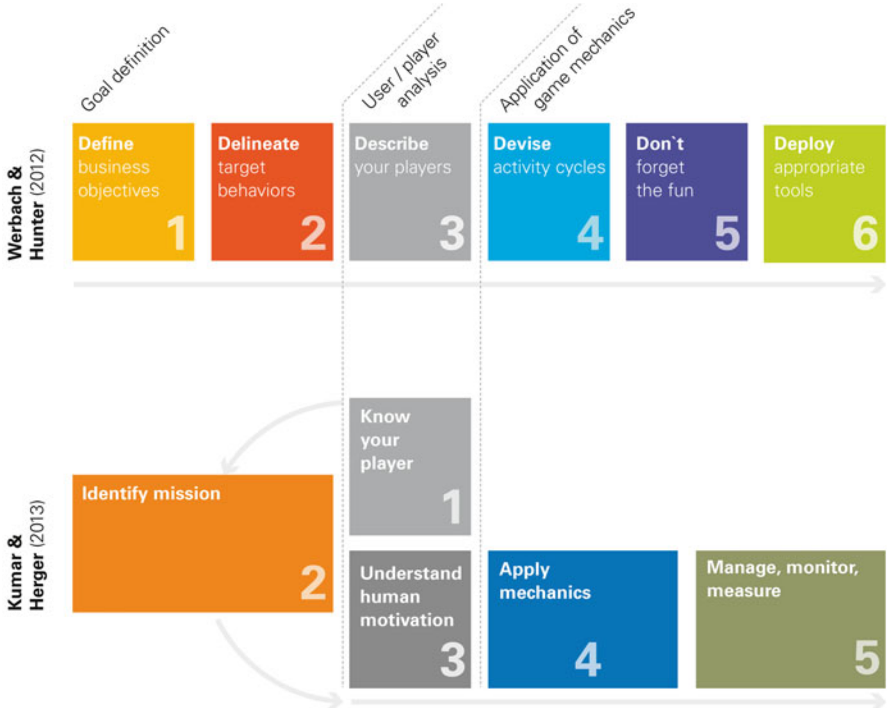


Fig. 31.1 Comparison of the gamification frameworks provided by Werbach and Hunter (2012) and Kumar and Herger (2013)

For this case study we will follow the framework provided by Werbach and Hunter (2012) due to our clear orientation towards sustainability as a business objective. We will therefore also perform our case study along the outlined steps and start by defining business objectives in the next section.

31.3 Applied Gamification: Gamifying Ride Sharing for Better Sustainability

Before coming to the business objectives, we want to spend a few moments focusing on sustainability and ride sharing in general: In the last 10 years, the term sustainability has become a business buzzword. Nowadays, sustainability seems to be a well-established corporate goal and for many large companies it is obligatory to have an annual sustainability report. Many initiatives that foster sustainability can be found in corporate landscapes these days, ranging from saving paper with the paperless office, investing in healthier food for employees, through to reducing emissions altogether, and so on. The idea of ride sharing (which is the idea of sharing cars or rides) has recently emerged alongside these other topics and is proven by the rising number of car sharing services (for example, BMW's "DriveNow", "Flinkster" by Deutsche Bahn, car2go, to name just a few).

For some companies it might be worth investing in "sustainable mobility" and such a service is encouraged at a corporate level to reach sustainability targets, particularly when employees live in the same commuter belt and when company cars are available.

While car sharing is a model of car rental, ride sharing is the sharing of commutes so that multiple persons travel in a car. Both, car and ride sharing do not simply influence classic economic objectives, such as saving fuel or reducing other corporate car-related costs. There are additional business objectives involved when it comes to implementing a corporate car or ride sharing system for better sustainability, for example, corporate community or brand reasons.

We will concentrate on a corporate ride sharing (and not carsharing) system for two reasons: First, we think that ride sharing has a huge potential to contribute to corporate sustainability objectives: Employees need to find a way to get to work and back every day and if only two persons share a ride instead of taking two separate cars then that's already a great win for sustainability. Secondly, as we at SAP already have a ride sharing solution on the market called TwoGo (http://www.twogo.com), we are pleased to have the possibility to refer to that solution every now and then within this chapter. As the scope and approach of TwoGo back then was different to our current gamification-framework-led approach, though, we know about the distinct focus on the topic of ride sharing, related players, and the chosen system elements in TwoGo. Apart from that, we want to stress that car sharing and ride sharing do not contradict but rather have the potential to complement each others.

31.3.1 Define Business Objectives

For the definition of the business objectives in a ride sharing context, we follow the segmentation of sustainability into three different areas as proposed by Blackburn (2007) in his sustainability handbook: Environmental sustainability, social sustainability, and economic sustainability.

Environmental sustainability focuses on caring about natural resources and reducing waste and pollution (Blackburn, 2007). Examples for environmental sustainability objectives in a rideshare setting are:

- Reducing the amount of carbon dioxide emitted per person. This includes aiming for a better efficiency in car use, for example, by maximizing the number of people in a car.
- Following the principle "Use rather than own". This principle is gaining more and more reception nowadays—sharing and using instead of possessing has become popular under the buzzword "share economy".

Social sustainability deals with "respect for employees" in general (Blackburn, 2007, p. 24), but might also aim at building enduring social relationships within a company. Derived objectives in the context of ride sharing can be:

- Encouraging employees to increase their social network on a ride. This encourages collaboration, improves communication and interdisciplinary language skills, and helps employees to get in touch with each other across areas and departments. Increasing the social network, though, is not to be understood as a mere quantitative increase in business relationships, but also as a valuable qualitative deepening of existing contacts. Therefore, relating to increasing social networks, company objectives might equally aim at:
  - a quantitative enhancement: get to know more colleagues
  - a qualitative enhancement: get to know colleagues better
- Encouraging people to increase their company knowledge on an informal basis (for example, knowledge about other projects, the company structure, and so on)
- Improving employee motivation: Employees feel cared for with the offer of a future-oriented mobility service. Apart from that, the self-perception as members of the company might be enhanced through the brand experience.
- Strengthening company stickiness: Anyone who is integrated in a social network is more unlikely to leave the company.

Economic sustainability describes "the wise use of financial resources" (Blackburn, 2007, p. 24). Examples for economic sustainability are:

- Reducing the amount of expenditures for company cars (such as acquisition costs, maintenance costs, insurance fees, gas costs, and so on)
- Decreasing the volume of infrastructure (for example, parking lots) needed for cars in order to save construction costs and maintenance costs
- Reducing the number of cars used for commuting that are congesting the streets and causing traffic jams during rush hours
- Maximizing employee mobility without a car of their own
- Making the company visible as an environmentally-friendly company for marketing purposes, brand positioning, and so on.

As usual, business goals can conflict with each other. For example employees who establish ride sharing routines, that is, riding with the same colleague every day and therefore deepening relationships (qualitative enhancement) will not be able to broaden their network (quantitative enhancement) to the same extent. So, there has to be a trade-off between these goals. However, sometimes various goals might even elevate each other, for example, social and environmental sustainability objectives might also affect and support commercial objectives. For example, the fact of colleagues networking together while they drive to work creates an added economic business value (Herger, 2013).

Economic sustainability will take the highest priority for the corporate strategy of most companies driven by the intent to realize profits. Therefore, reducing expenditure for company cars and infrastructure plays an important role. We will focus our attention towards player behavior supporting this goal. Nevertheless, the positive impact of a vivid social network should not be underestimated, as nowadays knowing *who* to ask can be *the* crucial corporate skill, especially in large companies. We therefore consider the social sustainability objective of increasing employees' social network (quantitative and qualitative) while sharing a ride as the priority two business objective. So, on the one hand, it is a worthwhile objective to encourage people with ride sharing routines to also get to know new colleagues and on the other hand, to encourage people enjoying different rides every day to also deepen their social relationships with existing contacts.

31.3.2 Delineate Target Behaviors

After having selected two business objectives, the target behaviors of the players should be derived along with success metrics for sustainable mobility. These behaviors should "promote the ultimate business objectives you previously defined, though the relationship may be indirect" (Werbach & Hunter, 2012, p. 90). In this case, the ultimate business goals of economic and social sustainability are best reflected in two quite simple success metrics, namely the *number of rides shared* and the *diversity of rides shared*.

Sharing rides can be seen as the key target behavior. The *number of rides shared* therefore constitutes the best indicator for reaching the goal of reducing expenditures for corporate cars and related infrastructure. Subordinate or related to the number of rides shared are further metrics such as:

- Oil/gas consumed
- Occupied seats
- Distance driven

And from a broader perspective:

- Number of cars on the streets to company and back
- Number of cars in corporate parking lots

Increasing the number of shared rides and thereby reducing oil/gas consumption, distances driven per car, and the number of cars in corporate parking lots directly affect company expenses spent for corporate cars, such as fuel cost, company car acquisition costs, recurring costs (inspections, insurance, repair, and so on) and related infrastructural costs, for example, for building new parking lots or maintaining old ones.

Sharing diverse rides, meaning riding with different people every day, is the second target behavior to foster with the corresponding success metric being the *diversity of rides* shared, for example, measured by how many different people one takes to work and back per month. Sharing diverse rides builds upon the idea of social sustainability as business objective number two in order to enhance the exchange of ideas and knowledge between employees. However, as said before, deepening existing social relationships might be equally desirable, and the proposed metric of diversity of rides shared can also be used to assess this. So, for example if this metric is defined as a percentage of the number of diverse rides divided by the number of total rides a value near 100 % (for example, ten different people taken on ten rides in total = 100 % diverse rides) represents the idea of a quantitative enhancement of the social network, whereas a value close to 1 % (1 colleague taken on 100 rides = 1 % diverse rides) represents a more qualitative enhancement of relationships.

Having said this, it becomes clear that the mere assessment of diverse rides shared on an overall level does not provide much value, besides knowing if the ride sharing community is on more diverse rides or not. However, if ride sharing regulars are to be encouraged to also meet new colleagues, it could be more interesting to analyze the progression of these metrics over time.

Of course, general metrics could be added to the list of metrics, such as the number of registered users of the system or the percentage of employees using the service, the number of daily or monthly active users (DAU/MAU), net promoter scores, and so on. Further general success metrics can be found in Kumar and Herger (2013, p. 95, p. 99).

31.3.3 Describe Your Players

There are several ways to find out more about the players. In the case of ride sharing for business, the target group can be defined as basically every employee of the company. However, this population can usually be further divided into subgroups of different player types who have different motivations or reservations to use or not use ride sharing. One approach to get to know these player types is to make use of general models of player types described elsewhere (see, for example, Bartle, 1996; Kim, 2010). Another approach is to invest in user research, or even to combine own research with player type models. Player research can comprise everything from analyzing statistical data, interviewing people to conducting a survey with the target group.

Important information to be gathered comprises data such as (modified according to Werbach & Hunter, 2012):

- Demographics (Gender, age)
- Psychographics (What are the things your players like to do, buy)
- Motivations (What motivates and demotivates your players?)

To get insights on employees' general demographics, their usual way to work, ride-share motivations and resentments we created a short questionnaire addressing these topics in 13 questions. We then randomly selected ten interviewees out of our business network and conducted structured interviews that took about 30 min each. After these interviews we analyzed the data in a qualitative manner, using typological analysis after Mayring (2002): We went through the different interview statements, looked for commonalities in motivations and constructed different player types.

We are aware of the fact that our interview sample is more of an exemplary sample to test the framework methodology instead of a representative sample of the whole population and hence, does not allow transferring the given results in the form of player types to all employees. There might be further player types that we have not addressed yet; there might be player types that we have classified, but that play a negligible role, as we do not know how our identified player types are distributed among the whole population. Although we think that interviewing players is the best way to find out more about their motivation, we recommend using statistical methods for calculating appropriate sample and effect sizes (as described e.g. in Bortz & Döring, 2006) in order to derive more representative player types. The collected data can then be analyzed either in a qualitative way as we did or by using quantitative methods such as e.g. cluster analysis for deriving player types.

Having identified six player types, we finally modeled avatars (or personas) as representations of typical players (see Fig. 31.2 for examples of player personas below). In the following list the player types will be described shortly and the corresponding Bartle (1996) player type classification is given in brackets.

- *Sarah Socializer* is a person who loves to chat to people and to meet new coworkers. She is a caring and outgoing person. (Socializer)
- *Greg Greenthinker* is highly-conscious of his carbon footprint and saving the environment in general. Minimizing traffic by car is already his personal top priority. (Achiever)
- *Sam Scrooge* enjoys the ride as a co-driver. He knows about several ways to save money, one of them being co-driver, and studies brochures and leaflets in order to find the best offers and bargains. (Achiever/explorer)
- *Steve Status* prefers to drive himself and loves his car. It is a status object for him that symbolizes his success and expresses his individuality. (Achiever/explorer)
- *Kevin Careful* hates to be dependent on people he doesn't know. He is afraid of having to wait for people that are unreliable and easily feels uncomfortable in a car with aggressive drivers. (Socializer)
- *Scott Sportsman* prefers to commute by bike although he does have a company car. To live healthy and be in shape is most important to him. (Achiever)

Player type Sarah Socializer is easy to target within a gamified system for ride sharing, as for her ride sharing is a fantastic opportunity to meet and chat. Also, Greg Greenthinker is easy to be attracted by a ride sharing service, as sustainable behavior is perfectly in harmony with his own personal goals. The same holds true for Sam Scrooge: He is a money saver par excellence and whenever an opportunity is offered to save some coins, he is part of the game. All three of them are already "made for" a rideshare system and are intrinsically motivated as their own player needs are in accordance with the characteristics of the system. It should not take much effort to motivate them to participate.

A different situation is given with Steve Status and Kevin Careful. Steve usually drives alone to work celebrating his car and status and sometimes crossing the speed limits as well. Targeting him for a ride sharing service means offering him ways in the system to show his passion for cars, his status, and his achievements, but also exploration and surprise—otherwise his motivations are not captured by the system.

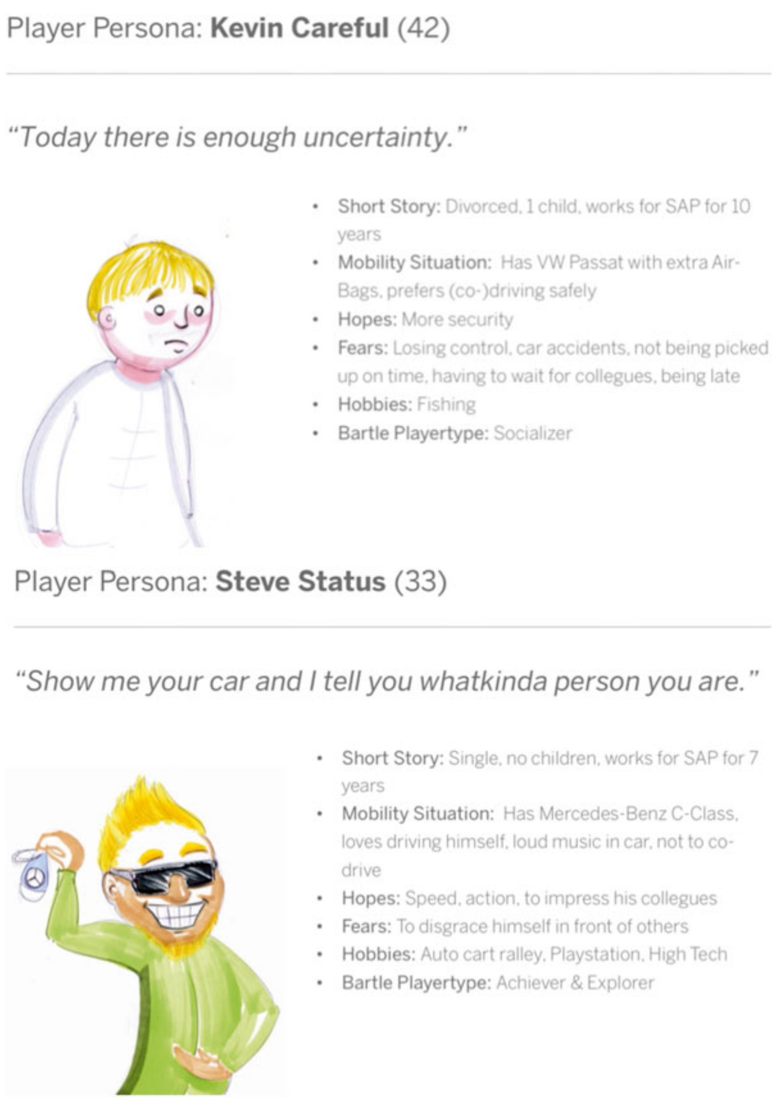


Fig. 31.2 Player Personas Kevin Careful and Steve Status with related player characteristics

In contrast, Kevin Careful would hesitate to join Steve Status for a ride. He hates uncertainty, unreliability, and insecurity. Although he really likes co-driving, as he is an anxious driver himself, he needs to know his (co-) driver very well, and he needs a feeling of trust and safety to really step into another person's car. That also implies that a rideshare system should provide a lot of information about the potential driver for him, maybe even an appraisal of driving abilities and reliability, and as a best case scenario it would match him with someone he can drive to work and home every day, without being exposed to diverse drivers at all.

Scott Sportsman, finally, should not be addressed as target group for the system—his healthy personal behavior should not get any interfering external motivation that might change it.

To conclude, with the gamified ride sharing system we target five player types with three of them being easily addressable by the system characteristics themselves and two player types requiring some more distinct gaming mechanisms to leverage motivation to participate in the system. By focusing on Steve Status and Kevin Careful in the upcoming sections, we also ensure that mechanisms for achievers, explorers, and socializers are considered within the gamified system, which also address the general Bartle (1996) player type needs of Sarah Socializer (socializer), Greg Greenthinker (achiever), and Sam Scrooge (achiever/explorer) and Kim's (2010) social actions for players accordingly.

31.3.4 Devise Activity Cycles

We discussed and defined activity cycles for the player types that were identified. First of all, we refined engagement loops for each of them to take specific and quite different motivations into account. The following example shows one of these loops of user actions triggered by motivation and resulting into some meaningful feedback that might create a new motivation (Fig. 31.3). The sequence that we visualized here in a spiral is, of course, hard to anticipate. So, we propose this output more as an orientation that needs more evaluation and user research. However, it is valuable preparatory work to weave player needs and wants into the game elements that will constitute possible activities within the service. While for the engagement loops we focus on the short-term activities within our ride sharing service, we then continued to elaborate these into long-term activities within progression stairs.

Building on different engagement loops, it is then possible to derive and discuss progression stairs. How might the ride sharing service be attractive and interesting to players even after a longer period of use? The evolution of a gamified ride sharing service experience over time might improve the stickiness of the service—players will appreciate a service with increasing complexity and constantly new challenges. The stairs shown are not meant to work solely in a strictly sequential way. With respect to different player types, it is necessary to consider different ways of approaching levels and challenges.

The design of freedom of choices, also known as autonomy (Deterding, Dixon, Khaled, & Nacke, 2011), is seen as an important element for the service experience. Since the game experience can be enhanced by surprises, we also consider incorporating some kind of randomness and chance into the service, like special events in the narration, dedicated game days, and extra bonus levels.

Within the onboarding phase, the player should start by getting simple tasks such as simply sharing a ride with someone new. However, not every player type would perceive this an easy task: For a player type like Steve Status this is easy to accomplish, although it might already be a hard thing to do for Kevin Careful. For Kevin, an easy thing would be sharing a ride with someone he knows very well.

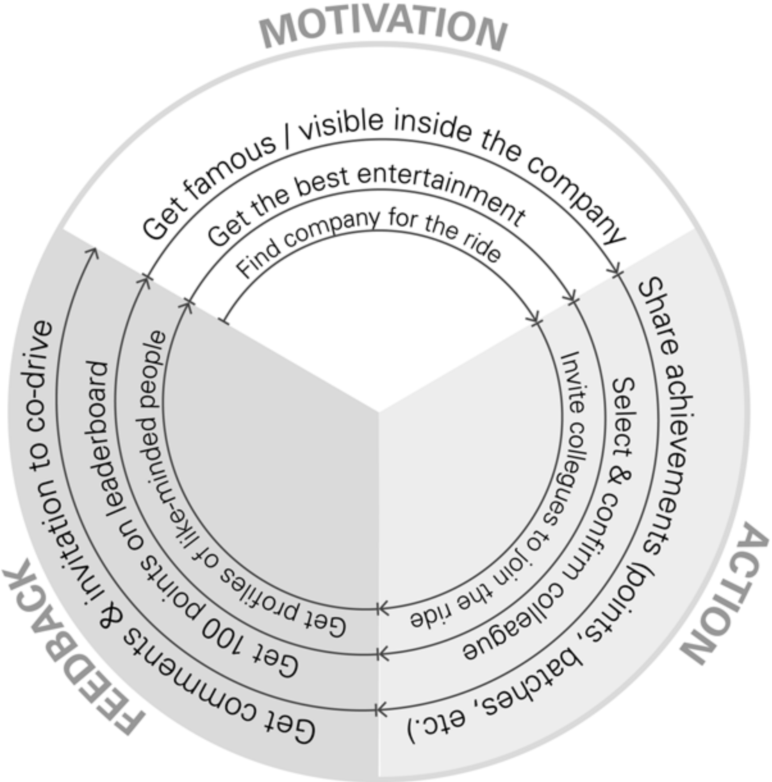


Fig. 31.3 Prototypical engagement loop (Werbach & Hunter, 2012) of player type Steve Status

With respect to the different motivations and needs of unequal player types, we illustrate our solution with a double-tracked progression stair model (Fig. 31.4). After the onboarding, the new ridesharer can choose his/her way of progressing towards mastery. Fitting to personal needs, the user perceives autonomy to develop his/her avatar towards the next level. The boss fight will not be the final level, but rather a reoccurring showdown event.

31.3.5 Don't Forget About the Fun

It might seem trivial to say that you should not forget about the fun when designing a gamified system. However, shaping an enjoyable experience for all players can be a tricky challenge to accomplish. So, how to ensure this?

One answer is to offer different ways of having fun within one system, because not only different player types request different kinds of fun, but even the needs for a certain type of fun may vary within one player type from day to day: "The best games cover a broad spectrum of fun. Maybe you're normally attracted to hard-core challenges, but today you just want to blow off steam with your friends. Ideally, a

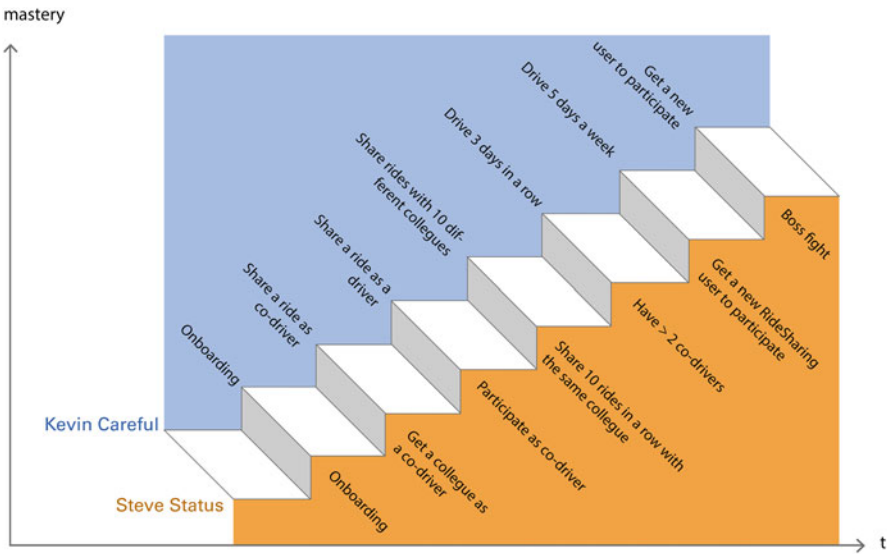


Fig. 31.4 Prototypical progression stairs (Werbach & Hunter, 2012) on the examples of player types Kevin Careful and Steve Status

gamified system should be flexible in the same way" (Werbach & Hunter, 2012, p. 99). In line with this, Lazzaro (2004) identified four kinds of fun that, put together in one gamified system, can make it fun to play for most players. These four kinds of fun are easy fun, hard fun, people fun, and serious fun. As they have been nicely illustrated and described in Lazzaro (2012), we will not present them here as well. For our ride sharing service, we recommend a good mixture of *all types of fun for all player types*, so that, for example, all players experience occasional surprising events (easy fun), they are able to participate in purposeful play with big, meaningful challenges (hard fun), and they get to know new people (people fun).

Furthermore, it can be helpful to have a look at the model of social actions for player types (Kim, 2010) for setting up the right mixture of *fun ingredients for a certain player type*. So, let's take the achiever for example. Achievers like Steven Status are driven by challenges and competitions—offering them a "hard fun" opportunity to win a fight, to complete a quest, or to gather points satisfies their inner need and will make a gamified system fun for them. However, going on one quest or competition after the other without having some other fun ingredients will quickly reduce the fun of the thing. So, by adding some easy fun (such as exploring new stuff) and some social fun (such as helping others) adds to the whole experience within the game. If all of the fun ingredients are then wrapped up in a "series of meaningful choices" (Werbach & Hunter, 2012, p. 38), the gamified system will be appealing to your players. The progression stairs described in the last section illustrate how such a good mixture of fun could look for two player types.

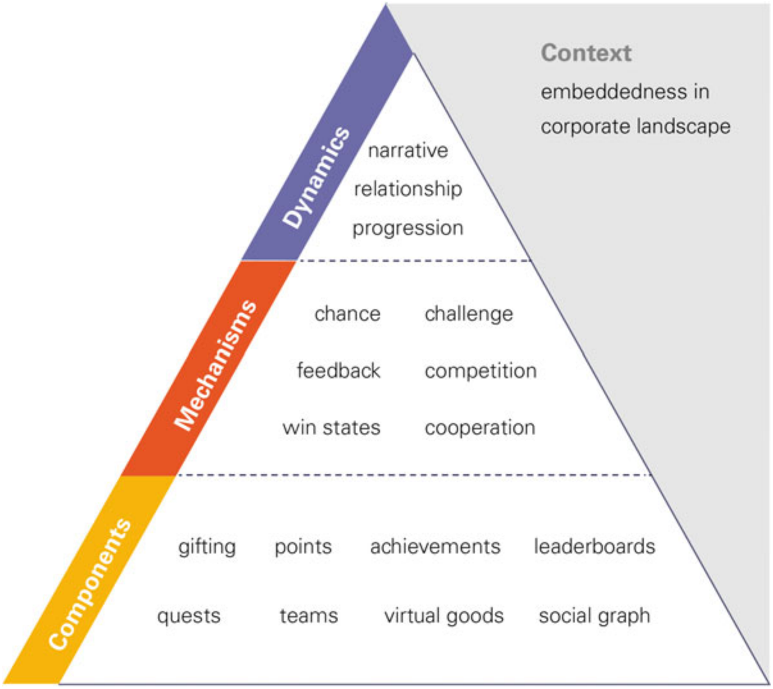


Fig. 31.5 Selected elements of game element hierarchy (Werbach & Hunter, 2012, p. 82) for the ride sharing system with complementary context element

31.3.6 Deploy Appropriate Tools

Having thought thoroughly through the five former stages, the appropriate mechanisms need to be selected to bring the system to life. Usually a lot of ideas have been gathered up to that point and now it is the time "to make decisions about what to include and exclude" (Werbach & Hunter, 2012, p. 100). To structure the conceptual ideas, we used the game element hierarchy according to Werbach and Hunter (2012) that separates dynamics (big picture elements) from mechanisms (basic processes) and components (specific instantiations of dynamics and mechanisms). The modified pyramid above (Fig. 31.5) displays selected elements used for our ride sharing concept. We also added context as a layer in the hierarchy because we felt that the gamified ride sharing system has to be tightly coupled with and embedded into the company fabric to be successful: From a company perspective, it is crucial to enable employees to integrate ride sharing into their lives in order to achieve a relevant contribution to sustainability objectives. Only if a critical mass of employees participate in ride sharing and consider it their routine way of commuting does the whole service have a significant impact on business goals.

Although several concepts could be derived out of these reflections (with economic sustainability being the number one business goal and social sustainability being number two), we focused on a concept that primarily leverages these goals.

Therefore, the whole concept is based on two high-level elements, the *narrative* (fostering economic sustainability) and *relationships* (fostering social sustainability). In the following we will describe these and other selected elements and will also show how an interface could look. Game hierarchy elements are written in italics to connect them easily to the pyramid. For this case study, we focus on a smartphone application as the format, as we experienced a need from the players' side to handle ride sharing offers and requests quickly, flexibly, and on-the-go with minimum time effort. Moreover, we will not present our solution for registration and log issues in this section, but will come directly to our central gamification elements.

31.4 Creating the Narrative: The Personification of Anti-Objectives

The number one goal of the ride sharing system is clear—to save money by having fewer cars on the streets and thereby lower costs for fuel, maintenance, and so on. However, simply showing the players the saved costs for the company might not be very motivating to use a ride sharing service. Also, some companies might not directly want to reimburse the saved money and pay it back to their employees. So, what gamification elements could be used to motivate people to participate? How do we tell the story of sustainable behavior in a game-like manner?

As fewer cars mean reduced waste and pollution, we propose to use a method that transports the main objective within a *narrative*. Narratives are central dynamics in the game element hierarchy. The question then becomes: How do we motivate people to engage for something rather abstract like waste and pollution? How can we get people to fight something they cannot see and grasp? The answer is: It is quite hard to do so. This is why we chose to give pollution a face—the face of Mr. Smoke. By personalizing business goals and giving them a face, people have something visible that they can fight. It is not without reason that the bosses in boss fights are often human-shaped, with eyes and hands and a general shape to be attacked. The personification of abstract business goals fulfills the same purpose—to make the opponent attackable. As the connection to boss fights is already given, it is quite natural to make a real *challenge* out of fighting Mr. Smoke and his colleagues such as Mrs. Pollution, and so on. The individual challenge then consists of saving a certain amount of CO2 emissions by sharing a particular number of rides with colleagues within a certain timeframe.

Example

Challenge: "Fight Mr. Smoke"

Objective: Save 200 kg of CO2 emissions by sharing 10 rides back and forth to your company with colleagues

Time constraints: 1 month

This way, monthly recurring challenges can be set up to reach the number one business goal. As *feedback*, the amount of CO2 that has already been saved is shown to the players in the form of a progress bar towards the CO2 savings goal.

In addition to these challenges, quests can motivate players in a similar way to go on rides with their colleagues. We propose to use the more comprehensive challenges above for longer-term goals that are to be completed within a fixed timeframe and to apply *quests* as complementary elements for short-term tasks without time restrictions. Quests therefore comprise quick-to-accomplish, simple tasks, such as (respective business goals in brackets)

- Share a ride with someone you have already shared a ride with (social sustainability, qualitative enhancement)
- Share a ride with someone new (social sustainability, quantitative enhancement)
- Share a ride with more than one/two/three/… colleagues (social sustainability, quantitative enhancement)
- Share a ride with a colleague for x days in a row (social sustainability, qualitative enhancement)
- Share a ride with someone from department x (social sustainability, quantitative enhancement)
- Encourage someone to use ride sharing who has not used the system before (social sustainability, quantitative enhancement)

Of course, sharing rides always contributes to the economic objectives as well. With this combination of challenges and quests, player needs for quick wins and challenging projects is fulfilled and also the traditional progression stair is taken into account, delivering little quests on a daily or weekly basis and a huge challenge at the end of or over a month. In addition, the whole system of quests has to be balanced according to player journey phases, progression stairs, and player types (on condition that this information was gathered during registration).

To allow for autonomy and freedom of choice alongside the triggered challenges and quests, some additional quests are selectable by the players at the beginning of each month, asking them to choose between, for example:

- Get to know a bunch of new people
- Get to know your colleagues better
- Care for your environment
- Squeeze in more people

Also, we recommend delivering some quests that are unexpected by the player since *chance* can enrich the game experience. Every now and then surprise quests pop up with exceptional challenges, such as

- Find someone with a red car to share a ride with you
- Bring a pastry for your ride share friend
- Ride back and forth with the same colleague today
- Take a ride share on the weekend

- Find someone to share a ride with the same hobby
- Get extra points today when a colleague gets into your car

Even if some of our targeted player types are quite intrinsically motivated to join the ride sharing system, we nevertheless propose to introduce *points* as an easy way of keeping count (Kumar & Herger, 2013), providing *feedback*, as an indicator of *progression* (Werbach & Hunter, 2012), and as a *virtual good*, so that after having completed challenges and quests points are unlocked. These points are gathered on the player's account and can be converted to tangible rewards (see next section). We suggest this as a way of fair play behavior from the company side, that is, letting players profit from their own savings, even if this does not necessarily result in reimbursing money.

31.5 Building the Relationships: Getting Cooperation into Motion

Ride sharing itself is a social behavior, so if the ride sharing system was only designed with this in mind, a central element would be missing. And of course, it might be quite lonely to go on these challenges alone. Therefore, we focused on relationships as a second central dynamic in the system to foster *cooperation* within *teams*.

We therefore propose challenges that require teaming up with others at a group level. For example, when fighting Mr. Smoke, an overall company goal of saving 20,000 kg of CO2 within 1 month is set. To reach this goal, each team (be it a department, friends, or ride sharing colleagues) has to contribute, perhaps by saving 1,000 kg each. For a team consisting of five players, an individual target would be set to 200 kg per player. This way, each player has to work and pursue his individual contribution to the team goal: Of course, individual targets can be overachieved and any additional contribution reduces the amount of CO2 to be saved by the team as a whole so that colleagues can compensate for each other. Only when the groups have reached the objective of saving 20,000 kg at a corporate level at the end is Mr. Smoke then defeated (*win state*) and transformed into a big pot of points that are distributed amongst all contributors. The points achieved for team challenges can then be spent on joint events, such as team trips, a better parking space for the group's car, and the like. Progress bars in the form of little clouds can be used to visualize the progress on the challenge: If the element of *competition* is to be used to push the battle a bit, then *leaderboards* can be useful to directly compare the current contribution status of the different teams.

If teams are made of corporate departments then it can be quite motivating for the players to beat the neighboring department in a challenge. However, this contradicts the idea of cohesion, so it should be well thought out before implementing such competitive elements. By such team challenges, the important factor of relatedness from self-determination theory (SDT; Deci & Ryan, 2000) is taken into account

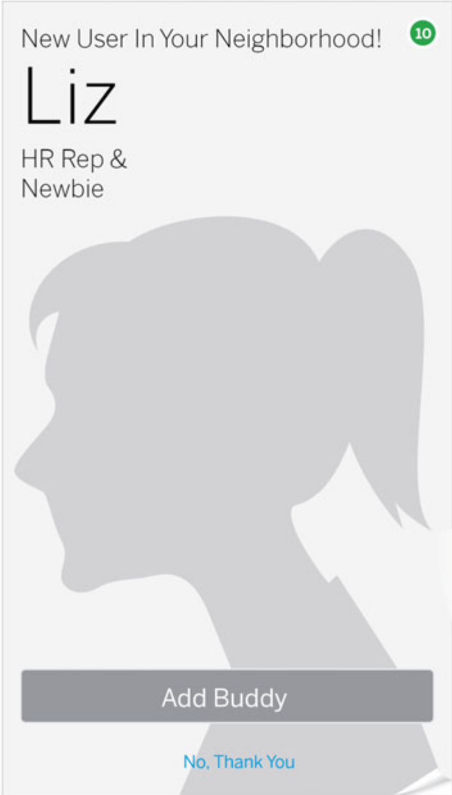


Fig. 31.6 Adding buddies in the latest concept of the SAP TwoGo ride sharing solution (TwoGo, 2013)

when supporting the human need for social connections. A second further important factor out of SDT must also be mentioned when we speak about team challenges: Mastery. When challenges on a team level are set up, then progression stairs should not only deal with mastery at an individual level, but also outline how mastery is achieved at team level (team mastery). As teams and cooperation play a crucial role within this system, we also recommend to have a social community feature within the system, that is, a representation of the players' social network (*social graph*). See Fig. 31.6 for an example of how this feature has been established for the SAP ride sharing solution TwoGo.

In contrast to group challenges, we propose quests to be formulated on an individual level. This way, players are also able to directly influence and work on their own quests (be it system-triggered or individually-chosen). Having the responsibility and direct influence on the results of a task addresses the feeling of autonomy, the third important factor in the self-determination theory (Deci & Ryan, 2000).

31.6 Making Progress: Green Feedback, Skill Unlocking, Gifting

Without getting feedback and experiencing progress, even a gamified system could be quite demotivating (Kumar & Herger, 2013). We therefore engineered several mechanisms into the system to provide feedback and visualize *achievements*. Not only is the progression within a challenge immediately shown as a growing cloud (see Fig. 31.7 below), but also after having completed challenges and quests, points are granted for quick feedback and as a *reward*. To show progress over a longer period of time, the player's representation of sustainable behavior (a car) that is set to black at the beginning slowly becomes a little more green every time a quest or challenge is completed. If no quest or challenge has been undertaken over a longer period of time, the avatar blends slightly back to black again, so that persistent participation in ridesharing is required to maintain the current status (also targeting a high DAU rate). Further components, such as skill unlocking, can also be used to signal the player has leveled up, for example, after having saved a certain amount of CO2, players acquire the new skill of transferring points or CO2 savings to other players (*gifting*).

Fig. 31.7 Conceptual wireframes of the suggested gamified ride sharing system

31.7 Selecting the Ride: Joyfully and Autonomously Picking the Driver

Another crucial element of the system is the way of matching people for a ride share. As ride sharing is the key activity within the whole system, we propose not only to enrich the ride sharing system by the above-mentioned gamification elements, such as quests, challenges, leaderboards, points, and so on to reduce the critique of pointsification. We also do not recommend performing the matchmaking in secret, as this is where players' journeys cross and the first social contact takes place. Instead we recommend making the setup and selection of a ride a playful activity of itself, letting people participate in the matchmaking process (again referring to autonomy) and displaying the matching in a vivid and enjoyable way. An example for how this could be done is shown above (see Fig. 31.7): When searching for a ride as co-driver, all available ride offers are directly shown on the screen. Free seats are indicated by people icons inside the car. A number on the car roof shows the points that can be gained when taking this ride (an algorithm calculates these points according to the number of free seats, current quests and challenges, diversity metrics, and so on). As this is supposed to be a real-time solution, players will see cars vanishing from the screen when they are fully booked and they will also see changes in available seats. Whenever a player wants to select a ride, he taps on the respective car and books himself onto it. This way, players can decide themselves with whom to go and which car to hop on to. The whole selection and booking process should result in a nice user experience, wrapped up in some visually appealing screens.

31.8 Discussion

The main concern of the process as described here was rather to test the framework introduced by Werbach and Hunter (2012) than to develop a sophisticated gamified system. However, one should ask how valid the presented results are. The results show a conceptual state of a gamified ride sharing service for increased sustainability within companies. We are aware that this study would benefit from more user research and user involvement in the evaluation phase. However, our attention was focused not only on the goal of having a gamified system as the result, but also on the process itself. Our aim was to explore and evaluate a given gamification framework. The importance of a framework as a guideline for our design process became clear during our study.

First of all, it put a systematic approach towards planning the whole process. Secondly, the framework served as a manual for the activities within the design process. Each step was helpful as a quality checkpoint. On the other hand, we felt that the framework of Werbach and Hunter (2012) has some limitations for our design process due to its rather linear structure. Refinement through continuous prototyping-testing-evaluation-cycles, as well as links back to objective definition and player description later in the process might not only serve as quality checks and filter of ideas. At the same time, these bridges between the separate phases also seem to improve the flow of the design process. These findings are in agreement with insights from Werbach and Hunter (2012):

> Design is an iterative process, and one that is learned by experience. The trick, then, is to go out there and practice. Start building gamified processes and see how they work. Playtest the design to see what might work and then see what actually does work. Build analytics into your system, change a few things, and see what helps move the needle. Interview your players and see what they liked and didn't like. Go back to the drawing board and start again. There's no shortcut for testing and iteration if you really care about producing a successful gamified system. (Werbach & Hunter, 2012, p. 101)

The intention to bridge the gap between different steps of the framework also created a—to our knowledge—new method: The personification of anti-objectives. Making abstract goals tangible in a narrative that embodies the business objectives was a valuable method to focus on the business goal setting.

To drive this exploration further, we will have to investigate how these approaches will contribute to the existing ride sharing service of SAP TwoGo. While the initial findings are promising, further research is necessary. Future studies will continue as an iterative user-centered process with a prototyping, test and evaluation phase, and a refinement in iterations. We have to check the feasibility of our solution together with stakeholders and development. To develop this service as a generative solution, we recommend testing and elaborating it in different settings: Different countries and different companies (especially with and without company cars) will show different requirements and bring up specific solutions. This cross-check is especially important to get quick feedback on how well the gamified service works, or as Werbach and Hunter (2012) put it:

> If you follow the design process, there is every chance that you will produce an interesting gamification implementation. But there are no guarantees that it will work. (Werbach & Hunter, 2012, p. 101)

This work demonstrated that the given framework is a helpful guidance when gamifiying a system. It is nevertheless a generic structure, so that some steps of the framework need to be adapted to the specific scenario and objectives of the service—we even added a further element to the gamification elements pyramid—and some iterations still have to be undertaken. However, through careful utilization, the given framework can substantially structure and enhance the design phase of each gamification project. It creates a stable foundation for a fruitful process and serves as an orientation and quality checklist.

31.9 Summary

This chapter is a modest contribution to the ongoing discussions about gamification as a method within service design. The aim was to show how the process of gamifying a system can be accomplished following a gamification framework.

The topic chosen for demonstration was sustainable behavior at company level and, in particular, sharing rides with colleagues. The purpose was not to come up with the best solution for a gamified ride sharing system, but rather show that gamification frameworks can provide a very structured and guided way of successively gamifying whatever system.

We started with a short introduction on gamification and gamification frameworks. For this case study, we opted for the gamification framework provided by Werbach and Hunter (2012) and followed its six steps accordingly. First, economic and social sustainability were defined as number one and two *business objectives*, incorporating saving company car costs and broadening employees' social networks. Thereafter, *target behaviors* of the players, for example, sharing rides and saving fuel, and related metrics, such as the number of rides shared and the diversity of rides shared, were specified. After that, six *player types* were described in the form of personas, ranging from people already caring about the environment through anxious co-drivers and up to status lovers, worshipping their car. *Activity cycles* in the form of engagement loops and progression stairs were then developed and examples of the basic mechanisms were illustrated for some player types. *Not forgetting about the fun* for players while executing the framework, though, was a constituent part of the next framework step, before the *deployment of appropriate tools* culminated in a presentation of the most prominent dynamics, mechanics, and components of the entire gamification concept. These were a strong focus on creating a meaningful narrative, establishing team challenges and individual quests, enhancing cooperation and relatedness among the players wherever possible, displaying feedback and progress in an intuitive, appealing way, and lastly making the selection of rides an enjoyable task in itself. The chapter closed with discussing the advantages and disadvantages of gamification frameworks and outlining further steps.

Acknowledgements We would like to thank the team at SAP TwoGo: Peter Graf, David Sommer, and Melanie Paul, and also other SAP colleagues Mario Herger and Konstantinos Drachtidis for their valuable input. Furthermore, we very much appreciate the guidance and help provided by Kevin Werbach from Pennsylvania State University.

References

Bartle, R. (1996). *Hearts, clubs, diamonds, spades: Players who suit muds*. Retrieved September 30, 2013, from http://www.mud.co.uk/richard/hcds.htm

Blackburn, W. R. (2007). *The sustainability handbook. The complete management guide to achieving social, economic and environmental sustainability*. London: Earthscan.

Bortz, J., & Döring, N. (2006). *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler* (4th ed.). Berlin, Germany: Springer.

Chorney, A. I. (2012). Taking the game out of gamification. *Dalhousie Journal of Interdisciplinary Management, 8*(1). Retrieved September 30, 2013, from http://ojs.library.dal.ca/djim/article/view/2012vol8Chorney/3132

Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227–268.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Designing gamification. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, City New York, 2011.*

Herger, M. (2013). *SAP's gamified carpooling application*. Retrieved August 8, 2013, from http://enterprise-gamification.com/index.php/en/sustainability/152-saps-gamified-carpooling-application

Kim, A. J. (2010). *Designing the player journey*. Retrieved September 30, 2013, from http://www.slideshare.net/amyjokim/gamification-101-design-the-player-journey

Kumar, J. M., & Herger, M. (2013). *Gamification at work: Designing engaging business software*. Aarhus, Denmark: The Interaction Design Foundation. Retrieved September 30, 2013, from http://www.interaction-design.org/books/gamification_at_work.html

Lazarro, N. (2012). *4keys2fun*. Retrieved September 24, 2013, from http://nicolelazzaro.com/wp-content/uploads/2012/03/4_keys_poster3.jpg

Lazzaro, N. (2004). *Why we play games: Four keys to more emotion without story*. Retrieved September 30, 2013, from http://www.xeodesign.com/xeodesign_whyweplaygames.pdf

Mayring, P. (2002). *Einführung in die qualitative Sozialforschung; eine Anleitung zu qualitativem Denken* (5th ed.). Weinheim, Germany: Beltz.

Nicholson, S. (2012). *A user-centered theoretical framework for meaningful gamification*. Paper presented at Games + Learning + Society 8.0, University of Wisconsin–Madison, Madison, 13-15 June 2012.

TwoGo. (2013). *Internal document on further concepts for future TwoGo*. Berlin, Germany: SAP AG.

Werbach, K., & Hunter, D. (2012). *For the win. How game thinking can revolutionize your business*. Philadelphia: Wharton Digital Press.

Yefeng, L., Alexandrova, T., & Najima, T. (2011). Gamifying intelligent environments. *International ACM workshop on ubiquitous meta user interfaces*. Retrieved September 30, 2013, from http://www.dcl.info.waseda.ac.jp/~yefeng/yefeng/pubs/2011/ubimui11_yefeng.pdf

Zichermann, G. (2011). *Gamification—The new loyalty* [Video]. Copenhagen, Denmark: Gamification Co. Retrieved September 30, 2013, from http://vimeo.com/25714530

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Chapter 32
Gamification-supported Exploration and Practicing for Automotive User Interfaces and Vehicle Functions

Stefan Diewald, Andreas Möller, Tobias Stockinger, Luis Roalter, Marion Koelle, Patrick Lindemann, and Matthias Kranz

32.1 Introduction

32.1.1 Motivation

People like gaming, winning, comparing, and sharing (Hsu & Lu, 2004). This has been known for thousands of years and has been exploited in so-called *serious games* (Abt, 2002) in many different areas such as the military, academics, medicine, or professional training (Zyda, 2005). Serious games make use of the entertaining gaming effect to educate, train and inform their "players" (Michael & Chen, 2005).

However, applications that are not framed in game scenarios can likewise benefit from gamification. Especially with the success of the location-based application Foursquare in 2010, which has made heavy use of game design elements in its application, the research and design community started to pay more attention to the so-called "gamification" of non-gaming applications. Since then, the buzzword "gamification" stands for *the* method for boosting the users' motivation, commitment, and participation. Deterding et al. researched the current use of gamification and proposed the following definition: "Gamification is the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011). However, a discussion about the term "gamification" has recently emerged. Some researchers and game designers think that many companies abused gamification by adding an

S. Diewald (✉) • A. Möller • L. Roalter
Technische Universität München, Distributed Multimodal Information Processing Group, Arcisstr. 21, Munich 80333, Germany
e-mail: stefan.diewald@tum.de; andreas.moeller@tum.de; roalter@tum.de

T. Stockinger • M. Koelle • P. Lindemann • M. Kranz
University of Passau, Innstr. 43, Passau 94032, Germany
e-mail: tobias.stockinger@uni-passau.de; marion.koelle@uni-passau.de; patrick.lindemann@uni-passau.de; matthias.kranz@uni-passau.de

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_32

independent “game layer” to an existing application and/or by using extrinsic rewards to achieve short-term success. The use of game design elements in non-game contexts with the goal of achieving long-term effects based on intrinsic motivation is often referred to as “gameful design” (Deterding et al., 2011). The term “gameful design” shall emphasize the fact that game elements should be part of the concept already during design and should not be added by an independent “gamification layer.” Applications equipped with game design elements we call “gamified” applications.

Since gamification can arouse sustainable motivation and strong commitment, it has found its way into the automotive domain. Automotive manufacturers are currently applying gamification approaches for three prominent use cases: marketing (Tillström, 2012), eco-driving (Inbar, Tractinsky, Tsimhoni, & Seder, 2011), and driving safety (Shi, Lee, Kurczak, & Lee, 2012). While marketing aims at convincing customers to buy a certain car, eco-driving and driving safety applications are integrated in the vehicles' infotainment systems. These in-vehicle applications try to educate the drivers by awarding points and badges for safe and ecological driving.

In our research, we investigate a new use case for gamification in the automotive domain: exploration of automotive user interfaces and practicing of vehicle functions. In a recent study,[1] it has been found that cars ranging from compact to premium level are suffering from user experience problems. Misplaced or too many controls, misleading labels, too deeply nested menus, and unreliable speech recognition are demotivating the users. In addition to the non-self-explanatory interfaces, users are often avoiding manuals for technical systems (Novick & Ward, 2006). These circumstances entail unsatisfied customers that are able to use only a fraction of their (often expensively bought) cars' functions.[2] In addition, a study of the U.S. National Highway Traffic Safety Administration (NHTSA) has revealed that secondary and tertiary tasks in vehicles, such as adjusting the radio and other devices integral to the vehicle, contribute to over 22 % of all investigated crashes and near-crashes (NHTSA, 2009). However, it has been shown that many of these problems can be overcome by practicing (Rouzikhah, King, & Rakotonirainy, 2013).

Therefore, we propose a gamification-supported framework for exploring and practicing automotive user interfaces and vehicle functions. The framework consists of a mobile application that recreates the vehicle cockpit for allowing offline exploration and training, and an in-vehicle application that replaces the owner's manual and provides hints and tips for the driver.

32.1.2 Contribution

In this chapter, we contribute a review of gamified applications in the automotive domain and an overview over gamified learning environments. By examining the gathered examples, we point out potential limitations and challenges of gamification on both considered areas.

[1] http://www.wiwo.de/technologie/auto/funktionen-im-auto-unsere-autos-sind-zu-schwer-zu-bedienen/7860276.html, last accessed 13 May 2013.

[2] http://www.wired.com/autopia/2013/04/car-tech-failing/, last accessed 12 May 2013.

Based on these findings, we contribute the concept and implementation of a gamified framework for exploration and practicing of automotive user interfaces and vehicle functions. Results of a first user study and experiences gathered during the development are summarized and serve as basis for some first guidelines that can support future researches in designing and evaluating gamified automotive applications.

32.1.3 Chapter Overview

In Sect. 32.2, we first present the game design elements and game mechanics that are commonly used in gamified systems. With this knowledge at hand, we analyze existing gamified examples in different automotive areas (Sect. 32.3) and briefly summarize important aspects of gamified learning applications (Sect. 32.4). In Sect. 32.5, the results of the analyses of Sects. 32.3 and 32.4 are summarized to challenges and limitations of gamification. Based on these findings, we present the concept and implementation of our gamified framework for exploring and practicing automotive user interfaces and vehicle functions in Sect. 32.6. Parts of the framework have been evaluated in a user study. The study and its results are summarized in Sect. 32.7. In Sect. 32.8, we compile guidelines for future gamified automotive application. The guidelines are based on our experiences from the development of the framework and from our experiment with the framework. Finally, we conclude by summarizing the presented ideas and by giving an outlook to our future work (Sect. 32.9).

32.2 Elements and Mechanics of Gamification

In order to analyze the currently available applications, the basics of gamification are summarized in this section. For creating a sustainable effect and lasting commitment, the source of motivation is important. Intrinsic motivation comes from the activity itself, whereas extrinsic motivation comes from the outside (Deci, 1972). While intrinsic motivation seems to be desirable, one also has to think about the users that do not get intrinsic reward solely from the activity. In that case, extrinsic rewards can substitute the missing initial intrinsic motivation. However, there is the danger that by giving too much extrinsic reward, the intrinsic reward diminishes (Deci, Koestner, & Ryan, 2001) and the person has to be kept in a reward loop forever (Zichermann & Cunningham, 2011, p. 27). In order to create intrinsic motivation, according to McGonigal, four things need to be considered: satisfying work (consisting of a clear goal and next actionable tasks), the hope/experience of being successful, social connection, and meaning (McGonigal, 2011, p. 53).

Satisfying work and the experience or hope of being successful can be fulfilled by the characteristics of games (McGonigal, 2011, p. 29ff):

- Goal: The sense of purpose. It focuses the users' attention and gives orientation.
- Rules: Limitations on how the goal can be achieved. They boost the users' creativity, foster strategic thinking, and help define the next actionable tasks.
- Feedback system: How close is the user to the goal? (progress bar, points, levels)
- Voluntary participation: Freedom to enter the game. Leads to acceptance of rules and feedback.

The goal of social connection can be achieved by involving friends via social networks or by teaming up people that have a common unique goal. McGonigal claims that meaning can occur when users are part of something "epic" (McGonigal, 2011, p. 61ff). That means, for example, that they can contribute to a superior goal that is carried out and lasts for a longer time (e.g., fighting climate change). People need something to master that adapts to their progress and their skills (Zichermann & Cunningham, 2011, p. 29). All of these factors make up games and, as a result, they are important parts of gameful design. In our analysis, we concentrate on game mechanics, since these are the basic components of a game (Hunicke, Leblanc, & Zubek, 2004). According to Zichermann and Cunningham (2011), the seven primary game mechanics are points, levels, leaderboards, badges, onboarding, challenges/quests, and engagement loops.

32.3 Gamification in the Automotive Domain

In this section, examples of automotive applications are examined. The analysis is split up in two parts: applications outside vehicles and applications for in-vehicle usage (Diewald, Möller, Roalter, Stockinger, & Kranz, 2013). The analysis focuses on applied gamification elements and includes a view on the chosen type of motivation.

32.3.1 Gamified Automotive Applications outside Vehicles

32.3.1.1 Automotive Marketing with Gamified Applications

Outside vehicles, the main areas of application are marketing and brand forming. By applying gamification, the automotive manufacturers want to create customers that are more attracted to their brands and more profitable.

An example is *Volkswagen*'s *BlueMotion Roulette*.[3] In order to promote the lower fuel consumption of their new *BlueMotion* car, *Volkswagen* created a game in which users could win the car by guessing how far it can drive with one tank of fuel.

[3] http://www.bluemotion.no/, last accessed May 29, 2013.

However, instead of creating a simple competition where the participants could enter their guesses, they took a real car and drove along a selected road in Norway. The route was visualized on *Google Maps* and the users could bet via their *Facebook* account on a single road segment that had not been taken by another player. On the competition day, the players could follow the car's journey live on the map and discuss it on *Facebook*. Since each user could only bet once, one could maximize her/his chance of winning by finding out more about the car and its fuel consumption before entering.

It can be assumed that for most users the possible extrinsic reward of winning a car was the decisive factor for joining the "game". However, the gaming experience caused by the roulette association, the easy onboarding by presenting the facts about the car and the game in a short simulation, and the challenge to beat other real players also caused intrinsic motivation for many players, which can be seen by the large amount of *Facebook likes* and comments.[4]

Many applications reward users with badges etc. just for driving around without having a clear goal. For example, the social driving application *Smileage*[5] rewards its users for meeting other vehicles that are also using the *Smileage* application. Another example is *MyFord Mobile*, which rewards its users, for instance, for driving 100,000 miles with an electric vehicle. The objective of such applications can be seen in marketing, since its main purpose is sharing these badges on different social networks.

32.3.1.2 Gamified Speed Monitoring Applications

The speed camera lottery[6] was designed to reward people for doing the right thing. Instead of just taking a picture of speeding cars, a modified traffic camera would photograph all passing cars. A portion of the fines from the speeders would be pooled in a lottery in which each of the law-obeying car owners would have a lottery ticket. A demo in Stockholm lasting for 3 days resulted in a drop of the average speed from 32 km per hour to 25 km per hour. In this example, the motivation is mainly caused by the extrinsic reward, which is the chance of winning the lottery. A deeper analysis of this application is difficult, since there are no numbers for comparing the effect against a standard traffic camera or for a longer period. However, it can be assumed that this gamified traffic camera could also lead to undesired effects. For instance, more traffic could occur on the road since people want to enter the lottery. Gamified road signs,[7] which display friendly or unhappy smilies depending on whether the speed limit is obeyed or not, are another example of applied gamification. The effect of these signs is based on instantaneous feedback and social pressure as all passersby can see the breach of rules.

[4] https://www.facebook.com/BlueMotionRoulette, last accessed May 29, 2013.

[5] http://smileage.vw.com/, last accessed June 5, 2013.

[6] http://wheels.blogs.nytimes.com/2010/11/30/speed-camera-lottery-wins-vw-fun-theory-contest, last accessed May 30, 2013.

[7] http://www.smileysid.co.uk/, last accessed June 5, 2013.

32.3.2 Gamified Automotive Applications in Vehicles

The following sections describe gamified applications that are intended for use in real vehicles.

32.3.2.1 Navigation and Efficient Driving

A popular gamified application is the community-based traffic and navigation mobile application *Waze*.[8] It rewards its users for mapping uncharted areas and reporting traffic issues. Points and leaderboards create a competition between users. However, these points are not only used for comparing with other users, they are also used as a confidence score for a user's contribution. The top x percent of users are further upgraded from *Waze Grown-Ups* to *Waze Warriors*, *Waze Knights*, or *Waze Royalties*. The contribution to an active community that has the goal to make driving more efficient partly creates an intrinsic motivation, which can cause users to diverge from their route to join in[9]

The *I-GEAR* (*incentives and gaming environments for automobile routing*) project aims at changing users' behavior in order to reduce traffic congestion (McCall & Koenig, 2012). For example, users could be rewarded for taking a later bus or going to a suburb shopping mall instead of the one in the city center with free bus tickets or discounts at a store in the selected suburb mall. In addition to the immediate rewards, users also would get points for sticking to the application's recommendations. These points could be converted into material rewards later. Drivers could also team up and gather points to win prizes like free car insurance for 1 year when their team has the highest score at the end of the year. This project sets a lot on extrinsic rewards.

32.3.2.2 Safe Driving

The mobile application *Driving Miss Daisy* by Shi et al. (2012) performs a gamified driving style assessment. Instead of just showing a score of points, the performance is evaluated by a virtual passenger on the backseat ('Miss Daisy') who cheers or whimpers depending on the driving performance. In addition, a game summary is presented at the end of a drive. Besides the instantaneous feedback over thumbs-up and thumbs-down, the driver can earn virtual money on each drive, which is accumulated over multiple rounds for comparison with other players. The application has several levels of difficulty which are increased based on the former performance. The performance of a drive can be compared to historical drives on the same route

[8] http://www.waze.com/, last accessed June 4, 2013.

[9] http://www.technologyreview.com/news/422583/social-surveillance-yields-smarter-directions/page/2/, last accessed May 28, 2013.

of the player him/herself (self-competition), and with the performance of other players (public competition).

CleverMiles[10] is based on an external device that has to be connected with the vehicle's on-board diagnostics II (OBD-II) port. The device logs and analyzes the driving, and when safe driving is detected, the user gets *CleverPoints* that can be redeemed against products from different partners. In order to improve the players' driving, the system displays driving style recommendations. The application further allows users to share the driving performance data with *Facebook* friends and other drivers. Since the application is still in closed beta-trial, no information about the effectiveness is available so far.

32.3.2.3 Eco-Driving

Gamified eco-driving applications can be found in many cars. An example is *Ford*'s *SmartGauge with EcoGuide*,[11] which was developed for hybrid vehicles. It informs the user about the current state and efficiency level of the vehicle's drive. When the car is driven at the most efficient level, "efficiency leaves" are growing on the right part of the dashboard as a reward for the user. Other examples are the color switching eco-gauge of the *Chevrolet Volt*, or *Kia*'s *ECOdynamics* system[12] which offers different setups that challenge the driver to get the best economy rating. With *Fiat*'s *eco*:*Drive*,[13] drivers can analyze their eco-driving-related behavior in real-time or afterwards at home. In addition to a score in form of an *eco*:*Index*, drivers can earn *eco*:*Badges* and contribute with their savings to create a better virtual place called *eco*:*Ville*.

The examined eco-driving applications challenge the users in a very emotional way (Tractinsky, Inbar, Tsimhoni, & Seder, 2011): Efficient eco-driving is indicated by green colors or by flourishing nature. In less efficient conditions, the displays are changing to the colors yellow or red and the leaves are disappearing. Thus, the user gets the feeling that something is broken or the vehicle is being mistreated. Competitive eco-driving can create a very strong intrinsic motivation. According to Deterding,[14] the gamified *EcoChallenge* application by Ecker, Holzer, Broy, and Butz (2011) was so motivating that users would even go through red lights, which is an unintended behavior.

---

[10] http://www.clevermiles.com/, last accessed May 20, 2013.

[11] http://stanfordbusiness.tumblr.com/post/32317645424/why-gamification-is-really-powerful, last accessed May 24, 2013.

[12] http://thenextweb.com/shareables/2012/09/22/can-kias-gamification-change-way-drive-cars/, last accessed May 24, 2013.

[13] http://www2.fiat.co.uk/ecodrive/, last accessed August 19, 2013.

[14] http://en.slideshare.net/dings/pawned-gamification-and-its-discontents, slide 41, last accessed June 5, 2013.

32.4 Gamified Learning and Exploration

The second pillar of our automotive training framework is gamified learning and exploration. Since there are several examples and an extensive theoretical background analysis of gamified learning and training environments in "EDUCATION", and "From Market Place to Collusion Detection: Case Studies of Gamification in Education", we concentrate in our overview on the basics and only present a few examples that were considered in the conception phase of our proposed framework.

32.4.1 Gamified Learning

Already in the 1980s, Malone conducted experiments to find out what makes computer games fun and how this can be used for instructional computer games (Malone, 1980). A thorough literature review on the positive impacts of gaming in learning, skill enhancement, and engagement settings has been presented by Connolly, Boyle, MacArthur, Hainey, and Boyle (2013). Their review revealed that gamified learning application and serious games could boost knowledge acquisition, content understanding as well as increase the learner's affection and motivation. However, they also point out that the learning effectiveness is not automatically optimized by integrating game mechanics in learning applications.

When analyzing current examples of gamified learning environments (Muntean, 2011; Simões, Redondo, & Vilas, 2013), the use of game elements does not directly optimize the learning efficacy, but has mainly an impact on the learners' motivation (Domínguez et al., 2013). This is also an important factor for our framework, since our goal is getting the drivers to explore the user interface of the car and practice the usage of other vehicle functions as early as possible and best before the first drive with an unknown vehicle.

32.4.2 Gamified Tutorials, Training and Exploration

Gamification is also applied in tutorials for online services and computer applications. For example, the online cloud storage service *Dropbox*[15] offers a tutorial mode that visualizes the users' 'learning' progress and rewards them with 250 MB extra space when completing the tutorial. Additional space can be gained by completing other different tasks on a task list with progress display. By using the space as extrinsic reward, the service lets its users take over advertising on social networks etc.

[15] https://www.dropbox.com/getspace, last accessed September 02, 2013.

GamiCAD is a gamified interactive tutorial system for first time *AutoCAD* users (Li, Grossman, & Fitzmaurice, 2012). A comparison of the gamified tutorial with the default in-product interactive tutorial system revealed that users of the gamified version showed higher subjective engagement levels and completed test tasks 20–76 % faster. *Ribbon Hero 2*[16] is a game for learning Microsoft Office. The interactive tutorial consists of game setting challenges, which expose students step-by-step to more Office features. Students are encouraged to explore and learn on their own through points that are awarded for using basic functions as well as new functions that can be unlocked by completing challenges. Another motivation is the score sharing functions that allows publishing the current score via social media.

Orientation Passport by Fitz-Walter, Tjondronegoro, and Wyeth (2011) is an example of a gamified mobile exploration application. The smartphone application is targeted at new students during their university orientation phase. It provides a digital orientation schedule of important student events accompanied with other helpful tools, such as an interactive campus map, a contact list, or a service information page. By checking into events, adding people to the contact list or answering questions to university services, the new students can unlock a maximum of 20 achievements. The results from a pilot study show that the achievement system motivated students to visit events and explore the campus and its services. However, downsides of the gamification were that some users only visited places once for unlocking an achievement and added random people as "friends" to their contact list to get the respective badge.

In order to enforce or train certain behaviors, aspects of behavioral economics can be combined with game elements. An example is the mobile application *SmartPiggy* (Stockinger, Koelle, Lindemann, Witzani, & Kranz, 2013). In this app, color-coded progress bars and badges support the task of saving money. In contrast to other implementations that only award badges to users, this application makes use of people's loss aversion and takes away gained badges when users fail to reach their goals.

Gamification cannot only persuade end-users to explore a system or application, but can also be used to explore the use and spread of technology. An example is the mobile application *NFC Heroes* (Kranz, Murmann, & Michahelles, 2013). The app is set in a trading card context and awards users with gadgets and points for documenting Near-Field Communication (NFC) technologies in their environment. The gathered data is used by researchers to explore the use of NFC and to measure the adoption of this technology.

Gamification is not only used for exploration and tutorials but also for different kinds of personal training. Example areas of mobile personal training applications are mobile fitness coaches (Kranz, Möller et al. 2013; McCallum, 2012) or training applications for teaching methods in (higher) education (Möller et al., 2011).

[16] http://www.ribbonhero.com/, last accessed August 19, 2013.

Especially for training applications, it is important to match the way of information presentation with the target audience. Expert users may not be willing to "play through a game" in order to access the information they are looking for.

32.5 Potential Limitations and Challenges of Gamification

Looking at the examined examples, some challenges, and limitations of gameful design can be derived:

Games are voluntary and have no serious consequences: All of the applications examined here fulfil the voluntary nature. However, when gamification approaches areas such as electronic road pricing (Merugu, Prabhakar, & Rama, 2009), the voluntary nature could be limited when the driver has to either take part in the game or stay out of the game area. The competitive eco-driving example showed that the seriousness of traffic regulations could be surpassed by the intrinsic motivation coming from the gaming character. Applications that can have an influence on the driving style should be analyzed and extensively tested before they are released or integrated into vehicles.

Games abstract and simplify complex processes for a better gaming experience: In order to have a clearer relationship between the actions and the goal, games often simplify complex processes. However, when gamifying a real process, the precision and accuracy has to meet the requirements of the process. For example, a safe driving assessment application that only rewards the user based on rules like "drive slowly and do not brake" would not meet the requirements of safe participation in road traffic.

Games live from instant and unambiguous feedback: To encourage desired behavior, immediate and unambiguous feedback is important. However, during driving it can be very difficult to clearly present feedback without distracting the driver from the driving task. Although little icons in the dashboard or audio feedback could reduce the distraction, these could be ambiguous so the driver might know to have achieved something without knowing exactly what was achieved. A solution could be to shift the detailed explanation of the achievement to the next stop (e.g., at red lights).

How to phase out extrinsic rewards: When the motivation of a gamified application is mainly based on extrinsic rewards, it can be a difficult process to phase out these rewards. An approach could be to draw the "player's" attention to the intrinsic rewards one gets from using the application (e.g., focus on the social connection, the mastered challenges, or the learning progress). At the same time, the extrinsic rewards, which perhaps helped to attract the user, could be gradually reduced. The use and height of extrinsic rewards should be looked at in detail during the testing phase. The reward should not exceed a certain value that motivates users to execute unnecessary, rash, and unsafe driving maneuvers.

32.6 Gamification-Based Framework for Automotive User Interface Training

32.6.1 Purpose of the Framework

In order to investigate the potential of gamification for exploring automotive user interfaces and practicing the use of (comfort) vehicle functions, we developed a prototypical framework. We had the following research questions (RQs) in mind during the conception phase of the framework:

- RQ1: Does gamification have an influence on the training motivation of the subjects?
- RQ2: Does gamification during the training phase have an influence on the driving performance?
- RQ3: Does gamification influence the acceptance of recommendations given by a training system?
- RQ4: Will subjects perform safety-critical actions or even follow dangerous recommendations while driving in order to get a higher score from the framework?

While RQ1 (effects on motivation), RQ2 (effects on driving performance) and RQ3 (effect on acceptance) focus on positive aspects of gamification, RQ4 is intended to unveil possible negative gamification effects (see also NEGATIVE ASPECTS). The focus of our research is on the effect of gamification on the actual driving performance.

32.6.2 General Functionality

The framework is split up into two gamification-supported exploration and practicing modes (see Fig. 32.1). The first approach is the *online mode* that is running directly on the car's in-vehicle infotainment (IVI) system. Similar to classical step-by-step tutorials, the 'tutorial and quiz mode' guides the driver through the most important functions and awards points and badges with ongoing progress. Examples of trained functions are e.g. (1) adjusting the seat, (2) activating the hazard warning lights, (3) activating the adaptive cruise control, or (4) changing the radio station. The different learning units are interrupted by randomly selected quiz questions to rehearse already learned functions. By answering the questions within a certain time limit (in a safe driving situation and vehicular context, e.g. while the car is parked on private property), the user can earn bonus points. In contrast to the 'tutorial and quiz mode', which is only available when the car is parked, the 'background mode' is monitoring the driving while the car is moving. Whenever the user performs a secondary or tertiary task (Kern & Schmidt, 2009), i.e. a task not directly related to driving, the driving behavior is analyzed in order to estimate the driver's distraction (for algorithms cf. Alonso, Vega, and Martín (2012)). At the end of the drive, the

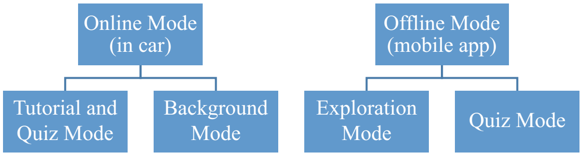


Fig. 32.1 The gamified exploration supports two modes: The *online mode* is running on the car's infotainment system, the *offline mode* is a mobile application for exploring the human machine interface (HMI) independent from the vehicle

application calculates a score where 100 % means that the driver is using the human machine interface (HMI) without noticeable distraction and 0 % means that a high amount of distraction was detected for each performed secondary and tertiary task. As a result, the application suggests the driver what should be further practiced, and—when available—it suggests less distracting control alternatives, e.g. using the steering wheel volume control instead of the radio's volume control, or controlling a function via the voice command system. This score is also saved in a high score list.

The in-car mode is complemented by the *offline mode* that is realized as a mobile application for smartphones and tablet PCs (Fig. 32.2). The 'exploration mode' allows exploring the human-machine interface. For newly identified functions, entries from a 'to explore' list are ticked off. In the 'quiz mode', random questions have to be answered by the user and points are awarded. When a set of questions on a special topic (e.g. the navigation system) has been successfully completed, an 'expert badge' is awarded to the user.

Both modes have been prototypically implemented. The *online mode* is implemented on a driving simulator based on a real car cockpit (see Fig. 32.3). By analyzing messages on the CAN (Controller Area Network) bus, the Java-based application can log the use of the car functions. In addition, the *online mode* also controls parts of the dashboard and the display on top of the center stack, which allows showing the feedback and the tutorial instructions directly on the car's built-in displays. The *offline mode* has been realized as mobile application for the Android platform. In both applications, the gamification elements can be turned off. This allows analyzing motivation and learning effects caused by gamification.

32.6.3 Sample Scenarios for the Gamified Automotive Training Framework

32.6.3.1 Interactive Tutorial for Car Buyers

The proposed framework can be used in different scenarios. An example is its usage as an interactive tutorial for car buyers. The exploration and tutorial functionality of the *online mode* can be used as a replacement for the owner's manual. It could be

Fig. 32.2 The three figures depict example screens of the mobile application that represents the *offline mode* of our proposed framework. (**a**) The main menu of the mobile application (*offline mode*). The cockpit mode allows free exploration of the vehicle's recreated cockpit (see Fig. 32.2b). (**b**) The cockpit mode of the mobile application. By clicking on an interactive element in the cockpit, the application shows usage details (see Fig. 32.2c) and awards points to the user for newly found functions. (**c**) The details view explains the usage of the different interactive elements. There is also a walk-through for the vehicles infotainment menu. The example in this figure shows details on the wiper stalk switch

Fig. 32.3 The driving simulator used for the evaluation of the in-vehicle mode (*online mode*) of the framework. It is the real cockpit of a BMW 5-series. The framework controls parts of the dashboard and the display on top of the center stack, and can log most controls by monitoring the vehicle's CAN bus

automatically started before the first drive with the new car and later on started on demand whenever the driver needs help or wants to explore unknown control elements or menu points.

The *offline mode* could be interesting for buyers that are waiting for the delivery of their ordered car. Using the mobile application distributed by the car manufacturer could increase the buyer's excited anticipation and ensure that one knows how to use the car's functions right from the beginning.

32.6.3.2 Guidance for Rental Car and Car Sharing Users

Especially when driving an unknown vehicle—as is often the case with rental cars and car sharing vehicles—drivers can be overtaxed by the operation of tertiary car functions (Kern & Schmidt, 2009). This could, for example, be overcome with a gamified preset mode that automatically starts when the driver enters the car. The *online mode* could be a virtual guide that shows the driver what one can adjust before the drive in order to have a less stressful drive. This could contain things like seat and mirrors adjustments, choosing the desired radio station, or setting the temperature of the air conditioning. Besides the intrinsic motivation of having a more convenient drive, possible extrinsic rewards could be the reduction of the insurance deductible or free car sharing minutes.

32.7 Evaluation of the *Offline Mode* Prototype

In a first test, the offline mode prototype has been evaluated in order to answer the research questions presented in Sect. 32.6.1.

32.7.1 Evaluation Setting and Methodology

For evaluating the effects of the *offline mode* on the driving performance and vehicle function handling, subjects had to perform given secondary and tertiary tasks while driving in a simulator (see Fig. 32.3).

In order to measure the effect of the gamified training application, the participants were randomly divided into two groups (between-subjects design):

1. Without any training (control group).
2. 10 min training with the *offline mode* (experiment group).

The metrics were time to task completion, lane deviation, subjective perceived workload, and ratings on a questionnaire. The perceived workload was measured by the NASA Task Load Index (NASA-TLX) questionnaire. The additional questionnaire asked about previous knowledge of the subjects and let them rate statements concerning their motivation as well as their perception of the gamefulness of the overall experiment.

32.7.1.1 Tasks

The driving task was the so-called *Lane Change Task*[17] by Daimler (Harbluk, Burns, Lochner, & Trbovich, 2007). The maximum speed was set to 60 km/h. The secondary or tertiary tasks (operating tasks) to be performed by the subjects were shown on the lower part of the dashboard and were triggered automatically based on the driven distance. The subjects were instructed to focus on their speed, to perform the lane changes indicated by the simulation tool, and to keep their track. Although the participants should focus on driving safety, the displayed operating tasks should be performed as fast as possible. The operating tasks are summarized in Table 32.1.

The experiment began with a brief introduction for both groups. In a pre-experiment questionnaire, demographic data, driving experience and experience with technical systems such as smartphones were gathered.

Afterwards, the experiment group got a short introduction to the mobile application prototype (*offline mode*). Then, the subjects could freely explore and use the gamified application for a maximum of 10 min. The subjects in the control group immediately progressed with the driving task.

---

[17] http://sunburst.usd.edu/~schieber/ppt/MATTES2003-powerpoint.pdf, last accessed September 23, 2013.

Table 32.1 Overview of secondary and tertiary tasks users had to operate during the drive

Task no.	Task description	Start distance (m)	End distance(m)
T1	Increase radio volume via steering wheel control	400	600
T2	Change radio station via steering wheel controls	800	1,000
T3	Play CD: Sheryl Crow	1,200	1,800
T4	Activate the active cruise control	2,000	2,400
T5	Start navigation to 'home'	2,600	3,300

The tasks were displayed on the lower part of the dashboard and were triggered automatically based on the driven distance. The task instruction was active from start distance to end distance and was hidden when the task was fulfilled

The driving task consisted of four laps (each around 3,300 m, ~3.5 min) in the *Lane Change Task* (*LCT*) simulation. In the first lap, subjects got an introduction to the simulation environment and to the *Lane Change Task*. In the second lap, ground truth data on the driving performance was recorded. During ground truth, no extra operating tasks had to be performed. For the last two laps, subjects had to perform the additional operating tasks (cf. Table 32.1) in parallel to the normal driving task. After the third lap, a summary of their operating performance in form of an automatically calculated score (composed of accomplished task score and time bonus) was presented to the subjects. Before they started the fourth lap, the experimenter told the subjects that the score is rather low and they could get into a high-score list when they perform the operation tasks faster and more accurate in the next lap. After each lap, subjects had to do a subjective assessment of their mental workload with the NASA Task Load Index questionnaire.

After the driving experiment, the subjects filled in a post-experiment questionnaire. The questionnaire included questions on the driving and operating performance. The experiment group further answered questions on the tested gamified mobile application.

32.7.1.2 Participants

For the first test, we recruited 30 subjects between 19 and 28 years (median = 25 years, standard deviation $\sigma = 2.53$). There were 5 female and 25 male participants. Most of the participants were students or research assistants. The average experiment duration was 35 min. Subjects received a direct compensation for their participation in form of a 5 € gift card for an online retailer. The average driving experience was 6.0 years ($\sigma = 2.53$). The subjects were randomly assigned to the experiment and control group. A Student's *t*-test ($\alpha = 0.05$, two-tail) on the driving experiences of the control and the experiment group showed no significant difference ($P(T \leq t) = 0.069$). In addition, there were no significant differences in experience with and interest in technical devices between both groups.

32.7.2 *Results*

32.7.2.1 Results of Driving Experiment

The presentation of the results focuses on the parts relevant for providing answers to our research questions.

The analysis of the *LCT* track deviation data gave the following results. In comparison to the second lap (ground truth) without additional operating tasks, the lane deviation increased for the control group on average about 48.7 % ($\sigma = 0.43$) for the third lap and 39.6 % ($\sigma = 0.46$) for the fourth lap. The experiment group had slightly better results. Their lane deviation increased by 42.1 % ($\sigma = 0.27$) for the third lap and 23.7 % ($\sigma = 0.27$) for the fourth lap. However, no significant differences could be found between the results for both laps (lap 1: $P(T \leq t) = 0.65$, lap 2: $P(T \leq t) = 0.26$).

The task completion rates were almost equal for both groups (see Table 32.2). The only significant difference can be seen for task 4. The completion rate for the active cruise control task is twice as high for the experiment group as for the control group.

The results from the subjective assessment of the mental workload with the NASA-TLX (weighted score from 0 to 100) correlate with the average lane deviation of the *LCT*. No significant difference was found between the groups. For the second lap (ground truth without operating task), an average NASA-TLX score of 24.7 ($\sigma = 13.9$) was calculated. The third lap (first experiment lap with operating tasks) had an average score of 57.0 ($\sigma = 21.3$), the fourth lap resulted in an average score of 39.4 ($\sigma = 18.4$). The average NASA-TLX scores of all users split up into categories are depicted in Fig. 32.4.

In addition, the subjects rated statements on the driving experiment on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The results are summarized in Table 32.3. The goal was to measure whether the usage of the mobile application changes the perception of the driving task. However, no significant differences between both groups could be observed.

Table 32.2 Accomplishment rates for operating tasks

	Lap 1		Lap 2	
Task	Control ($n = 15$)	Exp. ($n = 15$)	Control ($n = 14$)	Exp. ($n = 14$)
Task 1: Increase volume via steering wheel	93.3 %	93.3 %	100 %	100 %
Task 2: Change radio station via steering wheel	**80.0** %	73.3 %	78.6 %	78.6 %
Task 3: Play CD: Sheryl Crow	**80.0** %	73.3 %	**100** %	92.9 %
Task 4: Activate active cruise control	33.3 %	**60.0** %	35.7 %	**71.4** %
Task 5: Start navigation to ‘home’	**73.3** %	66.7 %	**100** %	78.6 %

There were 15 participants in both groups for the first lap. For the second lap, in each group one subject decided to end the driving experiment early

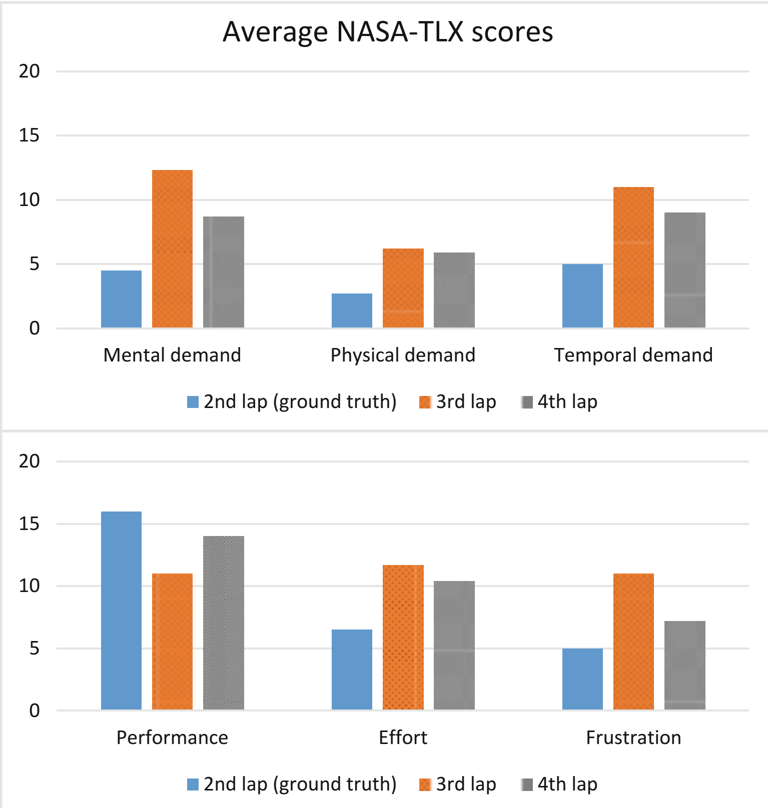


Fig. 32.4 Average NASA-TLX scores for all subjects. The subject could assess the different categories on a scale from 0 to 20 with 0 = very low and 20 = very high

Table 32.3 Mean and standard deviation (σ) of rated statements concerning the driving experiment

	Control group		Exp. group	
Statement	Mean	σ	Mean	σ
The operating tasks were too difficult for me	2.07	0.59	1.87	0.74
My goal was to drive safely	3.27	1.03	3.67	0.98
My goal was to accomplish the tasks quickly	4.34	0.62	4.27	0.70
My goal was to reach a high score	4.07	1.03	4.20	0.77
The experiment felt more like a game for me	3.47	0.92	3.34	1.05

The statements had to be rated on a 5-point Likert scale with 1 = 'strongly disagree' and 5 = 'strongly agree'. No significant differences between the control group and the experiment group can be observed

32.7.2.2 Results related to the Mobile Application

The subjects in the experiment group (n = 15) further rated statements on the mobile application on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The fun factor of the application was rated with an average score of 4.20 ($\sigma = 0.56$). The usefulness of the application was confirmed with an average rating of 4.27 ($\sigma = 0.46$). The subjects can further think of using such an application for unknown cars (mean = 3.80, $\sigma = 0.77$). Participants further thought that the use of the application made the operating tasks easier during the driving experiment (mean = 4.47, $\sigma = 0.52$). Regarding the motivation, the subjects stated with an average score of 4.73 ($\sigma = 0.46$) that the quiz mode with the ability to make a high score motivated them to improve their initial score.

32.7.3 Discussion

Based on the results from the performed experiment, answers to the research questions shall be provided in the discussion of the results.

32.7.3.1 Influence of Gamification on the Training Motivation (RQ1)

Subjects in the experiment group clearly stated that the possibility to improve their score in the quiz mode of the mobile application was a good incentive to perform the quiz several times. However, so far the quiz mode only asks for the location of input elements. For that reason, the quiz can quickly become boring. Subjects suggested to implement different categories of questions or to ask multiple-choice questions on the operating elements and their functions. In addition, the idea of unlocking new application features by exploring the virtual cockpit was appealing.

The individual statements of the subjects match with the rating of the application presented in Sect. 32.7.2.1. In summary, game elements had a positive influence on the training motivation. However, users need the feeling that the quiz evolves with their growing expertise.

32.7.3.2 Influence of Gamification on the Driving Performance (RQ2)

Although the subjects in the experiment group stated in the post-questionnaire that the use of the gamified mobile application had helped them during the driving experiment, no significant difference in the *LCT* results could be observed compared to the results of the control group (see Sect. 32.7.2.1). That means that the training application had no direct influence on the driving performance.

For the operation tasks, the results were comparable for both groups. The only significant difference was in task 4, which was the activation of the active cruise control. This was the only function in our operation task set that is not yet widely available and had to be operated through a small lever located behind the steering wheel. This indicates that the mobile training application is beneficial for functions that are not yet common in cars and/or are not plainly visible.

32.7.3.3 Influence of Gamification on Recommendations (RQ3)

Subjects stated in the final interviews that the mobile application had both informative and game character. Especially the cockpit view and the function list have been seen as an information source. The quiz mode was rated to be more like a 'learning game.' However, when we observed the users interacting with the mobile application, we noticed that the informative character faded into the background. Most subjects tapped systematically or completely randomly on the virtual cockpit in order to find all functions. When a function was found, the description was often just quickly scanned and possible recommendations or usage hints were overlooked. When we mentioned this in the interview, the subjects stated that their goal was to activate the quiz mode quickly.

32.7.3.4 Negative Aspects of Gamification (RQ4)

One negative aspect of gamification was already mentioned in Sect. 32.7.3.3. Instead of reading the information, subjects tried to keep the game flowing. A solution could be to implement a short compulsory break that allows the user to read the text. Another idea is to cut down the amount of information presented at a time. Alternatively, the textual explanation of functions could be enhanced with interactive graphics, video snippets, or audio.

For evaluating the game element 'score' and, thus, 'competition,' a score was computed during the driving experiment and displayed to the subjects after completing a lap. We further intensified the 'competition' after the first lap by saying that they can enter a high-score list when they get more points in the second lap. From the values in Table 32.3, it can be seen that on average the subjects concentrated more on the operating tasks and their score than on driving safely. Although both groups had only slightly the feeling that the experiment is more like a game (see Table 32.3), they disregarded the instruction that the main objective was to drive safely. When we asked the subjects why they had concentrated on the score, they mainly named the competition as decisive factor. The high-score list influenced even subjects who stated in the pre-experiment questionnaire not to be very competitive.

32.8 Towards Guidelines for Gamification in the Automotive Domain

The experiences gathered during the development and the first laboratory test with the framework could serve as a basis for future gamified automotive applications as well as their evaluation. The following statements summarize our findings:

Abstraction can be dangerous, **details also**: Games often abstract complex tasks in order to offer a better game flow experience (see Sect. 32.5). However, especially when gamifying real processes that could cause safety issues, the precision and accuracy has to meet the requirements of the process. For example, in a first version, we only delivered a very short and simplified description for the adaptive cruise control stalk switch, which lead to situation where subjects did not know how the set speed of the ACC could be reset. Some subjects activated the adaptive cruise control and the car in the simulation accelerated automatically to more than double the predetermined speed. However, also too much details can be dangerous during driving. Following the rule of immediate feedback (cf. Sect. 32.5), we created different icons with a short reward text that were shown on the dashboard of the simulator as soon as a task was solved. The message was only shown when the car drove straight and at a constant speed. However, some participants found these reward messages so interesting that they partially ignored the primary driving task they should focus on. Therefore, when designing a gamified application one has to find a balance for the right degree of detail and abstraction and how unambiguous feedback can be provided.

Make game rules clear: In our first experiments, we tried to hide the game mechanics, and did not offer an explanation on how points or awards can be earned. However, as soon as the subjects found out that they got points for a certain action, they repeated this action as often as possible to get as many points as possible. This led to drastic performance drops as the subjects' focus was on finding out the rules for getting more points. As already stated in Sect. 32.2, rules are important parts of games and need to be clear for the "players" (McGonigal, 2011, p. 29ff).

Test in a non-gaming context: The first iterations of the framework prototype were tested with a computer steering wheel in front of two large displays on a desk. The driving simulation software was similar to *Geoquake*'s *3D Google Maps* simulation.[18] Already during the first test rounds, we noticed that most participants had the feeling that the situation was unreal and more like a game. For that reason, we changed to the realistic car cockpit simulator afterwards (see Fig. 32.3). This hugely changed the perception of the subjects (see Table 32.3). On the software side, we changed from our own satellite image-based simulation tool to the established *Lane Change Task*. Its analysis tool further allows measuring the lane deviation (see Fig. 32.5) and comparing the subjects' driving performance when

[18] http://geoquake.jp/en/webgame/DrivingSimulatorPerspective/, last accessed September 27, 2013.

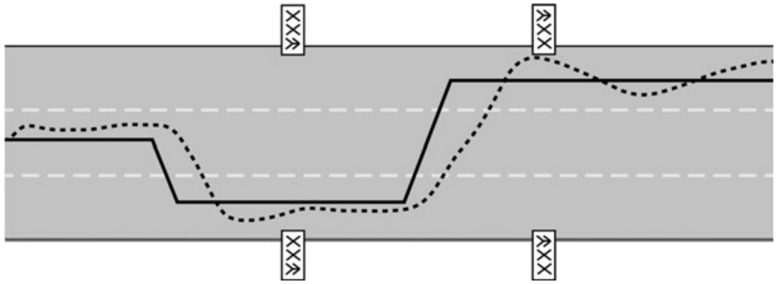


Fig. 32.5 The figure presents an example output of the track analysis tool of the *Lance Change Task* (*LCT*). The *solid black line* depicts the ideal track; the *dotted line* indicates the track driven by a subject during a task. By calculating the area between the two lines, the quality of the track keeping can be analyzed. This allows drawing conclusions on the subjects' distraction

performing secondary or tertiary tasks with their baseline driving when they only concentrate on the driving. In our experience, one can only find out the caused gaming effect of a gamified application, when it is tested in a non-gaming context, i.e. with a realistic driving simulation or a real car. In that way, it can be found out whether the gamified system has an influence on the seriousness of the driving task.

Do not gamify the task of driving: An important aspect we noticed during the experiment was that a gamified automotive application should not gamify the task of driving. For example, at an early stage, our framework suggested to use a different input modality for controlling a function when it noticed that the driver left the lane during an operation task, and awarded points when the driver successfully used the suggested modality (Diewald, Möller, Roalter, & Kranz, 2012). Although the application chose the drivers' preferred modality, the subjects mainly concentrated on gaining points and the driving performance drastically decreased.

Our results further show that competition is a very motivating factor for users to lose focus from the primary driving task (see Sect. 32.7.3.4). This coincides also with the observations of Deterding presented in Sect. 32.3.2.2, which means that competition for safety critical applications should be avoided.

The most important experiences from the tests during the development however were that the concept should be developed iteratively and that after each slight change of the game mechanics a test is necessary. Even the change from one game element to another can be critical and needs to be evaluated thoroughly.

32.9 Conclusion and Future Work

In this chapter, we first looked at common game elements and mechanics and then analyzed several examples of gamified applications in the automotive domain and for learning environments. Based on these analyses, we brought out limitations and challenges of gamification in the automotive domain, which were considered when creating our proposed gamified framework for exploring automotive user interfaces and practicing vehicle functions. After presenting the concept and implementation of this framework, we summarized the results from our first study. Based on these results and experiences during the development, we formulated some guidelines that we share in order to support further research on gamification in the automotive domain.

We are currently enhancing the mobile application and conducting an experiment with the *online mode* of the framework. We will investigate whether the training effect with a recreated virtual car interface (*offline mode*) is comparable to the effect when training with a real car interface (*online mode*). The comparison of the *offline mode* and the *online mode* will also be used to determine whether gamification in the real car distorts the perception of the seriousness of ‘driving a real car’.

Although gamification also has several negative aspects that need to be considered, we are convinced that our approach could improve the situation for people who often switch cars, but want to have stress-free and comfortable rides.

Acknowledgments We gratefully acknowledge the assistance in research and implementation of our student Duc Ha Minh and thank the Institute for Human-Machine Communication at Technische Universität München for letting us use their driving simulator.

References

Abt, C. C. (2002). *Serious games*. Lanham, MD: University Press of America.

Alonso, M., Vega, M. H., & Martín, O. (2012). Driving simulation study for the analysis of distraction effects in longitudinal driving behaviour. *Cognition, Technology & Work, 14*(4), 283–297. doi:10.1007/s10111-011-0180-9.

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2013). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661–686. doi:10.1016/j.compedu.2012.03.004.

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology, 22*(1), 113–120.

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research, 71*(1), 1–27.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “gamification”. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). Tampere, Finland: ACM. doi:10.1145/2181037.2181040.

Diewald, S., Möller, A., Roalter, L., Stockinger, T., & Kranz, M. (2013). Gameful design in the automotive domain: Review, outlook and challenges. *Proceedings of the 5th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 262–265). Eindhoven, Netherlands: ACM. doi:10.1145/2516540.2516575.

Diewald, S., Möller, A., Roalter, L., & Kranz, M. (2012). Gamification-supported exploration of natural user interfaces. *Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Portsmouth, NH* (pp. 47–48).

Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J.-J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*(1), 380–392. doi:10.1016/j.compe2du.2012.12.020.

Ecker, R., Holzer, P., Broy, V., & Butz, A. (2011). EcoChallenge: A race for efficiency. *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*. Stockholm, Sweden: ACM. doi:10.1145/2037373.2037389.

Fitz-Walter, Z., Tjondronegoro, D., & Wyeth, P. (2011). Orientation passport: Using gamification to engage university students. P*roceedings of the 23rd Australian Computer-Human Interaction Conference* (pp. 122–125). Canberra, Australia: ACM. doi:10.1145/2071536.2071554.

Harbluk, J. L., Burns, P. C., Lochner, M., & Trbovich, P. L. (2007). Using the lane-change test (LCT) to assess distraction: Tests of visual-manual and speech-based operation of navigation system interfaces. *Proceedings of the Fourth International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design, Stevenson, WA* (pp. 16–22).

Hsu, C.-L., & Lu, H.-P. (2004). Why do people play on-line games? An extended tam with social influences and flow experience. *Information & Management, 41*(7), 853–868. doi:10.1016/j.im.2003.08.014.

Hunicke, R., Leblanc, M., & Zubek, R. (2004). MDA: A formal approach to game design and game research. *Proceedings of the Challenges in Games AI Workshop at the 19th National Conference of Artificial Intelligence* (pp. 1–5).

Inbar, O., Tractinsky, N., Tsimhoni, O., & Seder, T. (2011). Driving the scoreboard: Motivating eco-driving through in-car gaming. *CHI 2011 Workshop Gamification: Using Game Design Elements in Non-Game Contexts*. Vancouver, BC, Canada.

Kern, D., & Schmidt, A. (2009). Design space for driver-based automotive user interfaces. *Proceedings of the 1st International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 3–10). Essen, Germany: ACM. doi:10.1145/1620509.1620511.

Kranz, M., Möller, A., Hammerla, N., Diewald, S., Plötz, T., Olivier, P., et al. (2013). The mobile fitness coach: Towards individualized skill assessment using personalized mobile devices. *Pervasive and Mobile Computing, 9*(2), 203–215. doi:10.1016/j.pmcj.2012.06.002.

Kranz, M., Murmann, L., & Michahelles, F. (2013). Research in the large: Challenges for large-scale mobile application research—A case study about NFC adoption using gamification via an app store. *International Journal of Mobile Learning and Organization, 5*(1), 45–61. doi:10.4018/jmhci.2013010103.

Li, W., Grossman, T., & Fitzmaurice, G. (2012). GamiCAD: A gamified tutorial system for first time AutoCAD users. *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology, Cambridge, MA* (pp. 103–112). doi:10.1145/2380116.2380131.

Malone, T. W. (1980). What makes things fun to learn? Heuristics for designing instructional computer games. *Proceedings of the 3rd ACM SIGSMALL Symposium and the 1st SIGPC Symposium on Small Systems* (pp. 162–169). Palo Alto, CA: ACM. doi:10.1145/800088.802839.

McCall, R., & Koenig, V. (2012). Gaming concepts and incentives to change driver behaviour. *Proceedings of the 11th Annual Mediterranean Ad Hoc Networking Workshop* (pp. 146–151). Ayia Napa, Cyprus.

McCallum, S. (2012). Gamification and serious games for personalized health. *Studies in Health Technology and Informatics, 177*, 85–96.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: The Penguin Group.

Merugu, D., Prabhakar, B. S., & Rama, N. S. (2009). An incentive mechanism for decongesting the roads: A pilot program. *Proceedings of the ACM Workshop on the Economics of Networked Systems*. ACM.

Michael, D. R., & Chen, S. (2005). *Serious games: Games that educate, train, and inform*. Boston: Thomson Course Technology.

Möller, A., Thielsch, A., Dallmeier, B., Roalter, L., Diewald, S., Hendrich, A., et al. (2011). MobiDics—improving university education with a mobile didactics toolbox. *Video Proceedings of the 9th International Conference on Pervasive Computing, San Francisco, CA*.

Muntean, C. I. (2011). Raising engagement in e-learning through gamification. *Proceedings of the 6th International Conference on Virtual Learning* (pp. 323–329). Taipei, Taiwan.

NHTSA. (2009). *Traffic safety facts—Research note DOT HS 811 216*. Washington, DC: U.S. Department of Transportation.

Novick, D. G., & Ward, K. (2006). Why don't people read the manual? *Proceedings of the 24th International Conference on Design of Communication, Myrtle Beach, SC* (pp. 11–18). doi:10.1145/1166324.1166329.

Rouzikhah, H., King, M., & Rakotonirainy, A. (2013). Examining the effects of an eco-driving message on driver distraction. *Accident Analysis and Prevention, 50*(1), 975–983. doi:10.1016/j.aap.2012.07.024.

Shi, C., Lee, H. J., Kurczak, J., & Lee, A. (2012). Routine driving infotainment app: Gamification of performance driving. *Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Portsmouth, NH* (pp. 181–183).

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior, 29*(2), 345–353. doi:10.1016/j.chb.2012.06.007.

Stockinger, T., Koelle, M., Lindemann, P., Witzani, L., & Kranz, M. (2013). SmartPiggy: A piggy bank that talks to your smartphone. *Proceedings of the 12th International Conference on Mobile and Ubiquitous Multimedia* (pp. 42:1–42:2). Luleå, Sweden: ACM. doi:10.1145/2541831.2541869.

Tillström, J. (2012). *Gamification in automotive marketing—A conceptual framework for implementation*. Helsinki, Finland: Helsinki Metropolia University of Applied Sciences.

Tractinsky, N., Inbar, O., Tsimhoni, O., & Seder, T. (2011). Slow down, you move too fast: Examining animation aesthetics to promote eco-driving. *Proceedings of the 3rd International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 193–202). Salzburg, Austria: ACM. doi:10.1145/2381416.2381447.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.

Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer, 38*(9), 25–32. doi:10.1109/MC.2005.297.

Chapter 33
Application of Game Thinking and Game Elements in New Joiner Induction and On-Boarding Process

A Business Case Study

Anantkumar Malikaveetil

33.1 Preface

Being an e-learning professional for a major part of my career, I have always been fascinated by the way we human beings learn. The learning theories, which basically put a framework around how we human beings grasp, process, and retain data form the main foundations of the e-learning industry. A lot of research has gone behind firming up these theories and even today scientists and academicians continue to explore how the human brain retains and recalls information.

According to the learning theories,[1] the way the brain of a child and an adult processes information differs. In the learning process of adults, a lot more factors come into picture, such as their past experiences, motivational factors, urgency, interpersonal relationships, etc. Worldwide, large companies pump in millions of dollars to get their staff trained by using various learning methodologies. Classroom trainings, Computer based trainings (CBTs), e-learning, workshops, and live webinars form a big chunk of the corporate training environment.

Game-based learning is a branch of learning where the participants are trained using a game based approach. It is a universal truth today that games and sports have a lot of learning inbuilt and can help shape the character and attitude of people. Some of the learnings are explicit, for example, learning to count using a board game. Some are implicit, such as realizing the importance of team work and coordination in a game of paintball.

In this chapter, I will be illustrating a game based learning case-study in a Software company environment. A large part of the IT industry's corporate training programs today are modelled around classroom or computer based training.

[1] Learning Theory (education) (http://en.wikipedia.org/wiki/Learning_theory_(education)).

A. Malikaveetil (✉)
Pune, India
e-mail: anant@abanyantree.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_33

Initially, game based training was confined to classrooms because of technology and budgetary constraints. With advancements in technology, game based learning started making inroads into learning programs through use of electronic media and e-Learning. New innovations in hand-held devices/smart phones have opened up the opportunities even further. I personally feel that in future the two forms of learning which would have a major impact in the way people learn would be storytelling and game based learning.

In the IT industry in India, outside e-learning, game based learning has largely been restricted to team building activities and programs. Coming from an e-learning background, I have always seen clients requesting us for a fun and engaging learning experience. The industry realizes that such request will go on increasing primarily because with new technology advancements the way people learn has changed. The current generation of kids are learning alphabets on a tablet which gives them an audio visual feedback based on their response. When this generation grows to become professionals their expectations from a corporate learning environment will be very different than those that are prevalent today.

Looking at the industry needs and all the research that has happened in this field got me thinking on how we can build games that can be applied in our corporate environment beyond the areas that are currently covered.

33.2 The Game

Over the last decade or so, reality game shows have slowly worked their way up the television viewership charts. Game shows, where individuals from ordinary backgrounds are put into various sports, adventure, social and business situations and their reactions, emotions, struggles, and ultimate triumphs are highlighted to keep us engaged while we eagerly await the next season of such shows.

One such famous TV reality game show is ‘The Amazing Race’, in which teams of two people, who have some form of a pre-existing personal relationship, race around the world and compete with other teams. The game logic is brilliant in its simplicity. Contestants strive to arrive first at “Pit Stops” at the end of each leg of the race to win prizes. If they come in last, there is the possibility of elimination or a significant disadvantage in the following leg. Contestants travel to and within multiple countries in a variety of transportation modes, including airplanes, hot air balloons, helicopters, trucks, bicycles, taxi-cabs, car, trains, buses, boats, and by foot. Clues provided in each leg lead the teams to the next destination or direct them to perform a task, either as a team or individually. These challenges are related in some manner to the country where they are located or its culture. Teams are progressively eliminated until only three teams are left. The team that arrives first in the final leg is awarded the grand prize.

Some of the skills required to win the game are: team work, people/resource management, gathering and using information, communication skills, problem solving, strategizing, and physical and mental strength. Above all, I believe that the

'The Amazing Race' has the right mix of game logic that would get anyone excited and interested.

Being a fan of 'The Amazing Race' and part of the world of corporate learning, it was an obvious next thought for me to want to put these two things together in action. A fitting moment arrived when I was heading a team of over 100 employees at one of my previous companies. We had some senior team members being inducted into the company and wanted to have a faster induction and on-boarding process for them. It was very important that they feel at ease with the new team, understand our company work culture, and start using our corporate systems effectively. Normally, using the traditional corporate learning approach, this process would have taken at least a few weeks or months to happen. I discussed my idea about modelling a game based approach to on-board the new comers with my core team and we quickly got ourselves busy planning and designing the approach. We wanted a game which would be fun to play and can be modelled around the things we wanted the new joiners to experience. 'The Amazing Race' was just the right game which had all the elements and the scope to wrap it around our requirements.

In the next section, I will take you through the areas we decided to model our game on and the approach we followed.

33.3 Induction and On-Boarding

So, we decided to give our Induction and On-boarding plan a new twist. We knew it would take a lot of careful planning and hard work to pull this off.

Induction is the first touch point for a new employee joining an organization. The first few days at work is a crucial period during which an employee needs to absorb a lot of information about the business, team structure, organizational culture, and get acquainted with their colleagues and seniors. It is the phase in which the company makes its first impression on a new employee.

A well planned induction program followed by a structured on-boarding process can help in making the new employee feel welcome and facilitate easy transition into a new work environment. Also, it helps in getting the new employee up to speed in a shorter time span and helps them to begin contributing to the business.

Like any other mid-sized IT company our original induction and on-boarding program was limited to traditional PowerPoint decks, hand-outs, and one-on-one meetings. My team wanted to try something different and we all felt positive and passionate about bringing a change and applying a learning approach to a critical business process. We had a couple of weeks to prepare before the new members were to join. We started with a systematic approach to building a game based Induction and On-boarding program. Since we were trying this for the first time we had to set our expectations right and at the same time capture the learning experience so that we could improvise it further.

This approach is described below and can be used as a reference in building your own game based corporate learning approach.

33.4 The Team

Our team comprised of managers from each skill area. We were a team of nine, including myself who were on the core team. Almost all of the core team members had extensive background in the eLearning domain and had keen interest in organizational development activities. We enlisted a couple of volunteers to support this activity. We also made a list of people who might have to spare some time from their normal work day to participate in the actual game on the day of the induction. The core team was divided in groups of two to take up different areas of the game development.

33.5 Approach

Traditional corporate induction training approaches rely heavily on rote learning. It is all about memorizing and recalling a bunch of facts. While this does meet the immediate objective of understanding the salient features of a company, it doesn't have any significant impact on speeding the new joiner assimilation in the system. Its non-personal, a bit boring, and does not allow the person to get a feel of his/her new workplace (Fig. 33.1).

Keeping the limitations of the traditional induction approach in mind we decided to apply a different methodology which has proven effective in a different format.

We decided on a Define, Design, Develop, Test, Deploy, and Analyze approach (Fig. 33.2).

This is based on the ADDIE[2] (Analysis, Design, Develop, Implement and Evaluate) eLearning model which is used to develop standard eLearning content.

33.6 Business Need

As a first step, we defined the business goals we wanted to achieve through this game. We identified that the primary business need was to get the new team members to be on-boarded faster so that they can become productive within a shorter period of time and add value to the business. For this to happen we felt the following points would be important for the new comers:

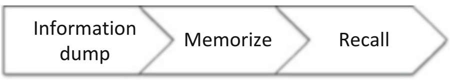


Fig. 33.1 Traditional induction approach

[2] ADDIE Model (http://en.wikipedia.org/wiki/ADDIE_Model).

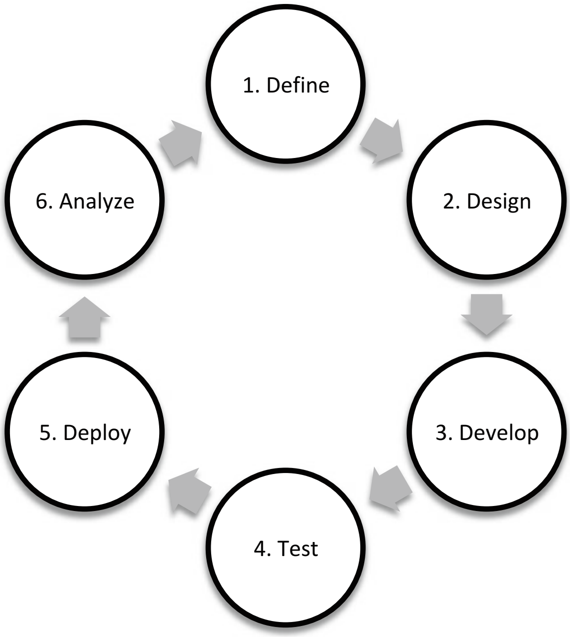


Fig. 33.2 The define, design, develop, test, deploy and analyze model

- Identify the various departments of the company
- Meet and spend quality time with the key team members
- Get to know our systems which they would need to use daily
- Familiarize themselves with the company's key products and services
- Get a quick understanding of our industry
- And last but not the least, have fun and enjoy the activity, which resonated with our work culture

We also planned to document and collect data about this activity so that we could refine the approach further for its future versions.

33.7 Design and Develop

In the design phase, we started by listing down the sequence in which we wanted the game to be staged. A list of departments, team members, systems, and existing internal online short-duration learning courses were made, which the participants will get to know, meet, or experience during this journey. As a part of the selection process it was ensured that each of the selected department, Line of Business (LoB), team member, and course selected were linked to one of the business goals identified earlier. Then based on the number of "pit stops" rough flow diagrams were developed to

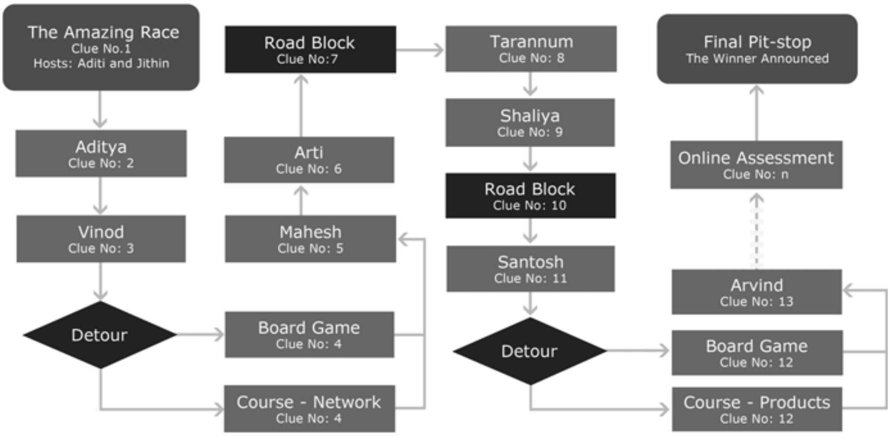


Fig. 33.3 Game flow chart

arrive at the final game flow. Once the number of pit stops were frozen, elements linked to each pit stop were listed out. Time limits were set as to how much time was to be spent at each pit stop by the participants and this helped us arrive at the total time necessary to conduct the game. Here is the graphical representation of the actual game flow chart (Fig. 33.3).

As part of the game, the participants would reach a pit stop which could be either a person, detour, or a roadblock.

To reach a pit stop, the participant would have to solve a simple cryptic clue which would lead them to the next milestone. This milestone could either be a key person, location (such as a conference room), a detour, or a roadblock. Here's a sample of a cryptic clue we used which referred to a person: "He is the top A-lister. But his surname is the most difficult tongue twister".

A 'detour' is where the participant could choose between two tasks which would have cryptic names such as 'In the Bin or On-line'. The participant will get to know the task only after they select an option. Here, 'In the Bin' refers to a fun game where participants have to complete a task of throwing plastic balls into a bin kept at a short distance. The balls need to be bounced off the floor at least once before landing in the bin. 'On-line' refers to an online course/game which the participants need to complete to get the clue to the next pit stop.

A 'road block' is a compulsory activity which all participants have to clear to get clue to the next pit stop. A 'road block' could be a fun activity or a nugget of compulsory information that an employee needs to know, such as our company data security policy.

The first person to reach the final pit stop would be the winner of the race.

Tasks were distributed to teams to arrange for, lead and manage the different aspects of the game development. For example, one team was assigned a task to select 4–5 simple fun games, which the participants will have to finish as a part of the "Pit Stops" and arrange for the items that would be needed to conduct it like balls, fun hats, rings, etc. A creative group was assigned the task of coming up with fun short cryptic clues to lead the participants to a department, person or task. The marketing team was given the task of branding the whole event to give it a professional touch. The game logic development team focused on the various paths which a participant could take, including the "mandatory paths" that contained the "must know" information that a new joiner cannot skip.

The whole game was designed keeping in mind that instead of a team of two, we would have individual participants and a time limit of 4 hours (Our normal induction program lasts from 8 to 14 hours spread out over 2 days).

Note: From our experience, I believe such a game could be implemented well in a small to mid-size company (100–500).

For larger companies this would require a bigger team with cross functional collaboration, effort and planning.

Here are some samples on how we tied the Pit stops and Detours with our business objectives.

Business objectives	Example	How it works
Identify the various departments of the company	**Cryptic Clue**: They keep our systems up and running; the motherboard, CPUs and the servers humming	The participants need to solve this simple cryptic clue to reach the IT department where one of the assigned team members would give them a brief overview of the department and the clue to the next pit stop
Get to know key team members as a part of the induction process.	**Cryptic clue**: Her workers buzz around with glee. They call her the Queen Bee	The participants need to solve this cryptic clue to reach the head of a department who would give them a brief overview of the department and the clue to the next pit stop
Get to know our internal systems which they would need to use on a daily basis	**Detour activity**: An online course giving an overview of our internal systems	On reaching a detour the participant gets a choice to select from two options. One of the detour activity is an online course which gives an overview of our internal systems. On successfully completing the course, the participant is handed the clue to the next pit stop

33.8 Pilot-Run

Since we knew that there were many elements to this game, it was very important that things worked as we had planned on paper. As a part of the preparation, we made the organizing team aware of the sequence of the game. The whole game flow was explained. Each team member had a printout of the game sequence. Employees who were to be a part of the game were made aware of their roles and the information or message that they had to deliver once a participant approached them. Others who were not directly participating in the game were explained the concept of the game so that they don't get distracted and their normal work doesn't suffer. It was important to have a pilot run of such a multi-step game process where multiple functions/teams were involved.

So, once we had the whole game plan ready and the organizing team prepared, we picked a couple of random team members to volunteer as participants and did a dry-run of the game to see if there were any refinements needed in the process. We realized we might need a game moderator who would keep a track of the speed at which participants were progressing and would take corrective actions to either slow-down or fasten up a participant. This was to ensure the competitive spirit of the game continues till the end. The moderator would also push in some impromptu characters to help in case a participant found a clue too cryptic to solve.

A successful pilot run was done after work hours to check the sequence. Unlike the main show, which has a male host, we had a male and a female host to kick-start and end the dry run event.

33.9 Game Day

On the induction day, the new joiners had the first part of the day blocked for routine paper work and joining formalities. Post lunch as per our new induction plan the new joiners were invited to a conference room where the hosts were present with a big LCD TV flashing the re-branded game logo and environment. The induction plan did not mention “a game” so this came as a pleasant surprise for the new joiners.

The hosts started by welcoming the participants to the game and explained the rules of the game. After a quick round of questions and answers, the participants were handed the first set of clues and the game started. Very soon the game picked up momentum and the participants got the hang of the game. They started solving the cryptic clues to move from one pit-stop to the next.

The penultimate leg of the race required the participant to answer a set of 10 questions related to the departments they visited, systems they used, and the people they met on their way towards the final destination. A passing score of 80 % earned them the final clue which directed them to the final pit stop, the same conference room where they started the game, the difference being this time the winner was received by a whole group of people who were earlier a part of the game. Once all the participants reached the final pit stop, the winner was announced and the hosts conducted fun and quick interview with all the participants.

33.10 Learning and Next Steps

The hosts interviewed the participants and the organizing team to get first-hand feedback about the game. Almost all the participants found the game to be fun and enjoyed the experience as it was a unique and fun-filled way to get to know the new company.

By the end of this unique induction program, the team of our new joiners was familiar with a big group of people in the company—this process would have taken weeks during the normal induction process. The game acted as a good icebreaker between the participants and our team members. Above all everyone found it to be a "fun-o-energetic" learning experience.

The game ended with a prize distribution ceremony and a quick reference guide was handed over to the participants which covered information on people and systems they had come across in the game. Later their interviews were published along with a short write up in our corporate magazine to make them feel a part of our work family.

To close the loop of the model the last step was to analyse and suggest changes for the next implementation. The next day we had a follow-up meeting with the organizing team to go through the feedback received and note down changes to be done for the next run. Feedback, thoughts, and suggestions were collected from the participants and as well as the organizing team members. Here are a few observations that we had from that meeting:

- Since this was the first time we had conceptualised and hosted the Amazing Race, the game preparation took us a good two weeks of lead time and involved multiple people to script, design, and organize the event.
- An actionable point was to document and create templates so that future runs could be managed by smaller teams and get implemented quickly.
- The game duration needed to be curtailed by an hour to keep the participants interested and not tire them physically.
- Also, the organizing team felt we could incorporate more technology elements such as use of mobile devices to make the whole experience even more engaging and showcase our company's technology oriented culture.

33.11 Participant Feedback

I found "The Amazing Race" as a real exciting game to on-board new employees. It's a fun way of learning more about the people, teams, and the company.—Aditya Joshi (Organizing Team Member)

The "The Amazing Race" was a great opportunity to bring out stuff that remains confined to our imagination most of the time. Game-based learning has always been something that interested me and this activity gave me a chance to explore various aspects in a very practical way.—Rohan Salvi (Organizing Team Member)

It was a fantastic experience. We don't mind hosting this game-based induction globally!—Jithin Thoma (One of the Hosts)

The Amazing Race, what can I say—truly amazing! A well-conceptualized and well-adapted format with an objective that was definitely met. It's a creative way for a newcomer to get acclimatized to the environment and meet new people. It's been a fun experience for me; thoroughly enjoyed it! Kudos to the entire team that organized and conceptualized it! I'd love to see how this can be adapted across time-zones and our offices.—Chetan Kalidas (Participant)

The very first day in any new office is always nerve-racking, but the Amazing Race made my first day truly a memorable one.—Ashoke Das (Participant)

Chapter 34
Gamification: The Measurement of Benefits

Keith Conley and Caitlin Donaldson

34.1 Overview

Measurement of benefits, through analytics, is an important practice as gamification endeavors to become pervasive throughout both educational and business-focused applications. Establishing methods to determine efficacy and discover points for program optimization leads to better understanding and increases the credibility of gamification as a vital tool. The practice also leads to better results as program managers and educators are able to fine-tune programs and drive on-going participation.

Establishing a basis for extracting success metrics and gaining understanding of what works does not happen by accident. Channeling early efforts to a proper use case and aligning the digital strategy and technical implementation are critical. The result is a unique set of consumable data points which has myriad applications.

Understanding the behavioral data through on-going and point-in-time analyses can lead to powerful insight. The suggested set-up and analyses included within this chapter are based on the approach taken by Bunchball and are intended to improve business and educational performance throughout their ecosystem by creating highly-active students and loyal customers, employees and partners.

34.2 Measurement Construct

The measurement plan, or framework, serves as the kick-off and root of initial deployment activities. The document details the goals and underlying gamification strategy so that technical implementation and analytics can adapt to the digital

K. Conley (✉) • C. Donaldson
Bunchball, 2200 Bridge Pkwy Suite 201, Redwood City, CA 94065, USA
e-mail: keith.conley@bunchball.com; caitlin.donaldson@bunchball.com

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5_34

environment in order to support the goals and enable optimization. This framework will provide a basis for digital strategy to ensure the key activities and data considerations are included in order to best utilize available game mechanics to meet the desired outcome. Technical implementation teams serve to elegantly architect solutions within digital environments that minimize latency, or other impacts to site performance, while including all desired interactivity to implement the digital strategy.

The documentation created at the start of the measurement and analysis process should include the following sections:

- Goal (business objective)
- Key Performance Indicators (KPIs)
- Key Actions & Challenges
- Relevant categorizations (for data parsing/segmentation)
- Benchmarks
- Data sources
- Reporting recommendation

To compile this information, business stakeholders are interviewed during the initial phase of a project. Detailing the above information at the front of the project planning period allows for considerations to be made to enable goal achievement, rather than having other considerations take precedence. The secondary goal of the document is to gather agreement for communicating business impact and discovering points of optimization once launched.

34.3 Goal Setting

At Bunchball, we encourage clients to tie deployment objectives to stated business goals. Clearly articulating the business purpose enables creativity within strategic, technical and analytical implementation, particularly when a straight line between the goals and what can be measured cannot be made. Goals, in this context, tie to meaningful business benefit, usually with an underlying return on investment (ROI) equation.

34.4 Exercise

(a) Example business Goal #1: Increase Engagement
(b) Example business Goal #2: Increase ad revenue on the web site

Which example above enables a team to move forward in a prescribed fashion? Which one can be directly tied to an ROI calculation? Example B clearly serves to focus strategic, technical, and analytical considerations. Example A is a benefit likely to be observed due to gamification and a commonly stated goal in gamification implementations. However, it is too vague to implement and is nearly impossible to demonstrate meaningful success, such as ROI. Furthermore, companies generally do not have a benchmark for current levels of engagement, making it difficult to show any change or improvement.

There are many popular constructs we advise clients to consider when setting their goals. If clients are unfamiliar with how to set meaningful goals, there are references:

SMART goals: Specific, Measurable, Attainable, Relevant, and Time-bound http://www.mindtools.com/pages/article/newHTE_87.htm#sthash.ZCwogJa9.dpuf

Most importantly, we encourage discussions about these questions to ensure we are able to drive a functional goal:

- What is the business initiative the deployment supports?
- How is the success of that business initiative measured?

A final consideration with goal-setting is that the goals should assist in the identification of KPIs. In all cases, this requires a grasp of the purpose behind the digital environment (tool, website, app, etc.) and its capabilities.

34.5 Establishing KPIs

KPIs serve as measurable components of the deployment goal and are direct reflections of goal achievement, or are listed due to a strong correlation. KPIs also are regularly defined more broadly than the business goals, establishing the path to success. We encourage clients to establish two categories of KPIs:

- Primary KPIs: direct links, or the closest correlating statistic to achieving the business goal
- Secondary KPIs: important metrics (i.e., statistics or measurements) used to support program learning or optimization

With the goals and KPIs established, the implementation teams have a strong footing for strategic design and technical implementation.

34.6 KPIs by Business Environment

Within many of the benefits listed among common Enterprise environments (Table 34.1), only a few are worded as items that can be considered goals, or even KPIs. As an example of that that works well, CRM's "Increased sales through better timing by anticipating" is a good goal because the end state is measurable and there is a clear ROI statement.

Others, such as Social Collaboration's ability to produce "More communication with customers" fall under the category of 'benefit'. The reason for this is that more

Table 34.1 Commonly expressed benefits of Enterprise tools

Social collaboration	CRM	HCM
Increase in employee connectedness and increased decision confidence	Increased sales through better timing by anticipating	Consistently achieve corporate objectives
More ideas generated and captured	Understand specific customer requirements	Retain talent
Employee Satisfaction	Cross-selling of other products by alternative suggestions	Proactively identify and fill talent gaps
Less e-mail	Identify which customers are profitable	Leverage cost of compliance and employee administration
Reduction in time to find answers	Forecast accuracy	Improve decision-making and manage capital more effectively
Increase in production, project collaboration and productivity	Sales, service and support deal more effectively with customers	Reduce risk
More communication with customers	Management improves because of quick and easy reports leading to deeper understanding	Implement value added activities
Increased customer retention	Sales and marketing win more business through better lead tracking	Turn HR into a strategic advisor
Higher brand awareness—increased search results	Business processes become more proficient	
Decrease in support call volume	Higher Renewals	
More feedback and ideas from customers	Sales bring in more revenue with better grasp on opportunities	
Increase in new customer sales	Staff productivity increase	
Expanding professional network	Purchasing improves and costs reduce due to better forecasting and scheduling	
Stay informed through access to network	Efficiency in cash flow due to better pipeline management, predicting needs	
	Sales teams developed more effectively	
	Marketing RI improved through better targeting	
	Greater understanding of customers	
	Clear team dynamics develop as info is shared across areas in company	

communication with customers is not a resulting end state that a company recognizes as directly impacting ROI. The act of more communication with customers would roll up into the goal of "Higher Customer Satisfaction" which can lead to an ROI statement by including improved customer retention and providing the opportunity to increase upsell.

Using the known benefits of systems is an excellent way to start identifying and ranking KPIs. As an example, Social Collaboration has a benefit of "More communication with customers." If this benefit is pertinent to the social collaboration application, the next step is to determine if it is in alignment with the deployment goals. If so, we can identify what supporting data we can collect and analyse, using these data as KPIs against the stated benefit.

Continuing with the "More communication with customers" example, we then look to the collected data to provide evidence for the benefit. There are multiple ways companies communicate with customers via social collaboration communities:

- Customer Chat Sessions
- FAQ views
- Questions Answered
- Answers Validated
- Question threads viewed

The individual actions are KPIs because the recording of those activities is the basis for demonstrating success against the benefit or goal (Table 34.2). Unique user counts for individuals taking the actions is a good place to start for looking at ways the tool enables more communication with customers.

We can also use similar KPIs in differing metrics. Looking at a second benefit which rolls up to "Improved retention rate of current clients" is stated as "Reduction in time to find answers." It rolls up to the same goal based upon research indicating that first contact resolution (FCR) is highly correlated to retention.

In this instance, the challenge is that the KPIs tracked for "Reduction in time to find answers" do not have a 1:1 ratio to FCR. In other words, viewing a FAQ page does not ensure the user's question was answered. In order to establish appropriate multipliers, we need external information. Many clients will use exit surveys to ascertain this type of information. When this is not available, the conversation can be guided from previous experience, which can fine-tune the approach to their environment.

In the example as listed, we recognize that a FCR response is provided when 'concluded surveys with clients indicating their issue was resolved within a single session'. However, only 10 % of FAQ views are considered as such and 15 % of Question threads viewed count against the benefit.

In total we are tracking three metrics against the stated goal of improved retention.

- Total clients encountered
- Total customer service actions taken
- Total FCR events

Table 34.2 Connecting behavioral metrics to business goals

Goal	Benefit	KPIs	Behavioral metric
Improve retention rate of current clients	More communication with customers	• Customer Chat Sessions	• Total clients encountered
		• FAQ views	• Total customer service actions taken
		• Questions Answered	
		• Answers Validated	
		• Question threads viewed	
	Reduction in time to find answers	• FCR survey responses	(FCR survey responses + 0.1*FAQ Views + 0.15*Question threads viewed)
		• FAQ views	
		• Question threads viewed	

The names for each metric can be decided between the analytics team and clients. Best practice is to ensure the metrics are defined explicitly within reporting.

34.7 Using the Right Data to Get the Metrics

When the business goal and KPIs have been defined, the next step is to determine the possibility of deriving the data necessary for tracking success within the gamification data. This is the final component of establishing the metrics. There are two components to assessing activities:

- Can the system record the behavior desired in real-time?
- Can the system "tell" the gamification engine the action occurred?

The answer to both of these questions needs to be "Yes" in order to be optimally tracked within the system.

Tracking within gamification deployments does not need to be exhaustive, but must include activities prior to end results or KPI. This is because gamification is best suited to motivate activities on the path to success, rather than simply impact the final result. Here are the key considerations to deciding if an action, or behavior, needs to be tracked.

1. Is the behavior related to a selected KPI? (i.e., either occurring pre-, or post-KPI)
2. Can the behavior be used to promote the KPI? (e.g., sharing and leveraging another's experience)

34.8 Data Considerations: Categorizations

34.8.1 Action Naming Convention

Proper naming conventions for actions, challenges, badges, notifications, and redemption are crucial to effectively tracking a program. Without clearly named actions and challenges, the onus falls on the analytics team to decipher what is meant. There are two critical aspects to a proper action nomenclature: Challenges and Reporting. If actions are improperly named or organized, achieving the maximum flexibility in your environment can quickly become challenging and analytics may seem less meaningful. Below is a quick guide into structuring this information.

The SITE_OBJECT_VERB is what we refer to as a baseline action. It is a baseline, because it describes what is happening within the experience. Beyond the baseline action, there are more data to be tracked. An easy example to think about is a "category" of content. A category could be many things: A character, a video category, a grade level, a content type (music vs. video), or even a Level. The category describes more about what is happening in the base action. The next level beyond the category is the Content Id. This is the most detailed descriptor for an action since it uniquely identifies the content. This SITE_OBJECT_VERB_CATEGORY_CID naming convention can be used to describe specific interactions with content. In the Nitro Admin Console, the baseline action should be setup: "SITE_OBJECT_VERB".

More specific interactions should be logged using metadata and contextual tags. When logging SITE_OBJECT_VERB_CATEGORY_CID in Nitro—the action does not need to exist in the Nitro Admin Console if it is logged along with the baseline action that has the same "SITE_OBJECT_VERB" prefix. In other words, log the baseline action, and the contextual action at the same time, but separated with a comma: SITE_OBJECT_VERB, SITE_OBJECT_VERB_CATEGORY_CID.

34.8.2 Segmentation

Digital strategy considerations also include what data is necessary from a user attribute and behavior standpoint that will be used to tailor individual experiences. When applicable, considerations include:

- Does a user's **role** play a part in the digital experience?
- Does **geography** play a part in the digital experience?
- Do specific **achievements** play a part in the digital experience?

Segmentation is crucial because it speaks to the personalization available within the digital medium. This component becomes available via discovery of available data through the measurement process and is therefore an important support to digital strategy.

34.8.3 Contextual Tags and Metadata

To this point, we've centered action tracking on measurable behaviors by the audience. This discussion often segues into a technical component which includes the handling of external data passed in relation to user attributes and action attributes. These external inputs, such as GEO, Business Unit Information, Title, etc., are used to segment the individual experience and carry-over into reporting. Segmentation can provide some of the more useful insights to better understand how different types of employees engage with the digital environment.

An additional feature that flows through to the Nitro Rules Engine is the concept of meta-data (i.e., extra data that describes the interaction). An example of this could be a user's current level, the name of a character they just saved, or the location of their login (web vs. mobile). In each of these cases, the additional behavior should be logged as meta-data for use in the rules engine and as a contextual tag for use in analytics.

If you would like to use the information in a challenge rule, send it as meta-data. For example, if you have SITE_OBJECT_VERB, you may have meta data such as "CATEGORY:GAMES" or "CATEGORY:ARTICLE". You can now use this metadata to set up rules on a challenge for interacting with the baseline action within a specific context, such as watching a video in the games category. In addition to this logging of meta-data, also include the meta-data as a contextual tag following the format: "SITE_OBJECT_VERB_METADATANAME_METADATAVALUE".

Examples of meta- and contextual-data include:

- Level
- Genre
- Game Genre
- Role
- GEO

The final consideration is the addition of a Locale and/or Region. For this, log the baseline action and the locale/region as a contextual tag in order to maximize the information available when providing analytics services. For example, SITE_OBJECT_VERB_REGION and SITE_OBJECT_VERB_LOCALE.

When considering actions to log in a new experience, follow the naming conventions above. This ensures consistency between deployments.

34.8.4 Verifying the Measurement Plan: Silent Tracking

One way we inform users of proper digital strategy is by tracking actions of users without reacting to them. This is often referred to as "Silent Tracking" or "baseline measurement" but it is meant to indicate the creation of a baseline without stimulus. In cases where behavioral benchmarks are unavailable, we're able to define frequency and composition of current behaviors. It can also identify what needs to be improved and determine what the proper increments are for motivating users. The tracking process also validates data structure and components.

Silent tracking is often the first time clients see behavioral data from their audience outside of rolled up web metrics. There's a big difference between statistics of 19,000 visits and 800 new leads yesterday and the behavioral-based data of individual users recording discrete actions.

Silent tracking reports detailed activity against your most sought after engagements. Behaviors such as video views, opt-ins, game plays, shares, etc. are put into context in two ways. The two measures are frequency, how often these activities occur within a select timeframe and composition, the percentage of the total audience taking a particular action. The summarized information can then be related to the business goals listed. The examples listed below are pertinent to using the benchmark data most effectively.

- Pareto Analysis: this 80/20 division gives us a good indication as to the overall engagement health of a tool or site
- Profiling: creation of behavioral models demonstrating users' behavioral characteristics while applying some level of segmentation
- Regression analysis: determining the primary contributors to behaviors linked to deployment KPIs

The information can be used within a gamification platform following a four-step process.

Step 1: Create new challenges. Using the silent tracking data and the Measurement and Learning plan (M&L; see the Appendix for an example), we have a good idea of some initial challenges we can use to increase engagement and drive toward our goals. In this case, we might use, "Tweet about our user group".

Step 2: Set the requirements. This is where the preference and group information listed within the M&L comes into play. As implemented by technical services, we select which groups, roles, or particular users are able to compete in this activity.

Step 3: Assign appropriate actions. Here, root actions can be used alone or paired to create multi-action challenges. Considerations for this component are regularly determined by the regression analysis and user composition metrics. If it is known that adding a second contact onto a sales opportunity is a key driver of closing that deal, we're going to want to encourage that action. We can also use this to encourage users to explore the environment to ensure they're getting the most value from the experience.

Step 4: Define rewards. This is crucial as you are adding the detail to which a good amount of the future optimization work can be employed. Here, the challenge can be connected with worth using a point offering, a badge that is included, and notifications that are triggered.

Initial estimates for point issuance, badge delivery, and notifications are made based upon current benchmarks and provide rich avenues for analysis and optimization later.

Finally, when live, you can see how users are interacting with the gamification elements and explain them in context. This allows us to see if the elements are working as designed as well as find root cause for what may be going on. Typically, this is the type of analysis that is required to support the on-going optimization of a program.

34.9 Analysis

Once the program has been set-up and the gamification functions of the program are deployed, planning and execution of the analyses of incoming data will begin. Throughout the analysis, the goals and KPIs outlined earlier serve as a basis for analyses moving forward. These goals and KPIs will determine what techniques and tools will be used. Analyses should include both the ability to monitor the program to ensure user activity is tracking to expectations as well as demonstrate insights into optimizations that can be made to improve the experience.

An important question to consider before and after launching a program is whether to conduct A/B testing. An A/B test compares the effect of two variants, A and B, to determine what changes occurred. The main purpose in running an A/B test is to help delineate between correlation and causation. The test involves creating two groups of users: the control group and the treatment group. We'll use a Customer Relationship Management (or CRM) system used by a sales team as an example. Here, the company decides to launch a small gamification program to the whole sales team in early March. Traffic and actions increase on the site which, at first, looks to be caused primarily, if not entirely, by gamification. After taking a closer look, the company finds that the jump in activity was correlated with the end of a quarter and could have happened with or without gamification's influence. An A/B test helps to separate out the activity increases caused specifically by the addition of gamification since both groups would have the same experience with the exception of the gamification component. This scenario highlights why A/B testing is important. It differentiates between trends that can directly be attributed to a specific treatment as opposed to normal behavior related to the time of year, content, or other factors that may skew the data.

When setting up an A/B test, make sure the control and treatment groups are truly randomized. Myriad factors can affect groups of users differently. Using our previous example of a sales team using a CRM system, dividing the users up by region or team could create a problem with correlation. For instance, if the treatment group selected is located in New York City, while the control group is located in San Francisco, an event in New York City such as a hurricane could negatively impact the New York City sales team causing the data to be skewed and show an incorrect impact from the treatment. Had the groups been selected with a mixture of New York City and San Francisco sales team members in both the control and treatment groups, the A/B test would be much more accurate.

The A/B test is best used to test different gamification mechanics. The specific gamification mechanic to be added or changed would only be accessible to the treatment group. The game mechanics that can be tested are almost limitless. These can include notifications to inform users about the next step in the program, the amount of points to award for an action, the availability of certain items in the store, the usage of a newsfeed or leaderboard, and the addition of badges. The main analysis to conduct when performing an A/B test is regression analysis to show whether the effects being seen are statistically significant as well as those that highlight the differences between the two groups. This chapter will dive into various analyses that can be run and will explain which can be used to analyze A/B test results.

When performing an A/B test, there are a few things to keep in mind.

Make sure the two variants (control and treatment) are conducted in parallel to avoid correlations mentioned earlier from skewing the results.

Determine the correct length of time needed to test the treatment. The goal is to have a length of time that is long enough to ensure a statistically significant result, but short enough to avoid alienating users if the treatment has an (unanticipated) negative outcome.

If possible, limit the A/B test exposure to new users to prevent established visitors from learning of a new site feature that could later be removed/changed.

Running multiple A/B tests is important in ensuring the best design. The first A/B test may not be successful, so plan to have more than one test.

In aggregate, gamification can be divided up into two different types of programs, the employee motivation program and the audience engagement program. Each will need to be analyzed from a similar, but different perspective. Both programs aim to achieve ongoing engagement of users. Analyses of employee motivation programs, however, should also focus on the effects the program has on key metrics of employee productivity. Key metrics can include the movement of opportunities through a sales funnel, call center stats (e.g., first call resolution or average call handling time), and quiz scores after moving through a learning management system (LMS). Audience engagement programs, on the other hand, have a secondary focus on conversion to registration and the analyses will have more of a basis in the number of new users registering for the program on a daily/weekly/monthly cadence.

It is useful to begin an analysis with an evaluation of user engagement since one of the primary objectives of gamification is to encourage users to stay engaged. A cohort analysis takes a group of users with a similar characteristic and maps out the change in that group from one time period to the next. One client used a cohort analysis to map gamification efforts introduced over time to monitor and improve retention and frequency of users. Their cohort analysis had users grouped together by the month they were introduced into the program. The analysis showed what percentage of users was active each month after their start. They were able to determine which measures were most successful by pinpointing which groups of users stayed the most engaged and at what times of the year. Cohort analyses are useful for A/B testing to provide a stark comparison of engagement between the two groups over similar time periods. Using a similar cohort analysis the user engagement for the control and treatment groups can be displayed to demonstrate whether the treatment caused engagement to increase and will show how the change affected the treatment group's engagement over time.

The next step is to dig deeper to understand more about the distribution of activity as well as the activities themselves of users within a program. A Pareto chart provides a great view of the distribution of activity across users. The graph to demonstrate the Pareto principle has the percentage of total users along the x-axis and the percentage of total actions along the y-axis to illustrate the distribution of activity across users. According to the Pareto principle, about 20 % of users should be completing 80 % of the actions on a site. To derive optimizations, focus in on the actions of the top 20 % and lower 80 % to determine what actions are being completed most by the more active users on the site compared with the least active. The program should be shaped to encourage the least active to have a similar distribution of activity as the top 20 % to keep motivation to stay engaged high across the full user base. A fortune 100 technology company used a Pareto chart to segment users among the top 20 % most active users and those in the lower 80 %. Using this information, the company was able to determine what their most engaged users were doing and how to spur more engagement from those in the lower 80 %.

A timestamp analysis should be used when the amount of time for a measure to progress from one state to the next is a valuable metric. Within the enterprise, it has particular merit when looking at the sales and marketing funnel. For instance, this analysis can show how many days it took for a lead to be converted forward one stage in a sales funnel. The audience engagement segment uses timestamp analyses to determine when the heavier bouts of user traffic occur. With a television network, the traffic might peak during the time popular shows air. Using this knowledge, audience engagement programs can use gamification to encourage user engagement to be spread out throughout the week rather than in a singular block of time. Timestamp analyses can help to determine whether measurable improvement is being seen among users in a treatment group in an A/B test. For example, results of the implementation of new challenges to a sales team in a treatment group can be determined by calculating the differences in the sales funnels for the treatment group compared with the control group.

Leveling provides a basis for which users can compare themselves against others as well as a goal for the user to strive toward. If a leveling structure is included in a program, it is important to analyze how well users are matriculating from one level to the next. Conforming to Mihaly Csikszentmihayli's theory of flow (Csikszentmihalyi, 1997), the first levels should be easier with the later levels getting progressively more difficult in order to keep users engaged. A client that used gamification as an on-boarding tool for complex software used a horizontal bar chart, or waterfall, to view the drop-off of users as they progressed through challenges and levels. The chart was important in showing whether users were having difficulty and, if so, where the difficulty was occurring. A timestamp analysis can be useful in this scenario as well to demonstrate the number of days users take to move from one level to the next. Optimizations made to a leveling structure can include A/B testing. If users are having difficulty moving from one level to the next, an A/B test can be conducted to determine whether different methods will help users to matriculate through levels either faster or slower.

Once the current user behavior has been vetted, analyses need to be conducted to determine how to affect future user behavior based on the data already available. The first way to do this would be through a cluster analysis. A cluster analysis can be used to demonstrate what motivates the user. For example, points and badges can each provide different levels of value to different types of users. By conducting a cluster analysis of points and challenges, the graph can demonstrate whether users are motivated more so by points or challenges and badges by determining where users are grouped. Using the information gleaned from the cluster analysis, the program should be structured to focus in on a user's key motivating factors. The factor that didn't motivate the users quite as heavily should be investigated to determine whether adjustments need to be made to capture the attention of all users. Any adjustments that are made should go through the A/B testing process first to ensure the best possible outcome.

Regression analyses should be used to study user behavior. A regression analysis would be setup to fit the program being evaluated. The length of time a user has been active can be the dependent variable to determine which actions best predict long term engagement. Once those actions are determined and it is understood why those actions are of importance, components that are commonly found among long-term users are then drawn into the on-boarding phase of the deployment. Another way to use a regression would be to set the dependent variable as the most desired endpoint for the user to complete. For instance, setting the dependent variable as whether the user switched from the free model to the paid model of a program. This type of analysis requires a logit model regression to determine the effect of an increase in each type of action on the likelihood of switching to a paid model.

Regression analyses are the most useful when conducting an A/B test. As mentioned earlier, this analysis shows whether the differences between the treatment and control groups are statistically significant or not. Continuing the example from earlier, let's imagine a new mechanic was deployed with a sales team. The sales of each employee could be set as the dependent variable, while a dummy variable (this variable would be equal to 1 if the employee were in the treatment group or 0 if they were in the control group) would be the primary independent variable. Make sure to include a range of independent variables that can also affect sales, which can include the team member's sales figures before the A/B test was conducted, what team they sit in, the region the team member is focused on, and any other variables that would impact the sales performance of a team member. A statistically significant result will provide insight into whether the treatment is effective. The results may also provide surprising observations of how other factors affect the dependent variable which could lead to the creation of new methods of engagement through gamification. For instance, in our example, the regression analysis may show that sales team members who have high predictions for future sales also have higher sales in the long run when holding all else equal.

A final, but critical, analytical component is to create a dashboard. There are many business intelligence (BI) tools that can be used to build out visualizations.

At Bunchball Inc, we use Tableau for our customized dashboards. This tool allows us to bring data in from a variety of sources and manipulate the views seamlessly. Within the dashboard, we use the KPIs determined earlier to dictate what metrics to focus on. Top line metrics are also important to monitor user adoption and engagement. These metrics include the total number of users and actions per user, the number of actions and challenges completed over time (usually on a weekly basis), and the percentage difference in users/actions from 1 week to the next. Analyses mentioned earlier can also be included in the dashboard to create a one point view that captures most, if not all, program metrics. Creating a dashboard for an A/B test can be particularly useful to garner any insights that can immediately be picked out by comparing the treatment and control groups side-by-side.

34.10 Conclusion

Analytics is a vital component when deploying gamification. The goals and KPIs that will drive the analytics must be determined even before beginning the gamification program to ensure that gamification elements target the key areas of the business. Digital strategy, technical services, and analytics need to be in alignment in order to design the program for optimal reporting. Agreeing to benchmarks and the primary method of communicating success helps ensure the team remains on task with optimizations and is consistent in the understanding of the program.

Once the program is underway, regularly refer back to the goals and KPIs while tracking user actions. The analyses that have been presented can answer the most important questions when tracking a gamification program.

- Are users engaged?
- What can be directly attributed to gamification?
- When are my users the most active?
- How are users progressing through the leveling structure we have designed?
- How can we continue to improve on the program?

Continual monitoring and optimization of a program is a primary component for a successful deployment and will help maintain a meaningful and engaging program.

The field of gamification is still a relatively new field. Further research is needed to expand the capabilities of analytics teams to develop best practices based on data. Particular topics that could use greater research include the ideal point constructs for leveling and what mixture of digital versus real rewards to offer users. A deeper familiarity with points and reward structures would enhance the gamification programs being offered to better ensure all users are profoundly engaged by gamification. Bunchball, Inc has been working on building out models for each of these subjects as we continue to shape our knowledge around best practices in gamification.

34.11 Appendix: Measurement and Learning Plan

Purpose: This document is used to align analytics, strategy and technical resources to ensure the goals of the program can be quantified via data analysis. The M&L is revised multiple times throughout the on-boarding process and shared with all team members. Edits should be made by both Bunchball Inc and client teams to ensure the end result reflects the needs and terminology of Bunchball Inc clientele.

Revision History:

Revision number	Revision date	Editor
V1		
V2		
V3		

(Please add rows as necessary)

Deployment Launch Date (planned):

Deployment Synopsis: (2–3 sentences describing the program including platform and audience description)

Goal (Business goals for program)

Primary KPIs (Key Performance Indicators—metrics, or statistics which inform success of the program, not the success of an individual challenge)

Deployment Activities (List the key actions and challenges which will be used inform the KPIs)

– Key Action Names (key actions your users take)
– Key Challenge Names (These may not be available early on in the on-boarding process)
– Relevant Categorizations (examples: Geo/Action Type/Language/Site)

Benchmarks (Previous results to serve a context for comparison on Primary KPIs)

Cadence (recommended frequency of reporting)

- Bunchball Inc Suggestions

  1. 3-day Live check-in
  2. 2-week check-in
  3. Monthly

Data Sources (List of systems available to assist in gathering/reporting of information. Examples below)

- Bunchball Inc Nitro
- Web Analytics Tool (Omniture Site Catalyst/Google Analytics)
- CRM System

Report Format

1. Topline views in Nitro Admin Console.

   Recommendation (filled out by Bunchball Inc)
   Secondary Analyses (to be identified by the client, examples below)

Question	Data Source	Metric
1. What type of content is the most compelling to our audience?	Nitro	Unique and repeat actions per content group and individual pieces of content
2. Do time-based challenges increase the frequency of visits?	Web tracking tool	Repeat visits by Nitro-exposed audience prior, during and post time-base challenge.

Reference

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life*. New York: Basic Books.

Index

A
Achievement systems (AS), 442–443
Action Design Research (ADR), 604
Advanced driver assistance systems (ADAS), 113
Advanced motivation scale (AMS), 256
Affordance
 artefact, 153
 communication theory, 155
 context and culture, 156–159
 digital game, 407
 dually, 154
 fundamental social theory, 153
 of gamification, 332
 HCI, 151
 motivation, 332
 non-game activities, 349
 real, 154
 service delivery, 50
 socio-cultural framework, 155
 'space' and 'place', 343
 task analysis/work flow, 155
Alternate reality games (ARGs), 8, 11, 14
The Amazing Race, 665
American Psychological Association (APA), 207, 209, 210
Analysis of variance (ANOVA), 463, 464
Application, gamification
 customizable achievement system, 448
 generic platforms and consequential performance, 449
 qualitative analysis, 448
 requirements, 448
 training of German Bundesliga club, 448
ARGs. *See* Alternate reality games (ARGs)
Artifact production, 405
AS. *See* Achievement systems (AS)
Assessment
 competency, 205
 current failures, 207–208
 data exchange, 447
 design principles, 214
 development (*see* Team-based management game)
 evidence-centered/formative, 56
 face-to-face setting, 404
 feedback, 364
 game-based solutions, 209–211
 game elements, 213
 gamification, 482–483
 hybrid methodology, 55
 learning outcomes, 225
 LeBlanc's theory, 73
 nDiVE, 318–319
 needs-based theory, 34
 parameters, 50
 performance and interactions, 403
 planning cycle, 59
 pre and post knowledge/skills, 59–60
 SGIBS, 375–380
 single-shot, 316
 social interaction, 360
 state space reconstructions, 410
 stealth, 205–206
 student performance, 48
 student procrastination, 213
 technical problems, 408
 theoretical and technical tools, 411

T. Reiners, L.C. Wood (eds.), *Gamification in Education and Business*,
DOI 10.1007/978-3-319-10208-5

Assessment (*cont.*)
theoretical framework, 72
time and space, 407
traditional brick, 65
training literature, 566
Atomistic data
cyclic dynamics, 409–410
incommensurable interpretations, 409
multicausality, 410–411
quantitative and qualitative research, 408
superposition, 411
time and event segmentation, 409
tokenization sequence, 411
Augmented reality adaption and basketball
"Action Modus,", 302
application "AR Basketball," three modes of game, 301
augmented reality application, 300, 303
"body height", 308
classic modus, 301
dependency on anthropometric attribute, 309
experimental phases, 304–305
explorative observation
execution times, 308
hit ratio per round, 308
of penalty shooting performance, 307
explorative observation of penalty shooting performance, 307
intermondial transfer, real and virtual worlds, 306
iOS mobile devices, 301
motion of parabola, 303
motion of shooting, 301
Proband classification, 306
results, 305–309
throwing motions, 302
training mode, 301–302
Authentic evaluation, 202, 204
Authenticity, virtual training environment
adult-focused learning, 317
cost vs benefit, 327
ghost images and rewind
expert performances, 320
introspective self-evaluation of performance, 320
Performance-Based Instruction, 320
integration of gamification mechanics
gamification tools, implications, 320
self-directed learning, 320
nDiVE, authentic assessment
'artificially intelligent' bots, 319
complex assessment practices, 319
incorporating gamification, 319
nDiVE, definition, 318
realism through technology, 318
save points and multiple lives, 321
sense of immersion, 318
structured learning environment, 317–318
time and space controls
distortion over relationships, 321
Supply Chain Game by Responsive.net, 321
"The Fresh Connection" simulation, 321
Automotive domain
marketing and brand forming, 640–641
Smileage application, 641
in vehicles
CleverMiles, 643
eco-driving applications, 643
navigation and driving, 642
safe driving, 642
Automotive user interfaces and vehicle functions
accomplishment rates, operating tasks, 653
contribution, 638–639
driving experiment, 653
'exploration mode', 648
game design elements, 638
gamification (*see* Gamification)
in-car mode, 648
interactive tutorial, car buyers, 648, 650
in-vehicle mode, 648, 650
mobile application, 655
motivation, 637
NASA-TLX scores, 654
offiine mode, 648, 649
offine mode prototype, 651–652
online mode, 647
purpose of framework, 647
rental car and car sharing users, 650
'tutorial and quiz mode', 647
Avatars
AUT students, 336
characteristics, 337
3D, 336
Drunken Avatar Encounter, 336–337
misbehaving, 337
personal configuration, 335

B
Badges. *See also*
gamification systems, 22
GBA, 214
goal setting, 176
learning outcomes, 169
loss aversion, 121
reward systems, 277

Behavioral economics (BE)
categorization, 89
demographic and economic population segments, 104
design errors, 102
encouraging engagement, 89–93
game designer's perspective, 81–82
gamification, 83–87
guiding action, 93–96
identity investment, 97–101
implementation errors, 101–102
irrational, 88
relevance, 88
traditional economic theory, 87
universal applicability, 102–103
Behaviorism
art of game design, 139
checkpoint, 137
computational thinking, 229
curriculum designers, 138
daily lives, 230
easter eggs, 138
e-learning and communication, 231
extinction, 137
fixed interval schedule of reinforcement, 137, 138
freedom of choice, 230
game designers, 135
human experience, 139
imagination, 230
learning theory, 223
master of the game, 231
multimedia environments, 230
POLA, 137
psychology, 143
research and discovery, 231
stimulus—response, 223
student's emotion, 230
team cooperation, 231
token economies, 135–136
Behavior-mapping model
description, 344
'individual place', 344–345
location specific policy, 346–348
mediating roles, 348
orientation policy, 346
sphere of space, 345–346
technical support, compensating policy dimension, 348
BE, mobile application design
case study
anchor, 121–122
core functionality, 120
loss aversion, 121
self control, 120–121
cognitive biases, 105
framing effects, 118–119
gamification, 110–112
HCI, 106–107
human behavior, 107
IKEA-effect, 118
irrational behavior and biases, 108
loss aversion, 117–118
mental accounting, 115–117
moneysaver prototype, 122–128
persuasive computing, 108–110
psychological computing, 112–115
Betamax case, 544–547
Big data methods
aspects of, 406
complexity science, 406
definition, 414
diverse, 405–406
e-learning, 404–405
IBM, 404
time-sensitivity, 406
voluminous, 405
Black Snow Interactive (BSI) *vs.* Mythic Entertainment, 545
Bragg *vs.* Linden Lab, 539–541
Business intelligence (BI) tools, 685–687
Business objectives
definition, 618
economic sustainability, 619–620
environmental sustainability, 618
gamifying ride sharing, 617
player analysis, 616
social sustainability, 619
Business scenarios
assessment, training literature, 566
employee motivations, 565
gamified interventions, 553, 554
motivational theory, 566
M2 Research, 553
onboarding, 558–560
organizational goals, 565
performance, 562–565
psychological research, 554
recruitment, 554–558
training, 560–562
unanticipated consequences, 553–554

C
Caillois' theory, 69–70, 72, 73
Career and Technical Education, 203
Case studies
business community, 277
cheating, exams, 286–287
fair grouping issue, 284–285

Case studies (*cont.*)
fair/healthy game, 288
Faraday's Law, 270, 271
framework and simulation, 272
game dynamics, 278
gamification process model, 271
learning activities, 278
mechanisms and environment, 278
peer tutoring, 279–282
player interaction behavior, 271, 272
potential problems, 562
programming tasks, 282–284
reflection problem, 284, 288
reward systems, 277
ride sharing (*see* Ride sharing)
self-reporting mechanism, 288
simulated market, 285–286
TEALsim, 270
Chronicle of Higher Education, 203, 204, 206
CLA. *See* Collegiate Learning Assessment (CLA)
Classification
developers and architects, 449
gamification solutions, 432
interdependencies or taxonomic, 453
CLT. *See* Cognitive load theory (CLT)
Cognitive evaluation theory (CET), 178
Cognitive load theory (CLT), 53–55
Cognitive science
behaviorism, 139
cocktail party effect, 143
constructivism, 223
flow zone, 139–140
mere ownership, 143
personality types, 140–142
third-person shooter, 142
visual language, 142
Collaborative virtual environment (CVE) setting
behavior-mapping model (*see* Behavior-mapping model)
'space' and 'place' notions, 331
team players creation, 342–343
Collaborative virtual space, structure, 333
Collegiate Learning Assessment (CLA), 204
Collusion detection. *See* Case studies
Color theory, 74–75
Competency assessments, 205
Competitive and cooperative behavior in teamwork
direct effects, 529–530
factory workers, 513
framework
analysis, 523
application, 527
dependent cooperation, 523, 524
game goals, 525
interaction design, 525–526
teamwork situations, 523, 524
user characteristics and experience, 526–527
gamification, 514–515
ideal teamwork situation, 513, 514
leadership game RANJ, 528
multiplayer Breakout game, 531
non-game contexts, 530–531
non-game teamwork (*see* Non-game teamwork)
persuasive game design model
gameful experiences, 520
game world experience, 520–521
gamification, 519–520
practice, 513, 514
project proposal and team formation, 553
Red Team game, 515, 528–529
research, 515
rules and goals, 521–523
structure, 514
transfer effects, 530
Completion rates
costs *vs.* outcomes, 202
engagement, 575
workplace skills, 203
Computational thinking
analytical and synthetic ability, 240
communication and work, 248
conditional statements, 237, 238, 241
data organization, 238
digital technology, 219
discovery and experiential learning, 219
dispositions, 237
early ages of man, 224
food chain, 242, 244
framework (*see* Framework, computations)
intrinsic motivation, 249
optimal algorithmic solutions, 224
organization and designing, 220
project ownership and team participation, 245
resultant core competency, 220
scratch projects, 240
self-assessment, 241–242, 246
testing and debugging procedures, 244
time and resources, 243
Conditional statements, 237–241
Conduct and penalties system, 347–348
Constructivist learning theory
educational process, 228
gamification elements, 249
learning outcomes, 229

learning process, 249
scaffolding, 247
students activation, 239, 246
Consumer and enterprise markets, differences
conflict of interest, 499
creative freedom, 498
design of gamified environment, 497–498
factors of motivation, 498
impact of failure, 498
purpose of gamification, 497
reasons for engagement, 497
Consumer protection
gamification providers, 551
terms of use, 539, 551
unfair competition
antitrust law, 547
copyright law, 547
German court rule, 548
individual consumers, 548
Picknplay, 548–549
slavish imitation in patent law, 548
trademark law, 547
the US, 536
Contract law
B2B contracts, 538
Bragg *vs.* Linden Lab, 539–541
Peter Ludlow *vs.* Electronic Arts, 541–542
Copyright law
Betamax Case, 544–547
Digital Millennium Copyright Act, 544
European Union Copyright Directive, 544
intellectual property rights, 543
Non-Disclosure Agreement (NDA), 543
the U.S. court, 543
Corporate, entrepreneurship and innovation, 390
Creativity
Belbin personality type test, 359
business purpose, 674
education, 144
financial investment, 212
gamification, 482
intellectual property laws, 543
intrinsic motivation, 178
open-ended tasks, 408
red teams, 515
reward-based gamification, 18
skills-based stealth assessments, 206
Critical thinking
GBA, 209
stakeholders, 209
stealth assessments, 206
CRM. *See* Customer relationship management (CRM)
Crowdsourcing, 483, 484
Crush the Castle and Angry Birds, HCI, 159–161
Culture
academic, 213
Angry Birds, 159
arbitrary, 159
communication, 156
confusions and misbehavior, 350
context, 152
CSCW, 157
disciplinary-orientation, 61
etiquette of cyberspace, 333
exclusive characteristics, 158
game interaction, 158, 159
Gibson's theory, 155
language, 157
Norman's theory, 158
performance-avoidance, 500
reward-based test, 3
and social norms, 346
socio-cultural framework, 157
synonymously, 156
Customer relationship management (CRM), 431, 446, 493, 675, 682, 687

D

Decision input mechanism
consultancy report, 368
control sheet, 366, 368
opportunity cards, 367, 369
Decision tracking features
cash flow, by team, 372, 373
post-game decision-tracking, 373, 374
Define, design, develop, test, deploy, and analyze approach, 666, 667
Design
affordance, 151
autonomy, 180
badge systems, 23
Caillois' framework, 76
characteristics, 265–266
computer games, 525
conjoint experiment, 574
consumer markets, 490
counterbalance, 123
creativity and financial investment, 212
cyclic principle, 264
domain and business experts, 434
educational gamified simulations, 266–270
educational simulations, 262
extrinsic motivation elements, 234
factors, 173

Design (*cont.*)
financial planning apps, 108
framing effects, 118–119
game-based learning, 358
game construction, 381
game mechanics components, 52
gamification applications, 166–168, 598
goals and task, 516–517
HCI, 157
IKEA-effect, 118
implementation, 598–599
interactive spaces, 323
internet-based brain, 14
justification, 52
leadership, 526
learning environments, 227
learning theory, 166
LoB, 667
logic development team, 669
loss aversion, 117–118
mental accounting, 115–117
meta-formalization, 84
methodology, 59
optimization and split-test, 102
orientation phases, 111
page-views, 102
principles, 214
project knowledge management system, 603–610
psychology, 448
RANJ, 528
red team, 528–529
road block, 668
serious games, 355
SGIBS, 361
specification workflow, 435
teamlink, 341
traditional classroom, 257
work, 498
Design process
educational simulation, 267, 268
pedagogical goal, 267
Design, project knowledge management
ADR approach, 604
feedback mechanism, 608–609
in-house developments, 603
leaderboard and rating mechanism, 607–608
mockup design, 606, 607
“project sonar,”, 606
and requirements, 604–606
social components, 609–610
‘Detour,’, 668
4-D Framework, 378–379
DiBella business, PIERSiM environment, 391, 392
2D icebreaker application, 339. *See also* 3D icebreaker game application
3D icebreaker game application
activity based icebreaking, 3D CVE, 340, 341
critical incident, 335
data sources, 336
Drunken Avatar Encounter, The, 336–337
mapping of elements, 338, 339
perceptions and reality, 337
self-representation, 340
‘space’ and ‘place’, 340–341
Digital badges
achievements, 190
corporate business organizations, 197
educational opportunities, 187
engagement, 192
Foursquare community, 191
frameworks, 193–195
implementations, 188
K-12 schooling, 196
learning experiences, 187
lifelong learning endeavours, 198
metadata, 190, 192
Middle Ages, 189
models, 195–196
Mozilla initiative, 191
Open2Study badges, 188
postsecondary environments, 196
robotics competencies, 190
scout badges, 189, 190
soft skills development, 192
Tumblr badge, 188, 189
Digital game-based learning, 596, 597
achievement systems, 442
diverse, 405
gamified e-learning experiences, 403
Digital learning/engagement, 192
Digital Millennium Copyright Act (DMCA), 544
Digital portfolio elements, 194
Digital revolution, 135
DMCA. *See* Digital Millennium Copyright Act (DMCA)
The Drunken Avatar Encounter
configuration, 336
misbehaving, “Drunken Polar Bear,” , 336, 337
Dynamics of complex performances, 415

E
ECD. *See* Evidence-centred design (ECD)
Eco-driving applications, 643
Education. *See* Gamification
EL. *See* Experiential Learning (EL)
E-learning analytics. *See* Game-based e-learning analytics
Electronic Arts *vs.* Peter Ludlow, 541–542
Electronic learning community, 241, 242
ELT. *See* Experiential Learning Theory (ELT)
Emotional transfer, 295
Employees
  applicants with employee referrals, 558
  car sharing, 618
  Director of Human Resources at organization, 557
  game fiction, 559
  interview data, 604
  job duties, 557
  leaderboard, 565
  learning assessments, 560
  motivation, 566
  organizational justice theory, 561
  performance appraisal process, 563
  social sustainability, 619
  training and performance management, 554
Encouraging engagement, behavioral economics
  intrinsic focus, 90–92
  loss aversion, 89–90
  pseudocertainty effect, 92–93
Engagement
  behaviorism, 10
  constructivism and interaction, 253
  driver, 70, 71
  EteRNA, 264
  game elements, 254
  gamification, 388
  knowledge management, 602
  loss aversion, 89
  model for engagement, 502
  motivation, 162, 255
  organizational commitment, 453
  phases, 503
  player type Steve Status, 625
  social, 13
  and user experience, 603
  users, non-game activities and supporting organizations, 349
Enterprise, gamification in
  areas of application, markets
    information, 493
    multiple domains, 493
  categories for players, 491
  and consumer-focused gamification, difference, 493–494
  within educational context, 390
  ERP, 461
  framework
    challenges in attaining objectives, 505
    designing gamified system, 506
    factors for motivation, 505–506
    goals and objectives, 503
    Heuristic Evaluation for Playability (HEP), 507
    mesurement, 507
    multiple parameters, 503
    need for, 502–503
  game mechanics, definition, 492
  gamification, 452
  goals, consumer markets, 490
  information systems, 431
  levels of gamification
    embedded, 492
    integrated, 492
    superficial, 492
  motivation, models, 491–492
  notion of games, characteristics, 491
  user engagement, 489
  user experience (UX), 489
"Epic win," 133, 135
EteRNA, 264
Ethic-moral transfer, 295
European Union Copyright Directive (EUCD), 544
Evidence-centred design (ECD), 56, 57
EVT. *See* Expectancy value theory (EVT)
Expectancy
  design component, 173
  engagement, 174
  instrumentality, 172
  learning environment, 174
  motivation, 172, 173
  performance-outcome relationship, 172
  reward systems, 174
  valence, 172
  value model, 173
Expectancy value theory (EVT)
  extrinsic motivation, 24
  games, 31
  goal-directed behavior, 30
  Skinner's reinforcement theory, 31
  task-specific beliefs, 31
Experiential Learning (EL), 356
Experiential learning program (case study), 509
Experiential Learning Theory (ELT), 52–53
Extrinsic motivation (EM), 256

F
Fantasy-related transfer, 296
FAQs. *See* Frequently Asked Questions (FAQs)
FCR. *See* First contact resolution (FCR)
Fear of failing
game failures, 213
risk-averse decision-making, 213
student procrastination, 213
Feedback, SGIBS game, 364
Fiero, 214
Flow zone, 139–141, 144, 209
Framework
advantages, 74
automotive training, 648–650
Caillois', 72
credential and evidence-based documentation, 194
ecosystem, 49
education, 48
enterprise (*see* Enterprise, gamification in)
evidence-based documentation, 194
expectancy theory, 172
experiential learning, 205
feedbacks and accomplishments, 194, 269
game theory, 72
gamification, 17, 55, 194, 236
learning process, 193, 220
mapping and learning, 162
MDA, 260
methodology, 62–64
modern programming and multimedia environments, 230
Mozilla's open badges program, 195
player-centered design, 616–617
pleasure of employees, 599
purpose, 647
role-playing games, 74
sales force practitioners, 51
self-determination theory, 5
socio-cultural, 155
stakeholders, 57
student behaviors, 194
teamwork situations, 523–527
trainee performance, 52
Framework, computations
capacities development, 234
cognitive—emotional context, 235
constructivist learning theory, 228–229
dispositions and behaviors, 235
gamification, 229–234
physical activity, 228
rewarding system, 227
student-centered gamification, 227
teachers development, 236
Framing effects, 118–119, 127
Frequently Asked Questions (FAQs), 14, 551, 677
Fritz's postulated transferability model, 294–295
First contact resolution (FCR), 677
Frustration, 213
Fun framework
altered state, 74
challenge, fellowship and discovery, 73
expression and submission, 73
hard and easy fun, 74
people factor, 74
sensation, fantasy and narrative, 73

G
Game-based assessment (GBA)
authentic evaluation, 201, 204
competency assessments, 205
completion rates, 202
computer games, 202
failures of assessments (*see* GBA, failures)
learning outcomes, 201
mysteries, 202
psychometrics, 201
social comparisons, 211–212
stealth assessment, 205–206
Game-based e-learning analytics
analytic methods, 404
atomistic data (*see* Atomistic data)
big data (*see* Big data methods)
classroom-based gamified systems, 404
complex and interactive performance, 404
data challenges, 415
Educational Data Mining (EDM), 403–404
and gamified, 407–408
holistic data (*see* Holistic data)
information modalities and types, 414
model-based scientific approaches, 403
qualitative and quantitative approaches, 403
voluminous and diverse data, 403
Game design
computational thinking applications, 220
copycat attack, 547
current state-of-market, 490
digital games, 13
ECD, 56
educational, 264
empirical research, 37
exposition, 7

external motivation, 4
game-based technology, 50
gamification strategies, 259–261
gamified simulation, 262
guess-work/intuition, 84
icebreaking modes, 338
implicit/explicit, 386
in-depth, 5
individual place, 349
input-calculation-output, 366
learning environments, 227
models and frameworks, 378–380
motivational theory, 49
Nicholson's effort, 349
non-game contexts, 451
pedagogical and instructional design heuristics, 254
performance assessment, 205
principles, 134
prosocial emotions, 457
psychological models, 432
real-world changes, 7
rules and goals, 521–523
SGIBS, 361–364
simple functional interaction, 152
target markets, 135
Game design, gamification
alternative frameworks, 72
Caillois' theory, 69–70, 72
color theory, 74–75
custom engagement, 70
direct and indirect, 69
field applications, 72
fun framework, 73–74
game attitude, 75
mixed-up experiences, 71
self-assessment test, 76–78
serious and training game, 68–69
web-based strategy, 68
Game development process
decision input mechanism, 366–369
decision tracking features (*see* Decision tracking features)
game structure for one period, 366, 367
sample graphs, period 6, 369–372
Game mechanics
adequate motivators, 611
digital communities, 596–597
isolation and application, 459
use, 484
visual (aggregated), 439
visual (basic), 438
Game theory, 68, 72, 134, 152, 278, 288, 518
Game thinking and elements
business goals, 666, 667
define, design, develop, test, deploy, and analyze approach, 666, 667
in design phase, 667
'detour,', 668, 669
flow chart, 667–668
game-based learning, 663
game day, 670
game flow, 669–670
induction and on-boarding plan, 665
IT industry, India, 664
learning experience, 670–671
participant feedback, 671
'road block', 668
skills requirement, 664–665
team, 666
'The Amazing Race', 665, 671
traditional induction training approaches, 666
TV reality game, 664
Gamification
airlines and hotels, 2
applications in company, 597
articles research, 595–596
in automotive domain, 640–643, 657–658
badges, 18
behavior change, 615
behaviorism, 223, 229–230, 233
benefits and critics, 598
business
experts, 433
modeling, 433–434
objectives, 618–620
car sharing, 618
case study (*see* Case studies)
casinos and recreational game, 1
choice, 9–10
cognitivism, 223
constructivism, 223
definition, 332, 596
delineate target behaviors, 620–621
deploy appropriate tools, 627–628
deployment, 436
design, 434–435
designers, 17
designer's perspective, definition, 519
mechanics and features, 386
orientation, 222, 225
devise activity cycles, 624–625
digital badges, 187–198
digital communities, 596–597
dimensions, 349–351

Gamification (*cont.*)
domain experts, 432
on driving performance (RQ2), 655–656
of education, 387–389
educational settings, 597
effects and influencing factors, 599–601
elements and mechanics, 332, 639–640
end user, 432
engagement, 12–14
environmentally-friendly lifestyle, 615
exploitationware, 221
exposition, 7–9
FarmVille/Bejeweled, 611
feedbacks, 232–234, 632
frameworks, 5, 616–617, 635
freedom of choice, 243
fun, 625–626
game design, 5
gamefulness, 519, 520
game-related concepts, 596, 597
games
characteristics, 386
formalization, 83–84
optimization, 84–85
transparency, 85
unfiltered behavior, 85–86
IKEA-effect, 118
imagination, 241
implementation, 436, 598–599
information, 10–12
intrinsic motivation, 4, 233, 243
IT experts, 433
journeys cross, players, 633
law (*see* Law)
layfulness, 519, 520
learning activities, 229
limitations and challenges, 646
loss aversion, 117–118
metacognitive skills, 232
Mezirow's model, 4
mobile applications, 110–112
monitoring, 436–437
motivation tools, 221, 222
non-game environments, 86–87
organismic integration theory, 4
player-based outcomes, 18
players (*see* Players, ride sharing)
pointsification, 221, 615, 628–630
practices, 616
project knowledge management
creation, storage and retrieval, 602
design (*see* Design, project knowledge management)
information systems (IS), 602
knowledge exchange, 601
motivators, knowledge sharing, 602
SQA sites, 601
user-centered design approach, 603
web-based service, 601
prototyping-testing-evaluation-cycles, 633
psychological theory (*see* Psychological theory)
on recommendations (RQ3), 656
reflection, 15–17
reward program, 221, 222
ride sharing, 617–618, 630
robust system, 17–18
self-determination theory, 222, 630–631
social interaction, 238
software development process, 432
team cooperation, 243, 524, 630
test, 436
on training motivation (RQ1), 655
TwoGo ride sharing solution, 631
user-centered process, 634
and virtual worlds, 389
visual representation, 232
Gamification measurement
artifactual and social elements, 50
author's perspective, 49
CLT, 53–55
digital media industry, 49
game-based learning and serious games, 48
game eco-system, 50
games, 47
GPAR, 61–62
Kirkpatrick four-level framework, 51–52
Kolbs' Experiential Theory, 52–53
learning, 50–51
maturation and expansion, 49
methodology, 62–64
play assessment diagnostics
Bayesian approach, 57
ECD, 56
evidence-centered/formative, 56
incentivization, 57
skills and knowledge, 56–57
social development, 55
stealth, 56
pre and post knowledge/skills assessment, 59–60
rule-based service systems, 50
scorecard, 57–59
search hits, 47, 48
tour de force, 48
traditional pedagogical practices, 48
Gamification mechanisms, 326. *See also* NDiVE, developments

Gamification performance assessment review (GPAR)
- contextualization, 61
- data analysis, 62
- evaluation framework, 61
- operationalization, 61–62
- robust measurement process, 64
- scale ratings, 62, 63

Gamification strategies
- feedback elements, 269
- interactivities, 269
- mechanics and elements, 268

Gamified designs
- aesthetics, 259
- classroom instruction, 258
- frameworks, 260
- game mechanics, 260–261, 266
- IM, 258
- instructional design, 166
- interactivity and feedback, 266, 267
- mediational process, 167
- meta-cognition, 167
- operational model, 265
- participants, 267
- pedagogical experts, 265
- Q2L, 258
- STEM fields, 258
- structural elements, 259
- target behavior/attitude, 167
- taxonomy, 167

Gamified learning and exploration
- computer games, 644
- environments, 644
- GamiCAD, 645
- mobile fitness coache, 645–646
- NFC, 645
- in tutorials, 644

Gamified science simulations
- class educational systems, 256–257
- conceptual knowledge, 264
- design and implementation costs, 261, 262
- electromagnetism, 254
- learning environments, 257
- mechanics, games, 262, 263
- misconceptions, 255
- motivation (*see* Motivation)
- PhET simulations, 255, 263
- student engagement, 255
- supercharged, 263
- video games, 257

Gamified teamwork situation, 521

Gaming
- applications, 483
- “conventional” methods, 420
- education, 420
- environment and components, 421–422
- explosion, 474
- fads and educational reforms, 421
- field controller, 474
- gamification, 484
- gaming engine tracks, 475
- HR departments, 480
- intelligent tutoring games/programs, 421
- mechanics, 484
- meta-analysis, 420
- non-gaming contexts, 451–452
- “passive instruction,”, 420–421
- psychological terminology, 422
- Quest to Learn, 421
- random assignment, 421
- students with digital environment, 418
- video games, 420

GBA, failures
- APA, 210
- authentic assessment, 207, 208
- critical thinking, 209
- game-testing, 210
- program development, 208
- psychometric principles, 209
- rubrics development, 210
- summative assessment, 208
- target audience, 207
- traditional measures, 206
- wheel reinvention, 207

Generic gamification platforms (GGPs)
- analyze, 445
- Bunchball ’s platform, 446
- classes, 447
- integratability, 445
- integrated platforms, 444
- non-invasive, 444–445
- performance, 445
- structured query language, 445

Goal setting theory
- attention and effort, 174
- badges, 176
- commitments, 175
- and entertainment, 358
- explicit signs, 176
- feedback, 175
- gamified environment, 176, 177
- goal-performance relationship, 175
- human motivation, 566
- learning environment, 177
- levels/leveling up, 176
- psychology, 109
- self-regulation, 175, 177
- SGIBS game design, 381

Goal setting theory (*cont.*)
situational constraint, 175
task, 27, 175
time pressure, 177
web-based training literature, 177
GPAR. *See* Gamification performance assessment review (GPAR)
Group decision support system (GDSS), 355
GSummit, 474
Guiding action, behavioral economics
people choice, 93–94
scarcity/urgency, 94–95
variable reinforcement schedule, 96

H

Hard fun, 74, 135, 626
HCI. *See* Human computer interaction (HCI)
Holistic data
"analyze-model-simulate-generate,", 412
'atomistic' data, 411
empirical probabilities, 412–413
gamified digital e-learning experience, 413
gender differences, 413
leverage database visualization, 412
model-driven data science methods, 412
network model, 413
post hoc discovery, 414
quasi-homomorphisms, 413–414
subsumption architectures, 413–414
trajectory carries, 413
Human computer interaction (HCI)
affordance, 153–159
BE, 106
communication and culture, 152
confirmation bias, 107
Crush the Castle and Angry Birds, 159–161
cultural boundaries and technological platforms, 156
design practices, 49
functional and non-functional requirements, 153
game design, 152
google play store, 107
introvert and extrovert gamers, 151
IS, 156
mobile scenario, 107
opt-out, 106
persuasion methods, 108
progress bars, 106
psychological and persuasive computing movement, 112
The Social Construction of Reality, 152
software development, 162
software engineering, 153
text labels and symbolism, 155
Hypermarket game, 360

I

IBM® Enterprise Social Network Service (SNS), 350
Ideal teamwork situation, 513, 514
IKEA-effect
ownership, 101
personal labor, 98
virtual currency, 108
Implementation
achievement systems (AS), 446
custom development projects, 446
customizable achievement system, 448
gamification, 436, 448, 598–599
integrability, 441
practitioners and researchers, 448
Incentives
arbitration, 288
badges, 191
environment and experiments, 319
EVT, 30
intrinsic/extrinsic, 30
knowledge, 54
learners, 287
learning experience, 258
organizational workforce, 481
personal investment theory, 28
programs, 3
rewards, 33–36
short-term and long term performance, 37
Individual place
behavior mapping model, 344
output of collaboration, 344–345
policies and supportive game designs, 345
"team place" and, 349
Induction and on-boarding plan, 665
Informal learning, 190, 194, 198
Informational transfer, 296
Information and communication technologies (ICT), 223, 348, 359
Information systems (IS)
communicates with gamification solution, 442
flexibility, 441
functional and non-functional requirements, 432
game design elements, 431
GGP, 444
invasivity, 441

IT experts, 436
risk, 431
Instrumental action orientated transfer, 295
Integrated gamification solution (IG), 443–444
Integrated solutions, 447
Interactive media, 545
Interactive multimedia, 226
Intramondial transfer, 298
Intrinsic focus, 90–92
Intrinsic motivation (IM), 4, 24, 144, 178, 233, 243, 249, 255, 326
Irrationality, 106–107
IS. *See* Information systems (IS)

J
JCT. *See* Job characteristics theory (JCT)
JD-R model. *See* Job demand-resource (JD-R) model
Job Characteristics Model (JCM), 498
Job characteristics theory (JCT), 453
Job demand-resource (JD-R) model
health impairment process, 455
job resources and demands, 453–456
motivational process, 455
prior validated theories, 453
PsyCap model, 460
social support, 455

K
The Keller Four Step ARCS Model, 379
Key performance indicators (KPIs)
behavioral metrics, 677–678
and business goal, 678
enterprise environments, 675–676
and FCR, 677
primary and secondary, 675
social collaboration communities, 676
Kirkpatrick four-level framework, 51–52
Knowledge reuse, 595, 603, 607
issues, 603
projects, 594

L
Lane Change Task (LCT), 651–652, 657
Lane Change Test (LCT), 113
Law
contracts (*see* Contract law)
copyright law (*see* Copyright law)
development process, 550
liability and measurability, 542–543
regulations, cases and practices, 538
unfair competition and consumer protection, 547–549, 551
unlawful acquisition, 550
LCT. *see Lane Change Task* (LCT); Lane Change Test (LCT)
Learning
activities
correlations, 237
daily life, 226
designing systems, 225
evaluation, 225
game dynamics, 278
game mechanisms, 225–226
ghost images, 320
harmonization, 224
pre/post assessment process, 60
robotic device, 227
student-centered framework, 225
transformative learning, 224
case study, 509–510
classical conditioning, 168
consequences, 169
engagement, 171
environment
administrators, 171
familiarisation, 316
virtual, 316
feedback support, 455
games, 484
gamification techniques, 476
HR departments, 480–481
IM, 171
operant conditioning, 168, 169
reinforcement, 169, 170
rewards schedules, 170
target responses, 169
test-taken, 168
Learning theory. *See also* Experiential learning theory (ELT)
Bloom's taxonomy classification, 358
four-dimensional framework (4-DF) development, 358–359
phases, 357
SGIBS game, 359–360
Liability
and measurability, gamification, 542–543
transfer effects, 529
Liberal Education and America’s Promise (LEAP) program, 203
Location specific policy, 346–348
Loss aversion
behavior, 128
common implementation errors, 90
endowment effect, 107

Loss aversion (*cont.*)
gamification factor, 117–118
in-game use, 90
non-game use, 90
player, 89
standard gamification badge system, 121

M
Management
assessment (*see* Team-based management game)
conflict, 517
Massive Open Online Courses (MOOCs), 197
Mastery, 457
MaxQDA, 607
Measurement and learning plan, 687–688
Measurement of benefits
A/B test, 683
action naming convention, 679
ad revenue on web site, 675
and analysis process, 674
business intelligence (BI) tools, 685–687
contextual tags and metadata, 680
and CRM, 682
description, 673
gamification functions, 682
goal setting, 674
KPIs (*see* Key performance indicators (KPIs))
regression analyses, 685
segmentation, 679
“silent tracking”/”baseline measurement,”, 680– 681
SMART goals, 675
technical implementation and analytics, 673–674
timestamp analysis, 684
Mental accounting
categorization, 115
decision making, 115
house money, 116
payment decoupling, 117
piggy bank, 126
psychological effects, 116
self-assessment, 124
self control, 120–121
spending behavior, 114
sunk costs, 116
Mere ownership effect, 143
Methodology
additional motivating factors, 578
average driving experience, 652
behavioral test, 76
class design, 422
conjoint analysis, 574–576
current systems, 480
design effective intervention, 59
driving task, 651–652
education and business, 48
engagement measurement, 574–575
evolutionary nature, 64
experiential approach driven, 390
experimental design, 576–577
game-like ways, 210
game setting, engagement, 577
gamification implementation, 47
gamification measurement framework, 62
hybrid, 55
integrators, 64
learning, 282
motivation theory, 171
participants, 124
pre/post assessment, 60
psychological models and methods, 432
scorecard, 64
self-reported data, 569
social science, 426
support implementation, 63
tasks, 123–124
Model
airline pilots, 476
behavior-mapping
gamification dimension, 349–351
individual place, 344–345
policy dimension, 346–348
sphere of place, 345
sphere of space, 345
business, 431, 433–434, 482
computational thinking, 224
digital badge, 195
educational gamification systems, 15
ERP system, 463, 466
expectancy-value, 172
experiential learning, 357–360
explanatory, 296–298
frameworks, 378–380
Fritz’s, 308
game theory, 134
gamification techniques, 271, 481
IKEA, 99
JD-R, 453–456
job-demand resource model, 453–456
job resources, 459
Kirkpatrick four-level framework, 51
learners connect, 4
mental, 7
motivation, 24–25
persuasive game design, 519–521
positive emotions, 458, 459

problem solving transfer, 295
psychological, 432
reflection, 15
research, 458–461
SDT, 180
simulation, 226
support implementation, 63
valid theory, 298
VEs, 331
video game, 37
Moneysaver prototype
anchors, 127–128
design approach, 122
gamification elements, 127
laboratory user, 124, 125
loss aversion, 128
methodology, 123–124
Motivation
AMS, 256
autonomy, 179
business and education, 36, 38–40
computer-animation, 253
computer-based testing, 559
concept of “flow,” 501
digital badges, 194
dominant clusters, 24
employees, 566
expectancy value model, 173
factors, 498
flow zone, 130–131
game
-design strategies, 254
mechanics, 210, 501
world experience, 521
games, 24–25
gamification, 21
goal-setting theory, 500
IKEA effect, 100
incentives and rewards, 33–36
integrative achievement, 500
interactive engagement formats, 253
intrinsic or extrinsic, 506
Job Characteristic Model (JCM), 500
leaderboard, 182, 211, 557, 565
learning, 255–256
and learning theories, 166
mapping game elements, 36
Maslow’s hierarchy, 37
Motivation Potential Score (MPS), 500
needs-based theory, 25–28
non-business contexts, 21
operant conditioning, 171
PBLs, 211
project knowledge management, 593–595
psychological research, 166
Red team meetings, 521
rewards-based theory, 30–32
SDT, 32–33, 178, 500
serious games, 22–23
social aspect, 24
social-based theory, 28–30
social comparisons, 211
spectrum, 24
survey research, 569–570
task complexity, 181
task design, 516
TEALsim, 254
training modules, 560
types, 499
Vroom’s expectancy theory, 555
Motor-driven skills, digital games influence, 292
Mozilla’s Open Badge system, 197–198
Multiplayer Breakout, 522, 523
Mythic Entertainment
vs. BSI, 545

N

NDiVE, developments
engagement with firms, 326
gamification mechanisms, 326
HMDs, 326
open environment, 326
virtual environment, 325
Near-field communication (NFC) technologies, 645
Need achievement theory, 25–27
Needs-based theory
goal setting, 27
hierarchies, 25, 26
need achievement, 25–27
self-efficacy, 27–28
Netiquette, cyberspace
“cyberbullying,”, 333
rules, 332–333
‘setting rules’ and ‘moderating discussions’ approaches, 333
New York Public Library (NYPL), 8, 9
NFC technologies. *See* Near-field communication (NFC) technologies
Non-Disclosure Agreement (NDA), 543, 547
Non-game teamwork
compete/cooperate behavior, 517–519
conflict management, 517
goals and task design, 516–517
Red teams, 515
sub-optimal outcomes, 516
NYPL. *See* New York Public Library (NYPL)

O

On-boarding plan, 665
Open Sim platform, 391
Organizations
  applicants, 554–555
  centered design, 349
  employees, 558
  M2 Research, 553
  performance appraisals, 562
  psychology, 518
  selection process, applicants, 556
  sexual harassment training, online, 560
  text and graphic based social activity, 350
Orientation policy, 346
Overjustification effect, 144

P

Paidia against ludus, 71
Participants, types of, 380
PBL. *See* Problem Based Learning (PBL)
Peer tutoring
  classrooms, 281
  game interface, 279, 280
  helpers and helpees, 279, 281
  IM, 282
  insurance points, 279
  programming task, 279
  solitary learners, 280–282
Perceived ease of use (PEOU), 460, 463–465
Perceived usefulness (PU), 464, 465
Performance
  Action Modus, 302
  assessment
    customizable achievement system, 448
    evaluation of rules, 441
    generic service approach, 445
    integrated solutions, 447
    person-environment fit theory, 452
    TAM's constructs, 460
  autonomous extrinsic motivation, 33
  behavior, 56–57
  conflict stimulation, 517
  digital games and simulations, 405
  digital strategy, 674
  direct correlation, 277
  domain-specific tasks, 205
  educational, 204
  enjoyment, 181
  expectancy, 173
  external reward, 178
  game-based e-learning experience, 404
  game-mechanic components, 58
  generic platforms, 449
  goal setting, 27
  holistic state space, 413
  incentives, 30
  informational transfer, 296
  integral measurement tool, 53
  integrated solutions, 447
  intrinsic motivation, 326
  knowledge-in-action, 414
  learning process, 54
  penalty shots, 300
  post-test, 559
  real-life criteria, 366
  real training situation, 293
  relatively unconstrained parameters, 408
  scorecard process, 64
  self-efficacy, 28
  self-evaluation, 320
  self-regulatory processes, 175
  social facilitation, 212
  state space reconstructions, 410
  statistic relevant differences, 309
  student, 48
  tasks, 18
  traditional educational research
      methods, 403
  training interventions, 52
  VIE theory, 172
Personal investment theory (PIT)
  cognitive elements, 29
  perceived options, 30
  personal incentives, 30
  virtual items, 34
Personality types, 104, 140–142, 151, 497
Persuasion
  Behavior model (FBM), 502
  game design model
    gameful experiences, 520
    game world experience, 520–521
    gamification, 519–520
  principles, 502
  technology, 108, 110, 113
Peter Ludlow *vs.* Electronic Arts, 541–542
Physical skills and digital gaming. *See*
      Augmented reality adaption and
      basketball
PIERSiM environment
  business
    and entrepreneurship education,
      389–390
    learning, 395
    strategising, 393, 394
  classroom experience, comparison,
      395, 396
  development barriers, 390

DiBella business, 391, 392
evaluations, 394–395
experience, 395
Hotel Island, 391, 392
learning, 392, 393, 395, 396
management teams, 385
Open Sim platform, 391
playing and learning, 385
recommendations, 395, 396
sample, gender profile, 394
satisfaction with experience, 397
wholesaler in, 390, 391
PIT. *See* Personal investment theory (PIT)
Platforms
Bunchball 's platform, 446
generic gamification (*see* Generic gamification platforms (GGPs))
integrated, 444
requirements and gamification (*see* Gamification)
Play
assessment diagnostics, 55–57
constant missions and challenges, 266
designers and funders, 6
educational system, 134
engagement, 456
extrinsic and intrinsic motivation, 24
freedom, 17
games, 4
gamified learning environment, 177
location-based game, 111
loss aversion, 121
ludic learning space, 7
monitor performance, 26
play-based gamification system, 6
playification, 6
psychology, 134
real-time/near real-time feedback, 477
reimbursing money, 630
rewards, 3
science museums, 7
social behaviors, 48
society, 5
standard rules, 538
students perform experiments, 226
teams and cooperation, 631
unfair competition laws, 547
video game, 28
Players, ride sharing
Greg Greenthinker, 622, 624
Kevin Careful, 622, 623
motivations/reservations, 621
Sam Scrooge, 622, 624
Sarah Socializer, 622, 624
Scott Sportsman, 622, 624
Steve Status, 622, 623
Pointsification, 221, 615, 633
challenges, 629
individual challenge, 628
personalizing business goals, 628, 629
player types, 630
ride sharing system, 628
Points, leaderboards, and badges (PBLs), 211
Principle of least astonishment (POLA), 137
Problem Based Learning (PBL), 356
Problem solving transfer, 295
Programming environments
control statement, 237
food chain, 242, 244
gamification, 243
Programming tasks
competition and collaboration, 283, 284
learning outcomes, 283
pair-programming, 283
test and practical problem, 283
Project knowledge management
bullet points possesses, 594
documentation work, 594
gamification (*see* Gamification)
organizational learning, improvement, 593
90-9-1 rule, 595
transactive memory system, 594
Project World, 610
Prosocial emotions, 457
Pseudocertainty effect, 92–93
Psychological capital (PsyCap)
hope, optimism and self-efficacy, 459
JD-R model, 459, 460
personal resources, 456
positive emotions, 456
TAM's constructs, 460
Psychological computing
ADAS, 113
apps, 114
behavioral economics, 112
biases, 114
judgment, 115
LCT, 113
personal finances, 114
Psychological science
behaviorism, 135–138
cognitive science, 139–143
game elements, 147
intrinsic motivation, 144
myths, 145–146
psychology, 134–135
video game addiction, 144

Psychological theory
experience points, 165
gamified design, 166–168
goal-setting, 174–177
learner engagement, 166
learning, 168–171
motivational processes, 166
SDT, 178–181
video game elements, 165
Psychology, workplace
application
ERP, 461–462
PEOU, 463–465
capital and positive emotions, 456
extrinsic and intrinsic nature, 452
in games
mastery, 457
positive emotions and personal resources, 457
purpose, 458
social components, 457
general hypothesis, 451
humans' predisposition, 474
model estimations, 466
non-gaming context, 452
PsyCap (*see* Psychological capital (PsyCap))
research model, 458–461
TAM antecedents, 465
theories and models, 452
in workplace
capital and positive emotions, 456
engagement and job satisfaction, 453
flow theory, 452–453
JD-R model (*see* Job demand-resource (JD-R) model)
organizational commitment, 453
person-environment fit theory, 452
positive emotions, 453
work-related illnesses, 452
Psychometrics
challenges, 407
immersive experiences, 405
social knowledge, 406
PU. *See* Perceived usefulness (PU)

Q
Quest to Learning (Q2L), 258

R
Rational unified process (RUP), 432, 433
Reflection problem, 288
Requirements
achievement systems, 447
classes, 446, 447
engineering, 152, 161
functional and non-functional, IS, 432, 440–441
and gamification platforms (*see* Gamification)
general gamification
basic concepts (l1), 437–439
gamification rules (L2), 438–439
taxonomy of game concepts, 437
generic platforms and integrated solutions, 447
implementation projects, practitioners and researchers, 448
individual characterization, 446
workflow includes, 434
Reward-based gamification
BLAP, 2
design elements, 174
incentive programs, 3
long-term change, 3
organization, 2
player-based outcomes, 18
points and badges, 11
real-world value, 3
SDT, 18
Skinner's concepts, 10
Rewards-based theory
EVT, 30–31
skinner's principle, 31–32
Ride sharing
business objectives, 618–620
car sharing services, 617–618
employees participate, 627
game element hierarchy, 627
gamification (*see* Gamification)
players, 621–624
social behavior, 630
TwoGo, 618, 631
'Road block', 668
RUP. *See* Rational unified process (RUP)

S
Schedules of reinforcement, 32, 136
Scholarship of teaching and learning (SoTL)
basic procedural flow, 422, 423
classroom, 426
experience points (XPs), 424
gamification, 423
gamified format, 424
instructor, 425

repeated measures design, 424–425
social science's methodology, 423
statistical significance, 426
students learning, 423
technology, 422
use, 422
Science, Technology, Engineering and Mathematics (STEM)
classroom instruction, 258
gamification framework, 254
motivation, 253
Scorecard
game-mechanic components, 58
gamification measurement, 57
GPAI, 57
integrators, 64
potential elements, 52
psycho-motor skills, 58
source, 58
validation process, 59
Scouting badge system, 190, 191
Scratch projects, 239, 240
SDT. *See* Self determination theory (SDT)
Self-assessment
computational thinking, 245, 247
constructivist learning theory, 228
gamification, 68
mental accounting efforts, 124
test
balanced game, 76
Caillois' framework, 76
gamification project, 68
gaming approach and objectives, 77–78
Self determination theory (SDT), 453, 498
amotivation, 179
autonomy, 33
CET, 178
computer experience, 181
control perceptions, 178
education, 33
EM, 179
external regulation, 179
extrinsic rewards, 179
game elements, 181
IM, 178
impressionists and novel painting techniques, 178
internal/external motivation, 32
intrinsic and extrinsic motivation, 178
JD-R model, 453
literature, 610
macro-theory, 499
mastery element, 17
social networking, 180
social networking site, 180
task complexity, 181
taxonomy, 179, 181
team challenges, 631
theoretical framework, 5
training task, 180
types, 33
Serious games, 596, 597
definition, 637
design and measurement, 355
eco-system, 50
education, 446
educational simulation, 261
entertainment, 22
game-based activities, 22
game-environments, 291
game-related concepts, 597
gamification, 23
gamified learning application, 644
learner retention and engagement, 48
Maslow's hierarchy, 25
motivational power, 23
real-world problems, 23
technical skills, 69
test players' skills and behaviors, 68
Serious Games Institute Business Simulation (SGIBS) game
assessments, 362–363
characteristics and features, 365–366
description, 357
Excel version 2010 software, 362
feedback, 364
inter-team competition, 362
METI undergraduate module, 361
strategic and detailed planning, 363
students' perception, game value, 376–378
test measurements and perception surveys, 375–376
time constraints, 363
Shaping. *See also* Gamification
badges, 34
classroom, 250
gamification, 111
physical/mental construction, 298
players, 625
reinforcing behaviors, 136
teaching machines, 169
Skinner's principle, 31–32
Slavish imitation law, 548
Social-based theory
games, 28
PIT, 29–30
social comparison, 29

Social comparison
  attitudes and abilities, 28
  competitive persons, 29
  evaluations, 29
  facilitation, 212
  feedback loop, 147
  game environment, 211
  games and assessment, 212
  GBA, 211
  leaderboards, 138, 211, 212
  motivational consequences, 211
  motivational effect, 34
  PBLs, 211
  social presence, 212
  theory, 28, 29, 34
  traditional assessments, 212
  visual feedback, 211
Social facilitation, 212
Social interactions
  fellowship, 73
  game mechanics, 492
  learning community, 238
  motivation, 363
  prosocial emotions, 457
Social presence, 212
Social Question and Answer (SQA) sites, 601
Software stores control, 360
SoTL. *See* Scholarship of teaching and learning (SoTL)
SQA sites. *See* Social Question and Answer (SQA) sites
SQL. *See* Structured query language (SQL)
Stack Overflow, 190
Stealth assessment
  Chronicle of Higher Education, 206
  GBA, 206
  physical principles, 205–206
  psychometrics, 206
Storytelling, immersive learners. *See also* Authenticity, virtual training environment
  gamified nudge
    careful design of the learning spaces, 323
    container terminal scenario, 324
    quests in games, 322
    sense of freedom, 323
    spaces, examining, 325
    stories and storytellers as tools, 325
  nonlinear narratives, unrestricted learning spaces, 321–322
    'authentic learning, 322
    mood and storytelling tools, 322
    provision of skills and knowledge, 322
    storytelling, features, 322
Structured query language (SQL), 445–446
Student-centered instructions, 255
Survey research, gamification
  application of gamification, 570–571
  background and motivation, 569–570
  Choice-based-conjoint (CBC) style, 573
  conjoint experiments, 573
  description of game versions
    in-game statements used in the monster scenario game, 581
    version 3: monsters: with correct answers, 579
    version 2.1: salesperson: no correct answers, 579
    version 2.2: salesperson: with correct answers, 579
    version 1.0: simple choice sets, 578
  experimental results
    drop-off rate, 582
    minimum efforts, 586
    number of choice tasks completed, 585–586
    reliability of results, 586–587
    research setting, 581–582
    self-reported engagement, 583–585
    time taken, 582–583
  gamification at work, 571
  gamification of surveys, 571–572
    gamified data-gathering tools, 572
    narrative quest, 571
  "idea generation" system, 571
  methodology
    additional motivating factors, 578
    applicability, conjoint analysis, 574–576
    conjoint experiment design, 574
    drop-off rates, calculation, 577, 583
    effect of the game setting on engagement, 577–578
    experimental design, 576–577
    measurement of engagement, 574–575
    measures of engagement, 577
    self-reported engagement questions, 575
  non-gaming context, 571
  respondent engagement in survey research, 572–573
  survey fatigue, 573
Sustainable innovation program (case study), 507–509

T

TAM. *See* Technology acceptance model (TAM)
Team-based management game
  description, 355
  GDSS, 355
  global changes, 356
  PBL/EL approaches, 356
  SBT and WMG, 356
  TBMR (*see* Team based mixed reality (TBMR))
Team based mixed reality (TBMR)
  description, 356
  hypermarket game, 360
  software stores control, 360
  xing game, 361
"Teamlink," JAVA 3D client server application, 335
Technology
  advantages and disadvantages, 418
  business requirements, 432
  educational change, 419–420
  game levels, 418
  invasivity, 441
  issues, game's life, 481–482
  learning, 418–419
  PEOU and PU, 460
  student learning, 419
  TAM (*see* Technology acceptance model (TAM))
Technology acceptance model (TAM), 460, 465
Theory(ies)
  autonomy, 9
  behavioral, 107
  brain functions, 483
  broaden-and-build, 456
  conservation of resources theory, 456
  constructivist learning, 228–229
  engaging experience, 12
  expectancy, 171–174
  explanatory models, 296–298
  FBM, 502
  flow, 452–453
  framework, 68
  game design, 69
  gamification, 51
  gamified instructional design, 166–168
  goal-setting, 174–177
  innovative learning models, 219
  internal *versus* external control, 31
  JCM, 500
  job characteristics theory, 453
  learning, 168–171
  learning evaluation, 52
  literature, 558
  motivation, 25, 166
  organismic integration, 4
  organizational justice, 561
  personal investment, 30
  person-environment fit, 452
  PsyCap, 459
  psychological, 166
  RGB, 75
  self-determination (*see* Self determination theory (SDT))
  skinner's reinforcement, 24
  social, 154
  social cognitive theory, 456
  spectrum, 23
  traditional economic, 87
  traditional psychometrics, 412
Theory(ies) and research, gamification
  engagement
    model for engagement, 502
    phases, 503
  motivation
    concept of "flow,", 501
    goal-setting theory, 500
    intrinsic or extrinsic, 506
    Job Characteristic Model (JCM), 500
    Motivation Potential Score (MPS), 500
    SDT, 500
  persuasion
    Behavior model (FBM), 502
    principles, 502
Timestamp analysis, 684
Time-transfer, 296
Token economies, 135–137
Traditional economic theory, 87
Traditional induction training approaches, 666
Training
  SBT, 356
  school-based entrepreneurship programmes, 390
Transferability, real and digital worlds
  digital games and motor-driven abilities, 292
  digital games, influences on sport motor-driven skills, 292
  "healthcare" and digital games, 293
  training effects, basketball players, 293
Transfer and transformation effects
  cognitive layer, 294
  computer simulations, 294
  depth of transfer, intramondial transfer, 299
  emotional transfer, 295
  ethic-moral transfer, 295
  fantasy-related transfer, 296
  framing competency, 301

Transfer and transformation effects (*cont.*)
Fritz's postulated transferability model, 294–295
informational transfer, 296
instrumental action orientated transfer, 295
intramondial transfer, 298
problem solving transfer, 295
processes, 296
processes of transfer, 296
schemes as explanatory models for (sport motoric)
cognitive schemes, 296
information, description, 297
recall scheme, 297
recognition scheme, 297
scheme, definition, 297
sensomotoric or rather the perceptive layer, 294
stable framing competency, 301
time-transfer, 296
transferability via a questionnaire, 298
transference, definition, 298
virtual gaming elements, 300
Transference, definition, 298
TwoGo ride sharing, 618, 631

U
Universal Design for Learning (UDL), 4, 9, 12
User-based, 90, 95, 414, 684
User engagement, 474, 483, 484

V
Video game addiction, 144, 146
Virtual learning environments, 316
Virtual worlds
immersive learning experiences, 358
PIERSiM (*see* PIERSiM environment)
policies, 334
Vroom's expectancy theory, 555

W
Wide-area network (WAN), 475
Wii-Sports Bowling, 292
Wilcoxon-Mann-Whitney-Test, 463

X
Xing game, 361