Feng-Qi Lai · James D. Lehman
Editors

Learning and Knowledge Analytics in Open Education

Selected Readings from the AECT-LKAOE 2015 Summer International Research Symposium

AECT
ASSOCIATION FOR EDUCATIONAL COMMUNICATIONS & TECHNOLOGY

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Foreword

These proceedings represent the intellectual enrichment, academic rigor, and thoughtful reflection among various top scholars in the field of educational communications. Dr. Feng-Qi Lai at Indiana State University and Dr. James Lehman at Purdue University have edited a text that is consistent with the AECT mission, which is to "provide international leadership by promoting scholarship and best practices in the creation, use, and management of technologies for effective teaching and learning in a wide range of settings." The content from the AECT-LKAOE 2015 Summer International Research Symposium introduces and explains innovative educational technologies that have a proven record of success across a variety of teaching and learning environments.

Indeed, the AECT-LKAOE 2015 Summer International Research Symposium is well represented in this collection of proceedings, which includes 16 papers. The first of these, "Learning Is a Journey, Not a Destination," by Phillip Harris and Donovan R. Walling, offers a philosophical perspective grounded by the fundamental processes common across teaching and learning in many forms and settings. The authors assert that educators' self-examination and self-understanding are keys to guiding learners, whoever they may be, on their learning journeys.

J. Michael Spector's "The Impact of Instructional Design: Questions of Conscience" articulates the tension that often exists "between the need to rely on instructional designers to cope with the complexities and challenges of planning and implementing learning environments in the digital age and a general distrust of instructional designers to deliver on promises to transform education using new technologies." Tristan E. Johnson, in "Using Data Analytics to Drive Performance and Instructional Decision Making," goes to the heart of the symposium's theme to examine "a need at many levels to conceptualize the types of data that would deliberately inform decision making."

In Yanyan Li, Haogang Bao, and Chang Xu's "Learning Analytics: Serving the Learning Process Design and Optimization," the authors propose a "process model of learning analytics," accompanied by a review of the research and challenges of "multi-source educational data collection and storage." Li et al. include an elaboration about how to align learning analytics with pedagogical and organizational goals. In "Design of Online Student Orientation with Conceptual and Procedural Scaffolding," Juhong Christie Liu and Andrea Adams report on a study concerning the design and development of an orientation course to prepare students for online learning. In particular, Liu and Adams focus on the design and development process and methods used for assessment.

"Improving Learning in MOOCs through Peer Feedback: How Is Learning Improved by Providing and Receiving Feedback?" by Jianli Jiao, Juqin Yang, Hongrui Zhong, and Gaimei Ren aims to answer the title question using a study that is based on a case involving a MOOC titled, "The Red Chamber Dream." J. Ana Donaldson's "Emerging Technology: Instructional Strategies for Nailing Jello-O to a Tree," despite the tongue-in-cheek title, takes up the serious matter of trying to keep up with ever-increasing numbers of emerging technologies. Donaldson also discusses "using Merrill's First Principles of Instruction and Keller's ARCS Model as a framework for instructional approaches that align with an experiential immersion methodology for learning about the new technology."

Marcus D. Childress, in "Utopian and Dystopian Futures for Learning Technologies," addresses a related theme with regard to how learning technologies and media continue to change and augment teaching and learning. This paper offers a brief history of "technological utopianism, ultimately leading to learning technologies and utopian/dystopian views for the future." Yan Li, Muhua Zhang, Curtis J. Bonk, Wenjun Zhang, and Yuqing Guo, in "Open Educational Resources (OER)-based Flipped Classroom Practice in an Undergraduate Course," take a practical tack, based on a study "to explore the process and effectiveness" of OER in a specific course at Zhejiang University in China.

In "Tracking Students' Activities in Serious Games," Jina Kang, Sa Liu, and Min Liu examine the Serious Game (SG), "a virtual process designed for the purpose of real-world problem solving." Kang, Liu and Liu focus on a study of "learning analytics of students' activities in a 3D immersive SG environment called Alien Rescue," a program designed for middle school science education. Robert A. Reiser, in "Eight Trends Affecting the Field of Instructional Design and Technology: Opportunities and Challenges," casts a wide net, providing a useful perspective. The purposes of this paper are "to identify some of the major trends that have affected the field over the past decade" and "to discuss some of the opportunities and/or challenges each of these trends presents for instructional design and technology professionals."

"Social Media: An Integration Guideline for Teaching and Learning in Higher Education," by Wei Zakharov, Akesha Horton, Pat Reid, James Willis, and Donalee Attardo, offers a thought-provoking examination of social media in educational contexts, noting in particular some underlying issues. According to the authors, "Trust, privacy, and safety are critical to learning in an open education." Rob Branch's "An Instructional Design Model for Information Science" provides an important perspective on conceptual models and introduces a "basic instructional design model for information science." M. David Merrill, in "If Content is King then e3 Instruction is Queen," avers, "When content information is accompanied by appropriate learning activities then more *effective, efficient,* and *engaging* learning is promoted"; thus, this paper focuses on achieving e3 learning.

This proceedings volume concludes with two papers that closely connect to factors that are central to the research symposium but also have broader applicability. Tristan E. Johnson, J. Michael Spector, and Hinhong (Maggie) Wang, in "Academic Writing, Publishing, and Presentations in Educational Technology," address misconceptions about academic writing and publishing "that sometimes inhibit or intimidate educational researchers" and offer practical advice. Finally, Feng-Qi Lai, one of the principle organizers of this symposium, draws on a study of faculty in educational technology at more than 30 universities in China for this concluding paper, "Chinese Scholars' Perspectives Regarding Educational Technology."

This collection of proceedings is a far-ranging, diverse compendium of ideas and information, from the philosophical to the practical. There is much to ponder here. For those who were in attendance at the symposium, the various papers provide a valuable mnemonic for an extraordinary experience. All readers should find insights and information to inform their own knowledge and practice within the realm of educational communications and technology.

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and

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Preface

This book is a collection of selected proceedings papers from the AECT-LKAOE 2015 Summer International Research Symposium. AECT is the Association for Educational Communications and Technology. LKAOE is the theme of the symposium: Learning and Knowledge Analytics in Open Education. This symposium was organized by AECT in partnership with Indiana State University (ISU) and hosted by East China Normal University (ECNU). The symposium was held on June 17–19, 2015, at the campus of East China Normal University in Shanghai, China.

The purpose of this book was to disseminate the essence of the symposium. Serving as an open-discussion forum, the symposium was designed to draw the best minds together for an intensive intellectual exchange of ideas and information about research, development, and applications on topics related to learning and knowledge analytics in open education in all disciplines. The contributors of this book include many well-known professors in the field, Drs. M. David Merrill and Robert A. Reiser; AECT presidents, Drs. J. Mike Spector, J. Ana Donaldson, Marcus D. Childress, and Robert Maribe Branch; and AECT Executive Director Dr. Phillip Harris. The target audience for this book is higher education faculty members, graduate students, scholars, and practitioners in educational technology and related fields. This book can be used as supplementary reading for courses in educational technology programs, including introductory courses, courses in distance education and instructional design, and beyond. Readers will learn about trends and issues in education today—and tomorrow—and the principles to follow in order to address challenges as the Internet and multimedia technologies continue to develop at tremendous speed.

The title of this book is the theme of the symposium. We decided to adopt this theme for the symposium because, according to ECNU, Chinese scholars in educational technology were most interested in this topic. There were six tracks, including learning-and-knowledge-analytics-related standards, policy, and pedagogy; learning design in open-ended learning environments (OELE); MOOCs (Massive Open Online Courses) and open education; new technology and new media; instructional designers as change agents in the age of open education; and other learning analytics studies and applications. This book includes chapters related to these six tracks of the theme of LKAOE.

This collection is composed of 16 chapters, arranged based on the order of the tracks for the symposium. The first chapter and the last two are not theme-related. They are included in the book because they were papers that the authors were invited to present at special sessions of the symposium serving special purposes. The first chapter asserts that learning is a journey, not a destination. By declaring so, the authors tell us: “Teachers must recognize the human differences inherent in the many ways their students acquire knowledge and construct understandings. Instruction must proceed in ways that accommodate these differences if the learners’ individual journeys are to be successful.” This chapter is important and placed as the first chapter because it lays a strong foundation to guide readers’ thinking as they read the other chapters in this book. Chapter 15 provides guidance for readers who are interested in academic writing and publishing. The chapter includes “some tips on writing clearly for an academic audience along with an editor’s perspective on publishing research.” The last chapter reports the findings of a qualitative study about perspectives that the Chinese scholars hold regarding educational technology. The purpose of this chapter was to provide those who are interested in engaging in collaborative programs or projects in educational technology with China with information they will need, such as a general picture of the scholars with whom they are going to work and what projects or programs they may want to consider undertaking with Chinese scholars in Chinese higher education.

Editing this book has been a learning process for me. First, I learned from the chapter authors. Most of them are prominent scholars in educational technology in the USA or China. Their views and the points they made were valuable to all of us who want to be better scholars in educational technology. Second, I learned from my co-editor. His thoroughness and strong sense of responsibility bring back memories of the years when I was a student at Purdue University. The knowledge and work ethics I learned from him as well as from my other Purdue professors made me a successful scholar today. Third, I learned how to work on an edited book. I have had the experience of writing a book as a sole author or co-author, but working on an edited collection was a new experience. I learned from AECT Executive Director Phil Harris his style of working with different people. I find that I truly have learned something from everyone with whom I have worked. I understand that publishing a good book requires more than just knowledge.

I was inspired and motivated to take on this editorial project because I would like to dedicate myself to global education. I chose education as my career because I always have remembered my late parents saying to me: “There are two best professions you may want to choose from—being a medical doctor or being an educator. Medical doctors save peoples’ lives and educators inspire learners and help improve the world.” I am grateful for the opportunity of compiling and editing this book, one of the best tasks I have been given in my life, awarded by AECT.

I feel equally grateful for the support I received from my co-editor, my professor at Purdue University, Dr. James Lehman. He did the hard part of the task. Without his help, this book would not be of this quality. I hope our readers will enjoy reading this book and learning from the scholars who are represented in its pages.

Acknowledgement

I would like to thank my graduate assistant Haisong Ye for his assistance with the formatting of the chapters.

Terre Haute, USA Feng-Qi Lai

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Editors and Contributors

About the Editors

Feng-Qi Lai Ph.D. is a professor of educational technology and the educational technology graduate program coordinator at Indiana State University. She received her doctorate in educational technology from Purdue University in 1997. After her graduation, she worked for corporations in the Chicago area until 2002 as the Director of Training and later as the Senior Instructional Designer/Project Manager. Prior to 1992, she taught K-12 and at the university for a total of more than 14 years while in China. Dr. Lai started her publications and translations in 1983. Her first translation entitled *Writing Scientific Papers in English* by O'Connor, M., & Woodford, F. P. was printed in 1983 (62,000 copies) and reprinted in 1985 (62,001–72,100). One of the papers she translated received the Award for Scientific English Translation at the Second Scientific Translation National Competition, China, in 1983. Her publications include books, book chapters, and journal papers in both English and Chinese. She also worked on more than three thousand phrases in *A Complete dictionary of English-Chinese idiomatic phrases* edited by Xing, Z., the work of which was started in 1991 and published in 1995. Since 2005, Dr. Lai has been actively involved in academic exchange with universities in China and invited to present by more than ten universities in China. She has received honorary titles and certificates from Shanghai Normal University (2006), Association of Shandong Higher Education (2007), Henan University (2013), Henan Normal University (2014), and East China Normal University (2015), respectively. She was one of the founders of Society of International Chinese in Educational Technology and the planner and general chair of AECT-LKAOE 2015 Summer International Research Symposium.

James D. Lehman Ph.D. is a professor of learning design and technology and the Director of the Discovery Learning Research Center at Purdue University. He has also served in leadership roles as an associate dean for discovery and faculty development in the College of Education and head of the Department of Curriculum and Instruction at Purdue. Professor Lehman's scholarship and teaching focuses on technology integration in education particularly in the sciences, e-learning, and interactive multimedia. He has published more than 50 refereed journal articles and book chapters and is a co-author of *Educational Technology for Teaching and Learning*, an educational technology textbook now in its 4th edition. He has secured grant funding totaling approximately $20 million and is currently involved in two NSF-funded projects, PD4CS: Professional Development for Computer Science which focuses on online professional development of teachers of computer science and SLED: Science Learning through Engineering Design which focuses on integrating engineering design as a vehicle for teaching science in the elementary grades. Professor Lehman is a member of Purdue's Teaching Academy and was inducted into its Book of Great Teachers.

Contributors

Andrea Adams M.Ed. is the Director of Faculty Development and e-Learning Programs in the Center for Instructional Technology at James Madison University. She has a master's degree in educational technology and has taught in both K-12 and higher education. She has conducted mixed-method studies, published in peer-reviewed journals and books, and presented at international, national, and regional conferences. Andrea was a fellow in the OLC Institute for Emerging Leadership in Online Learning and the Breakthrough Models Academy by EDUCAUSE and NGLC with the sponsorship from the Bill and Melinda Gates Foundation.

J. Ana Donaldson Ed.D. is a past-president of AECT (Association for Educational Communications and Technology) and is a contributing faculty member for Walden University in the Ph.D. Educational Technology program. She retired in 2009 as an associate professor of Instructional Technology from the University of Northern Iowa. Beside her years of classroom and online experience, she is a published author, keynote speaker, and international presenter. She co-authored with Rita-Marie Conrad: *Engaging the Online Learner: Activities for Creative Instruction* (2004 & 2011) and *Continuing to Engage the Online Learner: More Activities and Resources for Creative Instruction* (2012).

Donalee Attardo Ph.D. is Manager of Academic Technologies in the Office of Information Technology, University of Minnesota. Donalee holds a Ph.D. in linguistics from Purdue University and has been a specialist in educational technology in higher education for over 20 years, most at Purdue University, where she was a director of the Instructional Development Center in Teaching & Learning Technologies, and before that a senior educational technologist.

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Curtis J. Bonk Ph.D. is a former corporate controller and CPA who, after becoming sufficiently bored with such work, received his master's and Ph.D. degrees in educational psychology from the University of Wisconsin. Curt Bonk is now professor of Instructional Systems Technology at Indiana University and president of CourseShare. Drawing on his background as a corporate controller, CPA, educational psychologist, and instructional technologist, Bonk offers unique insights into the intersection of business, education, psychology, and technology. He has received the CyberStar Award from the Indiana Information Technology Association, the Most Outstanding Achievement Award from the US Distance Learning Association, and the Most Innovative Teaching in a Distance Education Program Award from the State of Indiana. In 2003, Curt founded SurveyShare, which he sold in 2010. From 2012 to 2015, Bonk has been annually named by *Education Next* and listed in *Education Week* among the top contributors to the public debate about education from more than 20,000 university-based academics. In 2014, he also was named the recipient of the Mildred B. and Charles A. Wedemeyer Award for Outstanding Practitioner in Distance Education. A well-known authority on emerging technologies for learning, Bonk reflects on his speaking experiences around the world in his popular blog, *TravelinEdMan*. He has authored over 300 publications, including several widely used technology books, including *The World Is Open: How Web Technology Is Revolutionizing Education* (2009), *Empowering Online Learning: 100 + Activities for Reading, Reflecting, Displaying, and Doing* (2008), *The Handbook of Blended Learning* (2006), and *Electronic Collaborators* (1998). His 2014 book, *Adding Some TEC-VARIETY: 100 + Activities for Motivating and Retaining Learners Online*, is freely available to download as an eBook in both English and Chinese at http://tec-variety.com/. Bonk's most recent book, *MOOCs and Open Education Around the World*, was published by Routledge in July 2015.

Robert Maribe Branch Ed.D. is a Professor of Learning, Design, and Technology at the University of Georgia. He is also the Head of the Department of Career and Information Studies. Rob earned an associate of science degree from New York City Technical College in Brooklyn, New York, a bachelor of science degree from Elizabeth City State University in North Carolina, and a master of arts degree from Ball State University in Muncie, Indiana. Rob taught secondary school in Botswana as a Peace Corps Volunteer and later joined the University of Botswana as a lecturer in the Engineering Design and Technology Department. Rob completed his Doctor of Education degree from Virginia Tech in 1989. Dr. Branch joined the faculty at Syracuse University and taught graduate courses and conducted research in the Department of Instructional Design, Development, and Evaluation rising to a tenured associate professor. Dr. Branch worked as a Fulbright lecturer/researcher at the University of KwaZulu-Natal in South Africa, where he co-founded the master's degree in Educational Technology, while conducting research on the complexities of intentional learning spaces. Dr. Branch is an editor of the *Educational Media and Technology Yearbook* and the *Survey of Instructional Development Models*. He recently published *Instructional Design: The ADDIE*

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Marcus D. Childress Ph.D. is an associate dean of the school of education, professor, and director of the Instructional Design and Performance Technology doctoral program at Baker University (Kansas). Dr. Childress earned his Ph.D. from Virginia Tech. His research interests include online learning, heutagogy and using virtual worlds for training and education. His research has been documented in publications such as *Distance Education*, *Journal of Research on Computers in Education*, *International Journal of Educational Telecommunications*, *Globalized e-Learning Cultural Challenges*, *EDUCAUSE Quarterly*, *Academic Leadership Journal*, and the *Encyclopedia of Distance Learning, Teaching, Technologies, and Applications*. In addition to his higher education experience, Dr. Childress' training involvement includes consulting with the Intel Corporation, the People's Bank of China Training Center, SchwindTEC, Virginia Modeling, Analysis and Simulation Center, and the United States Joint Training Analysis and Simulation Center; the world's leading research centers for computer modeling, simulation, and visualization. As a past-president of the Association for Educational Communications and Technology (AECT), he served on the executive committee and board of directors and was the convention chair for the 2012 AECT International Convention in Louisville, KY.

M. David Merrill Ph.D. has been engaged in the study of effective, efficient, and engaging instruction for more than 50 years since he started his PhD program at the University of Illinois in 1961. He was honored to receive the AECT Distinguished Service Award 2001 for advancing the field of instructional technology through scholarship, teaching, and leadership. He received a lifetime achievement award from the Utah State University College of Education 2010, and he was recognized as an Honored Alumni for the College of Education at BYU 2011. He recently received the ETR&D Distinguished Development Award from AECT. Since receiving his Ph.D. from the University of Illinois in 1964, he has served on the faculty of George Peabody College, Brigham Young University-Provo, Stanford University, the University of Southern California, Utah State University, Florida State University, and BYU Hawaii (as a missionary volunteer). He served a service mission at BYU Hawaii where he helped faculty put courses online. Since retiring, he has taught online courses at Florida State University, BYU Hawaii, University of Hawaii, and Utah State University. He is internationally recognized as a major contributor to the field of instructional technology, has published many books and articles in the field, and has lectured internationally. Among his principle contributions: TICCIT Authoring System 1970s, Component Display Theory and Elaboration Theory 1980s, Instructional Transaction Theory, automated instructional design and ID based on Knowledge Objects 1990's, and recently First Principles of Instruction.

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Jina Kang M.A. is a doctoral student in the learning technologies program at the University of Texas at Austin. She holds master's degrees in learning technologies and astronomy. She has been working as a teaching assistant for the classes related to instructional systems design and interactive multimedia production. Her main research interest is in serious games analytics: using students' logged actions in serious games to understand how the students solve a problem by interacting with various cognitive tools of the environment; visualizing their learning behavior; and providing just-in-time feedback via dashboards to help teachers facilitate the students' learning.

Yan Li Ph.D. is a professor of educational technology in the College of Education at Zhejiang University, China. She has presided over several international-, national-, and provincial-level research projects and has published series of academic papers or books. You may find her papers in journals such as *Computers & Education*, *British Journal of Educational Technology*, *Educational Technology Research & Development*, *Asia Pacific Journal of Education*, *Social Behavior and Personality*, *International Journal on Emerging Technologies in Learning*, and *Journal of International Agricultural and Extension Education*. Her research interests include distance education, open education resources, and diffusion of educational resources.

Yanyan Li Ph.D. is a professor in the School of Educational Technology at Beijing Normal University, where she teaches courses on data structures, intelligent information processing, and introduction to artificial intelligence. She received her

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Computing Research, Journal of Computing in Childhood Education, and has also reviewed for such research journals as *Language Learning & Technology*, *Instructional Science*, *Computers & Education*, *Interactive Learning Environments*, and *Learning, Media and Technology*. Her current R&D projects include studying the design and effectiveness of immersive, rich media environments on learning and motivation; learning analytics and data visualizations; understanding MOOCs as an emerging online learning tool; examining the affordances and constraints of using mobile technologies in teaching and learning; and use of Web 2.0 tools to facilitate instruction.

Sa Liu M.A. is a doctoral student in curriculum and instruction specializing in learning technologies. She has a master's degree in educational technology and a B. S. in computer science. Her research interests include game-based learning, technology-promoted teacher development, and computer-supported language learning.

Pat Reid Ed.D. has worked in faculty professional development and instructional design for over 20 years in higher education at Cleveland State University, Wintec and NorthTec, Purdue, and now at the University of Cincinnati. Pat works as part of both CET&L (where she is the Associate Director of Integrated Instruction) and eLearning (as Director of Instructional Innovation). In these roles, she works with instructional designers and faculty across the university, supporting instructional technology. Her focus is on helping instructors identify how to get technologies working to support their students' learning. Pat has an Ed.D. in Adult Education from Nova Southeastern University.

Robert A. Reiser Ph.D. is the Associate Dean for Research, a Distinguished Teaching Professor, and the Robert M. Morgan Professor of Instructional Systems in the College of Education at Florida State University. He has written five books and more than 75 articles and book chapters in the field of instructional design and technology. His most recent book, *Trends and Issues in Instructional Design and Technology* (2012), has received several outstanding book awards from major professional organizations, including the Association for Educational Communications and Technology and the International Society for Performance Improvement. Dr. Reiser's service activities have included founding, and chairing for 25 years, the AECT Division for Design and Development Awards Program. He also served for 20 years as an editorial board member of *Educational Technology Research and Development*, a premier research journal in the field of instructional design and technology. In recognition of his service efforts, the AECT Division of Design and Development has presented Dr. Reiser with its annual Presidential Award for Outstanding Service on four separate occasions. During the 39 years he has been at Florida State, Dr. Reiser has received several university awards, including a Professorial Excellence Award, a Developing Scholar Award, and a University Teaching Award. In April 2000, he received the University Distinguished Teacher Award, the highest teaching award at Florida State. Each year this award is given to one faculty member at Florida State who has, over his or her career, demonstrated a record of sustained teaching excellence. Dr. Reiser is the first member of the College of Education to have received this award.

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Chapter 1
Learning Is a Journey, not a Destination

Phillip Harris and Donovan R. Walling

Abstract The assertion—learning is a journey, not a destination—grounds this examination of learning, instructional design, teaching, and evaluation. It begins by focusing on self-understanding as key. Understanding and then guiding learning accordingly requires not only keen observation and responsive instruction but, more fundamentally, deep self-examination to understand one's own ingrained theories of learning coupled with the ability to move fluidly among alternative theories—whether or not they can be articulated. From this basis, the examination moves through discussions of the nature of teaching, designing learning, aligning evaluation, and considering what constitutes "normal."

Keywords Bell curve · Design · Evaluation · Instruction · Learning · Learning theory · Normal distribution · Teaching

Consider this assertion as a starting point: Learning is a journey, not a destination.

Although the intended destination for a group of learners may be similar—even essentially the same with only nuanced differences—the learning journey will be unique for each learner. That is the nature of human individuality. How then can a teacher guide the learning journey effectively?

To answer these questions teachers must first examine their own theories of learning. Note here that we use *teachers* as a convenient term encompassing all learning designers, regardless of whether they are active classroom practitioners. Teachers design learning along a continuum, from merely adopting prescribed designs developed by others to creating their own unique learning designs. For the purposes of this article, our focus is primarily on the latter that segment of the continuum involving active learning design. What, then, does it mean to have a theory of learning?

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There are many formal theories of learning—behaviorism, cognitivism, constructivism, transformative, multiple intelligences, brain-based, and so on. Few teachers adhere strictly to a formalized theory. Rather, teachers operationalize instruction based on internalized, personal theories of learning that they likely would find difficult to describe. Yet these operational theories provide the source of their approach to guiding their students' learning. These theories inform learning design, choices of resources, methods of evaluation, and all the rest.

If a traveler is well shod and fit, then an effective guide might point the way over terrain that is challenging but will ultimately prove to be a satisfying way to reach the destination. On the other hand, if a traveler is shoeless, then a guide might help the traveler wrap up his feet and take a smoother path to reach the same destination. It would be ineffective and unhelpful to treat two such travelers the same. So it must be with teachers and students. Teachers must recognize the human differences inherent in the many ways their students acquire knowledge and construct understandings. Instruction must proceed in ways that accommodate these differences if the learners' individual journeys are to be successful.

Understanding and then guiding accordingly requires not only keen observation and responsive instruction but, more fundamentally, deep self-examination to understand one's own ingrained theories of learning coupled with the ability to move fluidly among alternative theories—whether or not they can be articulated. For teachers to be truly effective instructional guides for their students' learning journeys, the instructional journey itself must begin with teachers' self-understanding.

1.1 What Is Teaching?

Often it is said that teachers teach as they were taught. Surely there is a grain of truth in this notion. But doesn't the study of instructional design change that? Don't teachers learn new ways to teach? Perhaps…but also, perhaps not, or at least not always. It can be difficult to *unlearn* something that has become ingrained, that feels "natural." What *does* teaching look like?

An important element of a teacher's self-understanding must begin with the examination of one's internalized perception of the behaviors that constitute teaching in practice, not merely in theory. A teacher supervisor comes unannounced to the classroom to observe the teacher. Students are working independently in groups, while the teacher watches and responds to occasional questions. The supervisor tells the teacher, "I'll come back later. Please let me know when you will be teaching." Wasn't the teacher teaching, really? Isn't structuring learning activities "teaching"? Clearly not, in the teacher supervisor's view. The supervisor expected the teacher to be presenting information, perhaps lecturing. That was the supervisor's perception of teaching. If teachers hold to a similar narrow view of teaching, then their choices of teaching activities will be limited by their internalized conceptions. Self-understanding is therefore crucial to effectively enlarging one's range of teaching practices to include the unfamiliar along with the already familiar, ingrained approaches.

Teachers recognize that learners vary in the knowledge and understandings they bring to school. No two students duplicate each other's mental stores or the ways by which they acquire information and construct understandings. Consequently, teachers need not only to understand how their students learn best but also how teachers' perceptions of teaching can facilitate or inhibit their students' learning journeys.

1.2 Getting from Point A to Point B

If learning is a journey, then isn't teaching simply a matter of getting students from Point A to Point B—that is, from a position of not knowing something to knowing that thing: how to tie one's shoelaces, how to add two-digit numbers, how to solve a quadratic equation, how to read and write? Teachers' self-understanding also requires examining a common presumption that learning is a linear pursuit. The notion of linear learning is akin to believing that all roads are straight, which real-life experience would contradict. Just as learners differ from one another and teachers must adopt views of teaching that suit the needs of their students, so too must there be the acknowledgment that students' learning pathways will differ according to the type of knowledge to be acquired and the skills needed to develop full understanding.

It is an understandable misconception to think in linear terms. For convenience, instructional design models tend to be framed as linear sequences. Consider, for example, the common ADDIE model:

1. Analysis
2. Design
3. Development
4. Implementation
5. Evaluation

That's straightforward: 1–2–3–4–5. Here is a road that stretches linearly from Point A (analysis) to Point B (evaluation)—or so it might seem. But this is the illusion of linearity. If students' knowledge and understandings differ, and how they acquire knowledge and construct understandings also differ, then getting from Point A to Point B often will not be straightforward. In fact, it is likely to be rather messy, something closer to Fig. 1.1—and that figure represents only three students' learning journeys.

Learning designs—incorporating all of the ADDIE features—must also consider how teachers plan learning journeys that accommodate student differences. Thus another question for teachers' self-understanding is to examine one's views of

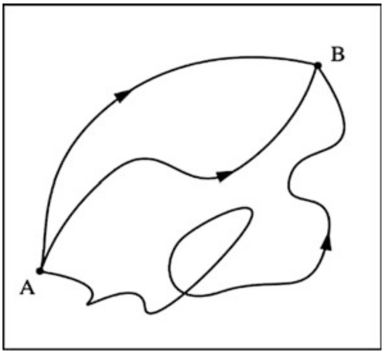

Fig. 1.1 From Point A to Point B

linear and nonlinear teaching. Maddux et al. (2001) take their cue from multimedia technology to make the following distinction:

> The ability to move about in a hypermedia program and choose what to explore next means this material is nonlinear. Teacher-centered Type I instruction is generally linear instruction: the lesson begins at a particular point and proceeds through a set sequence. In contrast, nonlinear instruction, which is generally student-centered Type II instruction, does not have a prescribed sequence (p. 101).

This contrast is a useful frame of reference. But the contrast should not be seen as an either/or proposition. After all, some students' minds are like high-speed trains, for which a linear, A-to-B model may be well suited. Other students' minds are better equipped to proceed in some nonlinear fashion.

When the "writing process" model came into vogue in the 1980s, this instructional design model was often misconceived as a linear learning approach. This illusion of linearity embodied two major misconceptions: (1) that writing is a deliberate, linear process and (2) that writers *should* write in a deliberate linear manner. Both misconceptions contradict how real writers actually write (Walling 2006). Learning designs based on the illusion of linearity will fail those students whose optimally successful learning journeys are nonlinear. Getting from Point A (an idea) to Point B (a finished manuscript) usually is as idiosyncratic and individualistic as the writers themselves. Writing journeys are like learning journeys—indeed they usually *are* learning journeys.

This is not to say that for some writers, for some writing situations, and for some topics a linear approach is ill suited. In fact, it may be the most appropriate choice. But the opposite also is true. Even the airline industry has found that nonlinear journeys can be more efficient and cost-effective (at least for the airline company), or else why would they route travelers from Indianapolis, Indiana, to, say, Rochester, New York, a distance of 524 miles, through Chicago, Illinois, which adds another 158 miles to the trip?

In real life, getting from Point A to Point B often is not a straight line. Learning is a real-life activity. So is teaching.

"Everyone learns differently—I get it" is easy to say. The concept is not hard to grasp intellectually. It is another matter to design learning experiences that accommodate learners' differences. This is the challenge of learning design. It is the challenge of teaching. And it is the challenge that every professional will be better prepared to meet if he or she invests time and attention focused on self-understanding: What do *I* believe about teaching and learning? And on what knowledge do I base my beliefs? Teachers' self-understanding is inextricably tied to understanding their students and the lessons—the tasks, the steps on the learning journey—that teachers construct and order.

1.3 Knowing the Learner, Knowing the Lesson

Let us make a distinction between "understanding" and "knowing" in this context: A teacher might say, "I understand eight-year-olds" or "I understand teenagers" or even "I understand undergrads." Such understanding is a generic sense of knowing, a familiarity often born of long experience of a group or class of individuals. But truly knowing a particular learner is a deeper level of knowledge and understanding. It embodies the aggregation and inspection of information gained through observation, conversation, questioning, and academic probing during the myriad interactions that form the substance of teacher–student engagement in the acts of teaching and learning. This sense of knowing is what allows teachers to tailor instruction to individuals, rather than merely to groups or classes.

Is this level of knowing really possible? At the most individual, probably not, or not usually. Most teachers and students do not have the luxury of exclusively one-to-one interactions. Yet there are moments when such up close and personal teaching and learning can and does occur. These moments contribute to the aggregation of knowledge and understandings that teachers use to shape how they help individual students on their learning journeys. The closer a learning design can approximate so-called individualized instruction, the better. Reflecting on how learners act—what they say and do in various learning situations—is vital to knowing learners as individuals.

For example, an English teacher observes that one of his ninth-grade students seems to be disengaged most of the time. The student—we'll call him Jim—makes only limited efforts to complete class assignments and never speaks up during discussions. Low-key, one-on-one conversations fail to elicit much information to help the teacher understand how to reach Jim. However, when a class assignment is given to demonstrate something each student likes to do, Jim becomes animated as he shows his expertise in skateboarding, his in-depth knowledge of boards, wheels, balance, and movement. Now, through observation, the teacher has some keys to unlock Jim's perceived resistance. Jim learns most effectively from a base of self-confidence, for instance. He is reluctant to venture into the unknown, and so one key to helping Jim on his learning journey is to tie new knowledge firmly to existing knowledge. Jim also prefers active engagement—he learns well kinesthetically—and so another key is finding ways to extend instruction beyond seat time into physical activity.

How teachers and learners feel about the learning situation affects their interactions. Students who dislike their life circumstances, whether the dislike arises directly from the school or elsewhere, carry that attitude into learning situations. Negativity in general usually negatively affects learning and causes resistance that teachers must recognize. Likewise, teachers themselves can feel negatively toward their work. They may feel burdened by too many students, too many responsibilities, too few choices about what, how, or who they teach. Such negativity blunts teachers' ability to discern learners' needs and to address them effectively. Choice versus compulsion often is the fulcrum: students' choice of learning strategies, teachers' choice of teaching strategies. Choice usually is seen as positive, whereas compulsion is viewed as negative. Some compulsion (for example, basic course requirements) may be necessary, but the key to successful teaching and learning is balance, just as it is a key to successful skateboarding.

None of this discussion of affect should be construed to say that all learning should be focused on happy-happy-happy. Rather teaching and learning needs to be structured in knowing ways that allow for learning situations to be positive, engaging, and fulfilling. Teacher self-understanding and knowing the learner help to make this happen.

This knowing the learner is complemented by knowing the lesson, which means not merely setting out tasks that may appear to lead to the learning destination but, rather, developing learning activities that link specifically to individual learners' discerned learning characteristics. In the learning design process, this is the third leg that works with teachers' self-understanding and knowing the learner to support and inform both day-to-day lessons and the totality of the learning journey, its length and breadth from starting point to destination.

On the surface this level of lesson responsiveness, of individualization, would appear to argue against a formalized curriculum. But such is not the case—if the curriculum is viewed as a general guidebook, rather than a set of prescriptions, for the learning journey. Guidebooks, after all, are intended for travelers of all conditions, those who go plodding along as well as those who skip and scramble. They offer optional sights and byways for those who need to meander toward a destination as well as straightaways and shortcuts for those who want to hurry along. What knowing the lesson does argue against is lockstep learning designs that force conformity—and often linearity—in modes and manners of teaching and learning. Such conformity is a form of compulsion. It cannot accommodate the range and variety of learners' individuality and does not permit teaching to be shaped and nuanced by teachers' self-understanding and knowledge of their students.

Knowing the learner and knowing the lesson, like self-understanding, are subject to continuous adjustment. This is a given. Learning is a journey. The one immutable characteristic of any journey is movement, which shifts the travelers' perspectives with every step.

1.4 Aligning Evaluation

All learning is a journey. Teaching is the act of helping learners to reach a particular destination—that is, to achieve a defined goal, regardless of the nature of the learning journey itself. Evaluation is the process by which teachers and learners determine whether the destination has been reached, the goal achieved.

The phrase "teachers and learners" is important. Evaluation in the context of learning is always formative—that is, designed to provide insights that "form," or shape, a future course of learning. The information provided through evaluation is essential to the learning process because it is equally valuable to teachers and learners, to help teachers better understand how to guide the learning journey and to help learners better understand their knowledge in the context of the learning journey. Thus evaluation occurs best in multiple applications so that periodic adjustments can be made in the course of the journey. Think of it this way: If a driver holds the steering wheel absolutely steady, the car will eventually run off the road. A driver must make adjustments to take into account changes in the road in order to steer consistently toward the destination.

Evaluation is deemed to be summative—that is, representing a summary of the learners' accomplishments—when a designated end point has been reached. Such end points, however, are not necessarily the destinations of true learning journeys. Rather, they are agreed on junctures in the learning journey when, for social, political, bureaucratic, or other reasons, evaluative results are used to judge and categorize.

If the goal is simple, then it is likely that the learning journey will be fairly straightforward and that the evaluation process can be equally simple. For example, if we want a student to learn how to add single-digit numbers, the learning journey is unlikely to require a highly elaborate instructional design. Evaluating whether this goal has been achieved need be no more complex than asking the student to demonstrate the single-digit addition process.

If the goal is complex, however, the learning journey will necessarily reflect that complexity, and so too must the evaluation process. For example, if we want a student to learn how to compose a successful paragraph, the learning design will need to incorporate learning about sentence structure and variety, transition words, sequencing, and other fairly sophisticated matters. A reasonable evaluative task will be to ask the student to write a demonstration paragraph, a relatively complex endeavor for the learner. And then the evaluator must determine the merits of the student's work, which is a similarly complex process.

Problems arise when simple evaluation processes are mismatched to complex learning goals or vice versa. A mismatch provides only misinformation. If the goal is to write a successful paragraph and success is evaluated using a simple multiple-choice grammar test, for instance, then the evaluation is a mismatch for the learning goal. Knowledge of grammar rules and conventions does not ensure that a student can construct a successful paragraph.

Matching learning goals and evaluation processes is termed *alignment*. Think of alignment as constructing a zebra-striped crosswalk on our learning journey from Point A to Point B. Alignment is a visible connector. Without attending to alignment, there is no reasonable way to conclude that the intended destination has been reached. Misalignment provides only misinformation—no rational basis for judging the success or failure of the teacher, the student, or the learning design.

The learner's capacity to demonstrate what has been learned must be understood in the context of the learning desired. The formative question for the teacher is, How did the learning design facilitate or inhibit learning? For the student a complementary question is, Am I on the right track in my learning journey? Teachers and students alike need to reflect on how the learning design affects learning processes.

1.5 What Is "Normal"?

Woven into the fabric of this paper is the theme of individuality, and individuals are infinitely variable. Students learn in different ways and at different rates. The problem of misalignment of learning goals and evaluation processes is exacerbated by expectations of "normality." Too often normality is prescribed by the so-called normal distribution of scores on tests. The "normal distribution" is popularly known as the bell curve. When an overlay of prescriptive normality is imposed on evaluation, the results are unreliable as indicators of progress toward a learning destination.

Carl Friedrich Gauss, a German mathematician, claimed to have hit upon the "normal distribution," or "continuous probability distribution," before the advent of the nineteenth century, though he did not publish it until a few years into the 1800s. In fact, Abraham de Moivre recorded the first "normal curve of error" in the 1730s but is rarely given credit. This distribution is not the only probability distribution in statistics, merely the most prominent. It is predicated on certain conditions, such as the central limit theorem, which states that the mean of a sufficiently large number of independent random variables will be approximately normally distributed—in other words, they will form a bell curve. The largest portion of the distribution will form the peak, or center, of the bell; and the variations will gradually tail off in either direction when the bell curve is graphically represented.

Adolph Quetelet, sometimes referred to as the father of quantitative social science, believed that the bell curve could be applied to social phenomena, which influenced social Darwinist ideology (Goertzel 1981). These permutations, among others, set the bell curve "of error" into education as a way of nominating an ideal, leaving behind its more appropriate use as a potential descriptor of actual performance.

Two key phrases to keep in mind are "sufficiently large number" and "independent random variables." For instance, if one could obtain a random sample of adult men worldwide and measure each man's height, one could plot the variations and find, in all probability, a normal distribution. Most men would cluster around the center at, let us say, between 5 and 6 ft tall. On either side of this peak, men of lesser height would tail off gradually to the left, and taller men would tail off to the right. In other words, at the tails, there would be very few men in the three-feet-tall or eight-feet-tall ends of the distribution.

But what if the men were not chosen at random and the sample was not particularly large? The bell curve distribution might hold as a general pattern, but the specifics could be very different. Pygmy men, for example, from the Aka or Mbuti peoples of central Africa would likely skew far to the left, peaking under the tribes' male average height of 5 ft. On the other hand, Watusi men average 6 ft 4 in., which would skew the distribution to the right.

Scores on classroom tests fail to meet both the large number and independent random variables criteria. Researchers O'Boyle and Aguinis (2012) suggest, alternatively, that distributions of individual performance—such as the learning of students at various levels of schooling—do not follow a Gaussian distribution but, rather, a Paretian distribution (see Fig. 1.2 showing a normal distribution overlaying one type of Paretian distribution). Named for Italian economist Vilfredo Pareto (1848–1923), this "power law" distribution, sometimes referred to as the "80/20 rule," was originally used to describe the allocation of wealth in Italian society—i.e., 80 % of the wealth generally rests in the hands of 20 % of the population. The distribution has broader applicability. The 80/20 rule is shorthand, not a fixed distribution; but it is consistent over many activities involving large groups of people and often fairly describes smaller groups as well.

For example, in a given classroom a small percentage of students is often responsible for achieving a large percentage of the top marks, on a sports team a small percentage of players is often responsible for garnering a large percentage of goals or points, and so forth. In education contexts the so-called Pareto Principle, rather than prescribing how students ought to perform, can be used to help students monitor their own learning. "Documenting a learner's errors using Pareto charts is an interesting way for learners to see evidence of growth, especially when they are working on discrete skills," according to staff development trainer Donna Curry (2001).

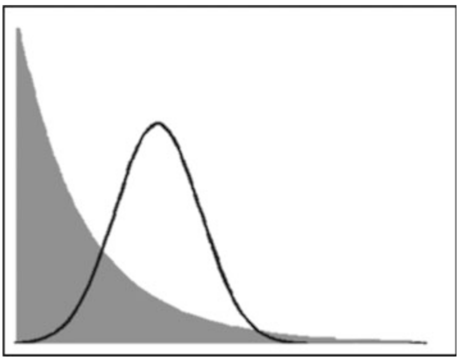

Fig. 1.2 Gaussian Curve overlaying Bell Curve

As practice experience and research like the work done by O'Boyle and Aguinis continues to accumulate, it seems hopeful that thoughtful educators and education policy makers may eventually be able to throw out the misleading bell curve and move away from prescribing how students ought to perform in favor of examining how students actually do perform and how learning can be encouraged, supported, and expanded for all students. At the very least, notions like the Pareto Principle can help educators reconsider what constitutes "normal" when it comes to teaching and learning.

1.6 Conclusion

The more keenly teachers hone their self-understanding, the more likely it is that learning design, implementation, and evaluation will become intuitive. The processes and approaches discussed in this paper form an approach to hands-on design research—that is, informal research collaboratively undertaken by teachers and learners that is therefore practice based and purpose driven. Such research informs intuition so that design, implementation, and evaluation become contextualized at a level approaching automaticity. In the words of Jane Fulton Suri (2008), chief creative officer at IDEO, a design and innovation firm in Palo Alto, California:

> Design research both *inspires imagination* and *informs intuition* through a variety of methods with related intents: to expose patterns underlying the rich reality of people's behaviors and experiences, to explore reactions to probes and prototypes, and to shed light on the unknown through iterative hypothesis and experiment (p. 54).

The metaphor of a journey—an exploration of the unknown—on which the travelers, both teachers and students, undertake to examine key questions is useful to frame the teaching–learning enterprise. Teachers' self-understanding is driven by a quest to know what *is* teaching, how can learning designs move very different learners from Point A to Point B of their learning journeys, what constitutes knowing the learner and knowing the lesson, and how can evaluation be aligned with both journey and destination in ways that inform learners and teachers about how learning can best be shaped. While destinations are important, what matters most in terms of designing learning from a deep basis of self-understanding is the learning journey.

References

Curry, D. (2001). The Pareto principle. *Field Notes*, *10*(3). System for Adult Basic Education Support, or SABES. Retrieved from http://www.sabes.org/resources/publications/fieldnotes/vol10/f03curry.htm.

Goertzel, T. (1981). The myth of the normal curve: A theoretical critique and examination of its role in teaching and research. *Humanity and Society, 5*, 14–31. (A condensed adaptation of this article, titled "The Myth of the Bell Curve.") Retrieved from http://crab.rutgers.edu/~goertzel/normalcurve.htm.

Maddux, C. D., Johnson, D. L., & Willis, J. W. (2001). *Educational computing: Learning with tomorrow's technologies* (3rd ed.). Boston: Pearson.

O'Boyle, Jr., E., & Aguinis, H. (2012). The best and the rest: Revisiting the norm of normality of individual performance. *Personnel Psychology, 65*(1), 79–119. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1744-6570.2011.01239.x/full.

Suri, J. F. (2008). Informing our intuition: Design research for radical innovation. *Rotman Management Magazine* (Winter), 53–57.

Walling, D. R. (2006). *Teaching writing to visual, auditory, and kinesthetic learners*. Thousand Oaks, CA: Corwin.

Chapter 2
The Impact of Instructional Design: Questions of Conscience

J. Michael Spector

Abstract Information and communications technologies that can be used in support of learning, performance, and instruction are changing at a rapid pace. There is now a vast array of learning resources available via the Internet, and there are many powerful and affordable mobile learning devices and applications that can be used in support of education and training. This situation creates serious challenges for instructional designers who are charged with recommending, selecting, sequencing, configuring, assessing, and/or managing educational resources and learning activities that comprise courses and programs of instruction. In addition to the burden of helping to create effective, engaging, and efficient learning environments and instructional systems, instructional designers have to live with a legacy of failing to deliver on previous promises to use technology to dramatically improve learning and instruction. What seems to be happening is that there is a tension between a need to rely on instructional designers to cope with the complexities and challenges of planning and implementing learning environments in the digital age and a general distrust of instructional designers to deliver on promises to transform education using new technologies. Issues pertaining to this tension are the focus of this piece.

Keywords Educational components · Emerging technologies · Information and communications technologies · Holistic approaches · Instructional design · Technology integration

2.1 Introduction

Dijkstra (1972) claimed that computers had not solved a single problem; they had only introduced the new problem of learning to use them effectively. The same might be said with regard to educational technology. There are many powerful and

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affordable technologies now available for integration into learning environments and instructional systems (Spector 2007, 2010, 2016; Spector and Ren 2015). The challenge is to make effective and efficient use of these technologies to support learning, performance, and instruction (Spector and Anderson 2000; Tennyson 1995). However, that challenge has not been met and increases as new technologies continue to emerge at a rapid rate (Cecez-Kecmanovic et al. 2014; Ely and Plomp 1986; Klassen et al. 2011; Natividad et al. 2015; Spector and Anderson 2000; Suppes 1978).

There have been many projects that achieved significant results and that provided a foundation for subsequent educational technology projects—especially notable were the Jasper Woodbury Project at Vanderbilt University (CTGV 1992) and the CSILE Project at the Ontario Institute for Studies in Education (Scardamalia et al. 1989). While these projects were remarkable in lighting the way for anchored instruction, collaborative learning, inquiry learning, and knowledge building, they had little impact in terms of large scale, sustained integration into curricula and instruction.

Only a very few educational efforts have managed to achieve sustained impact on a large scale. Two that come to mind in the USA are the Head Start Program and Sesame Street.

The Head Start Program was initiated in 1965 and continues to exist. Head Start was aimed at providing early childhood education, health, and nutrition to low-income children and their families. Head Start was an integral part of President Lyndon Johnson's so-call War on Poverty that began as a summer program to help disadvantaged children catch-up with their age group (Peck and Bell 2014).

The Sesame Street public preschool education television program was initiated in 1969, and still continues in 2015. Sesame Street was a result of a Carnegie Corporation grant to establish the Children's Television Workshop and was subsequently funded by the Ford Foundation and the U.S. Corporation for Public Broadcasting (Fisch and Truglio 2001).

One outcome of the success of Sesame Street was a prediction that educational television would transform instruction in public schools by putting a televised expert in every classroom to speak about every subject. That did not happen, although recorded talks by well-known experts were circulated by videotape and later in digital format. However, there has been no record of those recordings having a significant impact on learning. The modern counterpart of that experience is in the form of a MOOC (massive open online course), about which predictions are being made about radical transformation and significant impact on learning and instruction. No evidence of significant impact on learning is yet to be developed for MOOCs. While there is an appropriate place (in terms of a learning progression) to integrate such efforts into learning environments and instructional systems, there is no basis on which to make claims of dramatic improvements in learning based on such efforts.

The question that should be continually asked with regard to a new educational technology is whether and to what extent use of that technology will impact learning, performance, and/or instruction (Pirnay-Dummer et al. 2010; van

Merriënboer and Sweller 2005; Volkema 2010). The reminder that needs to accompany proposals to integrate new technologies is simple—namely, the challenge is not simply to put the technology in place; rather, the challenge is to make effective and efficient of a new technology (Clark 2014; Cuban 2001; Davies 2011). That potential certainly exists as many new technologies provide rich opportunities to engage and empower learners and those who support learners (An and Reigeluth 2011; Collins et al. 1991; NMC 2015; Paas et al. 2010). The remaining remarks provide one way to think about these challenges and reframe expectations with regard to emerging technologies and promises to transform learning and instruction using these technologies.

2.2 Discussion

If one accepts the general conclusion that the impact of information and communication technologies on learning and instruction has been much less than predicted, then one might be inclined to blame instructional designers—those who are responsible for planning, implementing, managing, and evaluating learning environments and instructional systems. While instructional designers have a responsibility to provide effective and efficient support of learning and instruction, including the use of appropriate technologies and strategies, they are not entirely at fault.

There are more fundamental issues that impede systematic, systemic, and sustained integration of new and emerging education technologies. The connections that should exist between educational, learning, and instructional theory, research, practice, and policy are seldom closely or effectively aligned. The researchers involved in Jasper Woodbury and CSILE did conduct studies in schools, but adjustments were not made in school practice and policy to ensure the continuation of support and dissemination of those efforts when the projects ended. Few if any school policies emerged from those projects that made systematic changes in curricula and educational practice that directly supported the kinds of anchored inquiry learning and collaborative knowledge building involved in those projects. Practice and policy were not changed as a result of research and theory. Without changes in practice and policy, instructional designers have limited opportunities to transform learning environments and instructional systems. It should be acknowledged, however, that many small-scale changes are occurring, thanks to the efforts of well-documented research and knowledgeable instructional designers.

Breakdowns in the chain of influence from research and theory into practice and policy occur at various places for many reasons, including lack of resources, differing priorities, disparate perspectives among stakeholders, and so on. Education systems are quite complex with many different components, involving a diversity of people and technologies, working with a variety of learners and learning tasks, toward goals that are often vague (see Fig. 2.1). This makes measurement of progress difficult and challenging. Without clear evidence of positive change, policymakers are reluctant to invest the resources required to support and maintain the continuation of many promising efforts.

Figure 2.1 depicts a simple way to conceptualize the components that comprise an instructional system or learning environment. Challenges in constructing meaningful educational systems occur at every level. At the lowest level in this hierarchy are the many resources available via the Internet. Many of these information objects may not consist of reliable or accurate information; they may be disassociated from a context; and they may not be configured or structured in a manner that is pertinent to the instructional design effort underway. Associating relevant and reliable validated information resources (a.k.a. knowledge objects) with a learning goal results in what might be considered a learning object. Many of these can be found in various MOOCs. While MOOCs are a relatively new development, only recently have MOOCs been designed by professionals (i.e., trained and experienced instructional designers). Moreover, MOOCs typically lack aspects normally considered part and parcel of a course—namely, learning activities with timely and informative feedback along with assessments to track development of a student's knowledge, skill, and competency. When personalized learning and instruction become a reality, MOOCs might eventually have a significant impact on learning. At their best, MOOCs have provided some access to education previously not available, and they have in a few cases led to communities of learners. The 'C' is 'MOOC' could stand for 'community'. However, there are many barriers involving privacy, proprietary rights, and more that stand in the way of big data and learning analytics taking MOOCs to a higher level.

In summary, there are many tensions, barriers, and issues that are obstacles to systemic and sustained progress in making effective and efficient use of technologies to support learning and instruction. Roblyer and Doering (2013) mention the following issues (and others) that challenge effective technology integration:

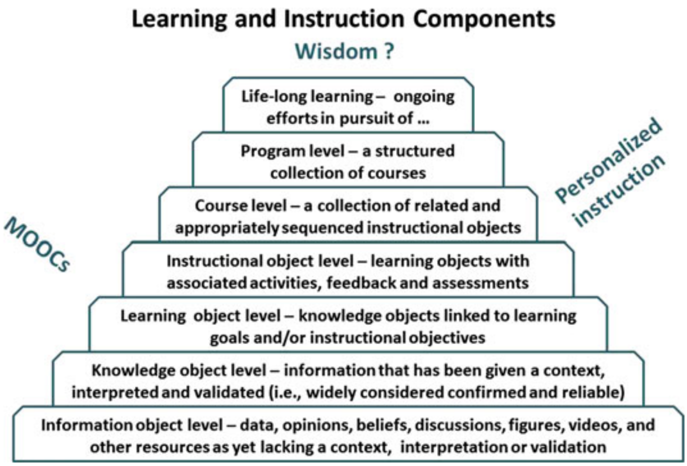

Fig. 2.1 Learning and instructional objects hierarchy

- The standards movement—this accountability movement creates expectations for what schools and teachers should do, with associated consequences; as a result, there are constraints on how innovative teachers and designers can be in embracing new approaches and technologies.
- Funding issues—federal and state funding of education has not grown much in the last 20 years in the USA, and in some cases funding has been declining; the cost of implementing new technologies and reshaping programs requires initial investments that are quite limited.
- The digital divide—integrating new technologies can put learners with limited access to those technologies at a disadvantage in their studies; the digital divide, when coupled with racial and gender issues, are serious policy challenges at every level.
- Distance education—virtual schools are appearing and traditional schools and colleges are offering more and more online courses; this creates enrollment and subsequent funding challenges, and it puts a burden on students pushed into distance learning situations who are not well prepared for the demands of those environments (e.g., success in online environments requires high degrees of self-regulation, motivation, and volition).
- Information and digital literacy—the effective use and integration of Internet-based resources requires a high degree of knowledge and skill on the part of designers, teachers and students in finding, interpreting, using and/or constructing meaningful, relevant, and reliable resources.
- Privacy, plagiarism, and Luddism—many challenges involve privacy rights and plagiarism as well as issues pertaining to work completed online without direct supervision; in addition, there are many (a.k.a Luddites) who are simply opposed to change and new technology for any number of other reasons (Ertmer and Ottenbreit-Leftwich 2010; Rogers 2003).

Another way to cluster these obstacles is in terms of (a) policy issues, (b) funding issues, and (c) expertise issues. Policy issues are perhaps the most critical in advancing progress in the area of instructional design and educational technology (Harris and Walling 2014). Policy issues are often not aligned with actual educational practices. One example of this issue now unfolding involves the Next Generation Science Standards, developed in the USA between 2010 and 2013, which are intended to emphasize understanding of the application of scientific knowledge and integration of engineering with science (see http://www.nextgenscience.org/). One of these standards for 8th grade science is to determine the factors that affect electric and magnetic forces. That standard recommends having students explore electromagnetic forces by constructing and testing an electromagnetic motor. The time allotted to teach this standard in a typical 8th grade physical science course is about a week or five 50-min lessons. The National Technology Leadership Summit (see http://ntlcoalition.org/) has been exploring this standard and its implementation in schools for 3 years and has come to the conclusion that it cannot be accomplished without substantial support (e.g., lessons and demonstrations about electromagnetic forces, an individual exercise to build a simple solenoid switch, a partially constructed electromagnetic motor followed by a small group exercise to complete the motor, test it under various conditions and explain the results of those tests). Using electricity in combination with magnetism to create mechanical movement is the technology underpinning that standard. Explaining how and why that is possible and what conditions influence the strength of the motor or switch comprise the desired science outcomes. The fact that it is yet to happen reflects a lack of alignment between a policy (in this case a national standard) and the realities of teaching and learning in a middle school in the USA. On the other hand, the new standards do reflect an approach to learning that is situated and engaging (Lave and Wenger 1991), so that standard, if properly implemented, might reflect an impact of Jasper Woodbury and CSILE.

Funding issues are the ones most often cited for lack of attainment of promised outcomes of integrating a new technology. It is generally true that limited funding limits what can be done. The researchers who create powerful educational technologies generally do so free from the funding constraints faced by educational institutions. A researcher wants to know what might be possible. Educational administrators want to know what can be done given the many constraints that exist.

There are additional challenges involving the expertise of school personnel (e.g., teachers, technicians, technology coordinators, media specialists, information systems personnel, etc.). The common thing for many educational support personnel is to do that with which they are already familiar and understand. This is not unreasonable given the reality that these people are typically quite busy and overwhelmed with existing tasks. When asked to implement something new, there is resistance, and many lack the required expertise. Training and providing professional development are then needed, but, given the funding constraints already mentioned, it becomes a challenge to train and retrain well-qualified personnel to support new educational technologies.

2.3 Conclusion

Briefly stated, the challenge facing an instructional designer is to plan, implement, test, deploy, and evaluate lessons, courses, and learning environments that are likely to be learning and cost-effective given (a) unlimited learning resources available on the Internet, (b) the power, flexibility, and mobility of available technologies, (c) the diversity of learners, and (d) ambitious learning goals and objectives. Overcoming the issues previously discussed requires recognizing a variety of learning perspectives and instructional approaches and getting those with very different backgrounds and expertise to work in unison toward reasonably well-defined and attainable goals. Rather than disparage those with different learning perspectives and instructional approaches, more could be accomplished by collaborating across various arbitrary boundaries that now divide professional practitioners (e.g., instructional designers vs. learning scientists, or direct instruction vs. open-ended inquiry).

Will instructional design and educational technologies begin to have a significant and positive impact on learning, performance, and instruction in the twenty-first century? There are some 85 years remaining to find out. Certainly policymakers, administrators, educators, researchers, and instructional designers can do better than the record established in the twentieth century. That century could be characterized as one of amazing new technologies that had little impact on systematic, systemic, large-scale sustained improvements in learning. We can do better.

References

An, Y., & Reigeluth, C. M. (2011). Creating technology-enhanced, learner-centered classrooms: K-12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education, 28*(2), 54–62.

Cecez-Kecmanovic, D., Kautz, K., & Abrahall, R. (2014). Reframing success and failure of information systems: A performative perspective. *MIS Quarterly, 38*(2), 561–588.

Clark, R. E. (2004). What works in distance learning: Instructional strategies. In H. O'Neil (Ed.), *What works in distance learning: Guidelines*. Greenwich, CT: Information Age Publishers.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making things visible. *American Educator*, *15*(3), 6–11, 38–46.

CTGV (Cognition and Technology Group at Vanderbilt). (1992). The Jasper Series as an example of anchored instruction: theory, program, description, and assessment data. *Educational Psychologist, 27*(3), 291–315.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

Davies, R. S. (2011). A framework for evaluating educational technology integration. *Tech Trends, 45*(5), 45–52.

Dijkstra, E. W. (1972). The humble programmer. *Communications of the ACM, 15*(10), 859–866.

Ely, D., & Plomp, T. (1986). The promises of educational technology: A reassessment. *International Review of Education, 32*(2), 231–249.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42* (3), 255–284.

Fisch, S. M., & Truglio, R. T. (2001). *"G" is for growing: Thirty years of research on children and Sesame Street*. Mahwah, NJ: Erlbaum.

Harris, P., & Walling, D. P. (2014). Policies governing educational technology practice and research. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (4th edn., pp. 627–640). New York: springer.

Klassen, R. M., Tze, V. M. C., Betts, S. M., & Gordon, K. A. (2011). Teacher efficacy research 1998–2009: Signs of progress or unfulfilled promise? *Educational Psychology Review, 23*(1), 21–43.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Natividad, G., Mayes, R., Choi, J-I, & Spector, J. M. (2015). Balancing stable educational goals with changing educational technologies. *E-Mentor*, *1*(58), 83–94. Retrieved from http://www.e-mentor.edu.pl/artykul/index/numer/58/id/1160.

NMC (2015). *Horizon report: 2015 higher education edition*. Retrieved from http://www.nmc.org/publication/nmc-horizon-report-2015-higher-education-edition/.

Paas, F., Alexander Renkl, A., & John Sweller, J. (2010). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist, 38*(1), 1–4.

Peck, L. R., & Bell, S. H. (2014). The role of program quality in determining Head Start's impact on child development [OPRE Report #2014-10]. Washington, DC: Office of Planning, Research and Evaluation, U.S. Department of Health and Human Services.

Pirnay-Dummer, P., Ifenthaler, D., & Spector, J. M. (2010). Highly integrated model assessment technology and tools. *Educational Technology Research and Development, 58*(1), 3–18.

Roblyer, M. D., & Doering, A. H. (2013). *Integrating educational technology into teaching* (6th ed.). Boston, MA: Pearson.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Scardamalia, M., Bereiter, C., McLean, R. S., Swallow, J., & Woodruff, E. (1989). Computer supported intentional learning environments. *Journal of Educational Computing Research, 5*, 51–68.

Spector, J. M. (2007). Emerging educational technologies and research directions. *Educational Technology & Society, 16*(2), 21–32.

Spector, J. M. (2010). Educational technology and change. *Techtrends: Linking Research & Practice to Improve Learning, 54*(5), 6–7.

Spector, J. M. (2016). *Foundations of educational technology: Integrative approaches and interdisciplinary perspectives* (2nd ed.). New York: Routledge.

Spector, J. M., & Anderson, T. M. (Eds.). (2000). *Integrated and holistic perspectives on learning, instruction and technology: Understanding complexity*. Dordrecht: Kluwer.

Spector, J. M., & Ren, Y. (2015). History of educational technology. In J. M. Spector (Ed.), *Encyclopedia of educational technology* (pp. 335–344). Thousand Oaks, CA: Sage Publications.

Suppes, P. (Ed.). (1978). *Impact of research on education: Some case studies*. Washington, DC: National Academy of Education.

Tennyson, R. (1995). Instructional systems development: The fourth generation. In R. Tennyson & A. Barron (Eds.), *Automating instructional design: Computer-based development and delivery tools* (pp. 33–78). New York: Springer.

van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147–177.

Volkema, R. J. (2010). Designing effective projects: Decision options for maximizing learning and project success. *Journal of Management Education*, *34*(4), 527–550. Retrieved from http://jme.sagepub.com/content/34/4/527.

Chapter 3
Using Data Analytics to Drive Performance and Instructional Decision-Making

Tristan E. Johnson

Abstract Data is automatically generated in many of the common behaviors that we engage in on a daily basis. However, while we may carry out analytics in an attempt to make meaning from this "incidental" data, there is a need at many levels to conceptualize the types of data that would deliberately inform decision-making. There are well-grounded processes that may be followed to identify the "strategic" data that are needed in order for analytics to effectively and strategically inform performance and instructional decision-making.

Keywords Data analytics · Learning analytics · Learning assessments · Theoretical framework · Impactful technology · Expertise development · Deliberate practice · Mediating mechanisms · Strategic data

3.1 Introduction

Data is automatically generated in many of the common behaviors that we engage in on a daily basis. However, while we may carry out analytics in an attempt to make meaning from this "incidental" data, there is a need at many levels to be more strategic in collecting the types of data that would deliberately inform decision-making. There are well-grounded processes that may be followed to identify the "strategic" data that are needed in order for analytics to effectively and strategically inform performance and instructional decision-making.

The big challenge is that having access to data does not mean that we are going to able to make sense of it. If we cannot make sense of the data then how can we carry out our mission to help people learn? As educators we have a unifying goal to help people learn and have a better life. One of the biggest educational challenges is knowing how best to deal with human variability. There are many nuances and individual differences—it can be very challenging to know what to do to impact

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learning. A plausible solution is to use data analytics to bring about our dream of helping all mankind learn. But what are the challenges? Where do we need to go from here? These questions can be answered by developing an assessment framework to provide the results from various data in order to make decisions and drive learning and performance.

3.2 Optimization Through Assessment

In looking at workplace education and training, we can see many constraints on initiatives. One of the key ideas that has been brought to the forefront was from one of the lead learning strategists who emphasized that according to her organization they do not train as much as they can. They train to the lowest point that is needed to reach minimum performance criteria and no more.

There is a lot of meaning with this position. From a systems perspective it is talking about optimization. There is the notion of designer/teacher responsibility in doing the best that we can to advance learning. This then drives efficiency. The key mechanism to drive efficiency is to build the right infrastructure and technology. In a nutshell, this can be operationalized as data analytics where the best benefit occurs when it is applied strategically thereby improving performance.

Let us take a look at a system that is part of our daily life and see what we can understand about transformative technology. Impactful technology requires (1) successive developmental approximations over long periods of time, (2) a focus (a strategic plan) so that the work being done is moving in a forward direction, and (3) involvement of many teams of innovators who compete yet guide each other toward the end goal.

3.3 Global Positioning

Knowing where something is has been important for mankind. There are stories about forefathers who wanted to know where they were and what was around them. These stories involve Explorers, Discovers, Travelers, and Scientists, all of whom have longed to know where they were on the Earth. To locate their position, they developed techniques that used the sun and stars to help them understand where they were, both in relation to the Earth and to their place within the universe, ultimately leading to understanding mankind’s role in the cosmos. It is interesting that in order to understand themselves, they had to look outward first.

The techniques used to determine one’s position involved calculating two positions. The specific data for geographic coordinates that specify a point on Earth’s surface is known as Longitude—east-west position, and Latitude—north–

south position. Latitude was easy to calculate as it is based on the altitude of the sun at noon. This is measured with the aid of a sun's declination table for a specific day or from many stars at night. However, longitude was difficult to calculate. Ocean navigators relied on dead reckoning skills. Measurements were inaccurate on long voyages without sight of land, in part due to the fact that it was difficult to keep accurate time while at sea for many months. The measurement of Longitude was historically a most important practical application for safe ocean navigation. The end solution was centered in solar time equals longitude. Keep in mind that finding a method of determining longitude took centuries and involved some of the greatest scientific minds, as well as using the greatest craftsmen perfecting the most accurate clocks in the world.

Modern-day explorers use geographic coordinate data for global positioning. This data describes where one is on the surface of the earth. Using this technology to provide data was tremendously difficult initially. What you found were several competing systems across many different sectors. In 1973 a group was formed to create a plan so that a superior system could be developed by synthesizing the best technologies. The new system was called the Global Positioning System (GPS). This approach was based on many years of expertise across a number of disciplines. Since that time, continued improvements of the system have occurred.

The Global Positioning System (GPS) is comprised of three segments.

1. GPS Satellite Constellation—The space segment (SS) is composed of the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance.
2. Ground Control Network—The control segment is composed of a master control station (MCS), four dedicated ground antennas, and six dedicated monitor stations. The MCS operates the system and provides command and control functions for the satellite constellation.
3. User Equipment—The user segment is composed of two positioning services.

   - GPS Precise Positioning Service—defense use (secure system), hundreds of thousands units
   - GPS Standard Positioning Service—civil, commercial, and scientific use—tens of millions units

The user equipment, often referred to as "GPS receivers," captures and processes L-band signals from the satellites in view for the computation of user position, velocity, and time.

Multibillion-dollar satellites have been deployed over many years with successive improvements. To illustrate the development over time here are a few key events related to the GPS. What we see from this chronology is the progress of innovative development with successive improvement, with decreasing costs, and ultimately the proliferation in modern society (Table 3.1).

Table 3.1 Key events in the progress and development of the global positioning system

Event	Progress and developmental details
First satellite launched	• In 1978, the first experimental Block-I GPS satellite was launched
Size and weight reduction	• In 1991, a project to create a miniature GPS receiver replaced the previous 50 lb military receivers with a 2.75 lb handheld receiver
Sharing of technology to a civilian use	• In 1996, U.S. President Bill Clinton issued a policy directive declaring GPS a dual-use system
Enhancement in accuracy and reliability	• In 1998, United States Vice President Al Gore announced plans to upgrade GPS with two new civilian signals for enhanced user accuracy and reliability, particularly with respect to aviation safety • Low-cost, single-receiver SPS projects (100 m accuracy) • Medium-cost, differential SPS code Positioning (1–10 m accuracy) • High-cost, single-receiver PPS projects (20 m accuracy) • High-cost, differential carrier phase surveys (1 mm–1 cm accuracy)
Application to mobile phone	• In November 2004, Qualcomm announced successful tests of assisted GPS for mobile phones

3.4 GPS and Learning

So how does this relate to data analytics in learning settings? Just as with the global positioning problem, there is an initial need, a need for information. Then there is the need for making sense of the information to be applied to a practical problem. In the field of learning, just as for sailors at sea, there is a need for understanding where the student is in relation to where they want to be. By understanding better their learning location, the learner and the instructor can:

- Navigate a course of action with assurance
- Coordinate with others
- Know how confident they are in making decisions
- Understand how far they have progressed
- Diagnose their learning deficiencies.

3.5 Impactful Technology

The example of the GPS shows us the key ideas that we need to consider when dealing with data analytics applied to performance and learning solutions. What we have seen from impactful innovative technology is that it:

(1) Involves many teams of innovators with competing ideas;
(2) Requires successive developmental improvements over long time periods;
(3) Serves to focus (strategic plan) the collective efforts to move the work in a forward direction; and
(4) Has a broad impact on the target population (high value/low cost).

Let us take a look as these key factors and how they apply to learning analytics.

There is a need for a multifaceted approach to solve our learning and education challenges. It is important to bring researchers and practitioners together who are essentially competing such that they have individual expertise, yet see the value to join forces to lead the development of future technology. Some of the individuals that might have a strong interest in developing data analytics for learning could include: Educational Technologists, Computer Scientists, Software Engineers, Mathematicians, Information Technologist, Teachers, Learning Scientists, Cognitive Psychologists, Programmers, Philosophers, Data Scientists, Informatics Specialists, Instructional Designers, and Database Engineers.

From working together, there are many lessons that stakeholders have learned about working in the data analytics space. Some of the insights we have gained about data analytics include the following:

- Data analytics gives us an answer but this is not necessarily THE answer
- Data analytics predict better than we usually can predict
- Data analytics enable us to see that there is more than one right answer
- Data analytics do not get rid of the messiness of dealing with complexity
- Data analytics support the users to simplify the reasoning behind the logic and not just providing pages of data
- Data analytics models need to be scrutinized
- Results need to be validated
- There is no single best tool or methods
- Data that you need is not always in form that you can process
- There can be data issues—data merge or reformat or not good data
- Not all data are equally available
- Computer programming is needed to get data
- Insight or approach might add value but maybe not enough value.

While all these lessons perhaps seem simple, one of the more difficult and complex tasks needed to further this type of technology development is taking existing scientific methods from different fields and combining them to create the needed innovation.

3.6 Strategy and Focus

A critical component for moving forward and making progress is to have a focus (a strategic plan). There are many possible solutions to our learning challenges. Some solutions have better accuracy and reliability. For example, we know what instructional strategies work at a macro level. But what we are seeing is that we need to have strategies that can be customized at an individual level yet delivered to the masses—Mass Customization. One of the most promising areas in learning is to have individual-level feedback on a large scale. For example, formative assessments are needed to improve learning efficiencies but the framework for developing the algorithms are missing and very complex to develop. The cost of developing these algorithms is high; in order for the development to be cost-effective they would to be produced on a large scale.

3.7 Strategy for Using Data Analytics to Create Meaningful Assessments to Drive Performance and Enhance Instructional Decision-Making

Let us consider a systems approach to our problem of feedback. In order to design training and other activities to improve human performance in any domain, successful performance must be understood. Much of this understanding may be gained by effectively identifying and studying exceptional performers.

The expertise approach identifies how the superior performance mechanisms elicited from comparisons of expert and competent performers can be acquired through training and practice. Teaching and developing the use of these mechanisms through deliberate practice should allow learning organizations to continually improve their skills and to pass them on to others (Ericsson et al. 1993).

A systematic approach for understanding expert performance includes:

1. Measuring performance;
2. Identifying both superior and expert performers;
3. Understanding the mechanisms that allow individuals to excel; and
4. Using this information to inform future training and performance improvement strategies.

The expert performance approach (Ericsson and Smith 1991) offers an effective method for identifying mediators of expert performance in selected domains and understanding how these mediators can be acquired. This approach can be applied to performance assessment and feedback. The objectives of the expertise approach are to (1) discover the mediating mechanisms that drive superior and/or expert performance in specific domains and to (2) establish training methods to ensure that the learners acquire the mediating mechanisms of superior and/or expert performance in their domains. An expertise approach can identify specific motor and knowledge-based cognitive mechanisms that are applied in establishing the essence of effective, high-level domain performance.

3.8 Measure Performance

3.8.1 Step 1: Identify Representative Tasks

The initial step is to accurately identify representative, discriminating tasks that are intrinsic to domain performance, that can be captured in a controlled environment, and in which experts can exhibit superior, reproducible performance (Ericsson and Smith 1991). These tasks allow an expert to consistently demonstrate a significantly higher level of performance than an individual who may only display competence in the domain.

3.9 Identify Expert Performers

3.9.1 Step 2: Select Expert and Nonexpert Performers

The next step is to identify expert and non-expert, or novice, performers in the domain. This can be difficult since those who have been in the domain for many years may not have developed expertise but merely the ability to perform adequately and follow the "rules." In sports or games, there are measurements that can objectively define the superior performers. However, in many domains, experts can only be identified with subjective assessment protocols such as observer consensus techniques.

For example, stockbrokers are often referred to as "experts" in stock selection, though few of them outpace the market averages, and then not for a protracted period (Elton et al. 1993). Often their supposed "expertise" is in their ability to convince investors that they can pick the fastest growing securities. Thus it becomes important to adhere to principles described in the previous section in order to accurately select truly superior performers and less-skilled performers.

3.10 Identify Mediating Mechanisms

3.10.1 Step 3: Analyze Performance to Understand Mechanisms that Allow Individuals to Excel

Once experts and nonexperts have been defined and selected, they can be tested on the representative tasks using observation of performance, verbal protocols, and historical information gathering to determine differences between expert performers and less-skilled performers. An analysis of these differences can determine the mediating mechanisms, that is, mechanisms that mediate expert performance in the domain or skill specialty.

In addition to direct observation, comparison of skilled and unskilled players in thought processes can be identified by verbal protocols (Ericsson and Simon 1993), which provide vital information about the mediating mechanisms of highly skilled performance. A verbal protocol can be elicited by training a performer to "think aloud" as he or she performs a task. For example, in sports the evidence of an expert's anticipation of an opponent's shot, which can be obtained through think-aloud protocols, gives coach and pupil a mediator that must be acquired in order to improve performance.

Mediators of performance may be identified by simulating representative tasks, either in a controlled environment or in the field. For example, flight simulators duplicate the conditions in an aircraft cockpit but present little, if any, safety hazard if pilot error occurs. In addition, some militaries run "war games" which incorporate representative tasks across the combat context. However, there are no scientifically evaluated differences between the best performers and others. Assessing these differences can be valuable in understanding how and why individuals differ in performance and the mediating mechanisms necessary for superior and/or expert performance.

By observing the differences between expert and less-skilled performers, and by analyzing verbal protocols taken from the participants, indicators of the cognitive processes that mediate the superior performance can be determined (Ericsson and Smith 1991; Ericsson and Simon 1993). In badminton, the player who is able to most quickly predict the shuttle's path has a big advantage in moving to the best position to return it. If one does not locate the shuttle before it is hit, he or she may not be able to reach it before it has passed. In a combat situation, the officer who can strategically coordinate his or her weapons quickly and effectively and repel enemy air or sea attack will survive to say, "Mission accomplished." Once the mediators have been identified, additional studies can be developed to draw out critical aspects (Ericsson and Smith 1991).

3.11 Facilitate Acquisition of Mediating Mechanisms

3.11.1 Step 4: Use Information to Drive Future Training and Performance Improvement Strategies

Following the determination of mediating mechanisms, one can begin to address which previous instruction and domain activities are linked to the observed expert performance and how the mediating mechanisms are acquired. A daily training program or other appropriate performance improvement intervention can then be established that focuses on the acquisition of these mechanisms.

The acquisition of specific, high-level cognitive and motor skills has been shown to be largely a result of deliberate practice. The term deliberate practice describes training activities that have been specially designed, often by a coach or mentor, to improve some particular aspect of an individual's target performance (Ericsson et al. 1993). In this regard, deliberate practice can be distinguished from time spent simply engaging in the activity for its own sake, without a specific goal of improving performance.

In badminton, for example, cues are transmitted to the knowledgeable opponent by the opponent's arm and racquet movement. Knowing this fact facilitates the development of training programs that will allow trainees to acquire this anticipatory advantage. In combat, observing enemy positions will convey to the knowledgeable officer when and where an attack is most likely to occur and thus allow for better strategic planning and decision-making in setting defenses and exploiting enemy weaknesses.

3.12 Broad Impact on Learning

In summary, the expertise approach may provide an innovative method of identifying superior and expert performers, defining mechanisms that mediate highly skilled performance, evaluating performance, identifying performance weaknesses, and providing the fundamentals for developing effective learning and training techniques for domain growth.

Coupling an expertise approach that specifically focuses on identifying key components of performance expertise with a data analytics approach that has the power to numerically and mathematically analyze data in an automated way, we are approaching the potential that we have seen in the GPS technology applied to learning analytics. The application of the data can be used in various ways from looking at a learning system to looking at a group of learners to providing specific relevant feedback to a specific learner.

With big data, we have seen how we can collect many points of data from a number of disparate conditions, but making meaning from the data is critical to creating value. If we can strategically identify mediating mechanisms that are key to superior performance, we can set up reporting and feedback systems that can comprise a learning analytics logic framework to provide data analytic-driven assessments thereby driving performance and enhancing instructional decision-making.

References

Elton, E. J., Gruber, M. J., Das, S., & Hlavka, M. (1993). Efficiency with costly information: A reinterpretation of evidence from managed portfolios. *The Review of Financial Studies, 6*(1), 1–22.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis*. Cambridge, MA: The MIT Press.

Ericsson, K. A., & Smith, J. (1991). Prospects and limits of the empirical study of expertise: An introduction. In K. A. Ericsson & J. Smith (Eds.), *Toward a theory of expertise: Prospects and limits* (pp. 1–38). Cambridge: Cambridge University Press.

Ericsson, K. A., Krampe, R. T. H., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363–406.

Chapter 4
Learning Analytics: Serving the Learning Process Design and Optimization

Yanyan Li, Haogang Bao and Chang Xu

Abstract Data growth in the information era is changing commercial and scientific research. In educational settings, a key question to address is how to effectively use the massive and complex data to serve the teaching and learning optimization. Therefore, as an emerging data analysis technology, learning analytics increasingly draws more attention. This paper proposes a process model of learning analytics, reviews the research and challenges of multi-source educational data collection and storage, generalizes typical data analysis approaches, and elaborates on how to align learning analytics with pedagogical and organizational goals.

Keywords Learning analytics · Process model · Educational data collection · Pedagogical context

4.1 Introduction

The proliferation of diverse learning environments, such as learning management systems (LMS), online learning communities, personal learning environments (PLE), and adaptive learning systems, produces impressive amounts of data. Different types of data relating to learners' learning process can be tracked and stored, which makes it possible to identify the preferences of the students, refine teaching methods to better fit students' needs, and provide empirical evidence for educational decision-making. Nevertheless, exploitation of such available educational data is still rare. In educational settings, a key issue to address is how to

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effectively use the massive and complex data to serve the teaching and learning optimization.

Learning analytics (LA) is an emerging field in which sophisticated analytic tools are used to improve learning and education. Different from other similar fields, like business intelligence, academic analytics, and educational data mining, learning analytics aims at serving the design and optimization of the learning process. While some studies have been carried out on LA, other issues that potentially affect the acceptance and impact of LA, like the compatibility of datasets, privacy, and interpretation of results, still remain to be explored. The implementation of LA in the learning process also must be carefully crafted in order to be successful and beneficial (Greller and Drachsler 2012).

This necessity motivated researchers to identify critical LA factors or dimensions which needs to be reckoned with to ensure an appropriate exploitation of LA in educational settings. Elias proposed an ongoing three-phase cycle that aims at the continual improvement of learning and teaching. The three phases comprise data gathering, information processing, and knowledge application (Elias 2011). With a general morphological analysis approach, Greller and Drachsler (2012) outlined a generic design framework composed of six dimensions (i.e., stakeholders, objectives, data, instruments, external constraints, and internal limitations) deduced from discussions in the emerging research community. In addition, Chatti et al. (2012) described a reference model for LA based on four dimensions, namely data and environments (what?), stakeholders (who?), objectives (why?), and methods (how?).

By summarizing the essential factors of LA, this paper proposes a process model of learning analytics from the data processing cycle perspective. The remainder of this paper is organized as follows. Section 4.2 presents the process model of learning analytics; Sect. 4.3 introduces the status and challenges of multisource data collecting and storage; Sect. 4.4 generalizes typical data analysis approaches; Sect. 4.5 elaborates on how to optimize learning and teaching, and Sect. 4.6 concludes the paper.

4.2 Process Model of Learning Analytics

As illustrated in Fig. 4.1, the overall LA process is an iterative cycle. To better serve learning process design and optimization, LA mainly focuses on measuring and analyzing educational data (e.g., students' activities, interaction data) collected from various sources. These sources can be the learning environment where learning activities occur (e.g., classrooms, platforms, mobile devices), or the educational environment that refers to educational policy, educational management, etc. With the underlying techniques, the educational data are processed via four steps, including data collection, data storage, data analysis, and data visualization. Following that, the analysis results are interpreted in the pedagogical context before being delivered to the stakeholders. With a comprehensive consideration of expert

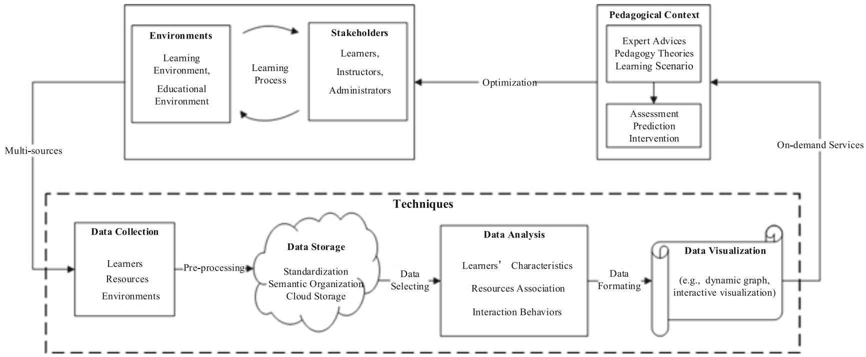

Fig. 4.1 Process model of learning analytics

advice, pedagogical theories, and the learning scenario, on-demand services can be encapsulated in a suitable way to support learning in terms of assessment, prediction, and intervention. In this way, the application of LA can be of benefit to different stakeholders, including learners, instructors, and administrators.

LA adopts different techniques to detect and reveal the interesting patterns hidden in the educational datasets. The first step in any LA effort is to collect data derived from learning process in learning environments. The data sources include not only data from a variety of learning management systems, course management systems, and online communities, but also from traditional learning environments where learning activities happens, especially in classrooms. The collected educational data can be classified into three main categories: (1) data of learners, such as the log data, learning preferences, learning outcomes, etc.; (2) data of learning resources like relevant courses, instructional guidance, learning management, etc.; (3) data of the learning environment which refers to the time, location, and learning devices.

It is necessary to preprocess data by removing irrelevant or redundant data and transforming valid data into a suitable format before storing. An important and unique feature of educational data is that it is hierarchical. Data at the keystroke level, the answer level, the session level, the student level, the classroom level, the teacher level, and the school level are nested inside one another (Baker et al. 2011; Romero and Ventura 2010). Therefore, the storage of a large volume of data requires taking consideration of the types and features of data, semantic relevance, and a uniform of data format. Several data preprocessing tasks, borrowed from data mining field, can be used in this step. These include data cleaning, data integration, data transformation, data reduction, data modeling, user and session identification, and path completion (Han and Kamber 2006; Liu 2006; Romero and Ventura 2007). In the latest studies, there has been an increasing interest in cloud storage in the field of information storage as it enjoys advantages including on-demand and continuous service, low price, and data security.

According to the objective of learning analytics, data is selected for analyzing and accordingly provides strong support for the establishment of smart learning environment that is able to identify learning context, detect learning models, and understand learning needs. The research on LA can be summarized into three categories: (1) analysis of interaction behavior, which utilizes the massive data generated from learning process to have an in-depth analysis of students' knowledge building process, study level, social network, etc.; (2) analysis of teaching and learning resources, which aims to discover and establish semantic correlations among different resources to enable students to select and use resources effectively; (3) analysis of learners' characteristics, which is to realize personalized learning by identifying learning models based on accurate analysis of students' interests and preferences. Moreover, analysis of learners' behaviors and emotions will help to discover the learning process by perceiving and identifying learners' expressions (e.g., gesture and facial signs).

Results of LA should be presented in a clear format that is understandable without data mining expert knowledge. The visualization of analysis results should be presented graphically instead of by just presenting plain tables. Besides, the visualization of data should support users for exploring the data in more detail according to their needs.

4.3 Multisource Data Collection and Storage

Educational data is the foundation of the LA process. Distributed data sources already possess impressive amount of data about students and their learning process. Learning management systems (LMS) accumulate log data of the students' activities and interaction data, such as reading, writing, accessing and uploading learning materials, and taking tests, and they sometimes have simple, built-in reporting tools (Romero and Ventura 2007).

However, the challenge for such centralized systems is the lack of generally accepted data format standards for the LMS. Thus, analytic tools must be tailored to each system's particular data structure, reducing their interoperability and increasing development costs. Many educational organizations and content-development enterprises have made efforts to develop standards for e-Learning content interoperability (Friesen 2005), such as IMS (http://www.imsglobal.org/), IEEE LTSC (http://ieeeltsc.org.), and the ISO/IEC (http://www.iso.org/iso/iso_technical_committee?commid=45392). China also proposed E-Learning standards called "Chinese E-Learning Technology Standards (CELTS)" (http://www.celtsc.edu.cn/index.html) in 2002. It presents standards in terms of four aspects, namely learning resources, learners, learning environments, and educational administrations. The standards stipulate the feature of metadata for learning resources, student interactions, information model for competency, and so on. These standards are proposed to achieve the content interoperability but not for data collection.

Most current studies on LA depend on data collected from online learning environments because of the easy access to them. However, it is relatively difficult to collect massive amount of data generated in classrooms or other learning places. Lack of specific guidance and standards in data screening increases the difficulty of data storage. The increasing growth of user-generated content, facilitated by cheap or free tools of production and creativity, renders a vast amount of data produced by learners across different learning contexts. With the assistance of advanced devices (e.g., sensors, eye tracking systems, wearable devices), it is possible to collect more complex data related to students' emotions and daily learning activities in classrooms and other learning places. However, the big data of different formats is often distributed across multiple media and websites in networked environments. Without common overarching context for the available data, traces of such activities may be fragmented across multiple logs and may not match analytic needs (Suthers and Rosen 2011). Therefore, the challenge is how to aggregate raw data of different formats collected from multiple and heterogeneous sources, and how to integrate the data with semantic linking to create a complicated educational data set.

4.4 Typical Approaches of Data Analysis and Visualization

The purpose of data analysis is to discover useful patterns and unveil meaningful information about learners and their learning process. Three factors need to be considered in data collection. One of them is the number of learners, whether it is a single learner, a class, or multiple learners in a grade or school. Special attention also needs to be paid on the length of time no matter whether it is 1 week, one month, a semester, or an even longer period. Another factor is granularity, like a course or multiple courses. Once necessary data is obtained, appropriate approaches should be adopted in learning analysis to meet different demands. Competing methods, algorithms, and technologies applied to the same set of data may result in different outcomes, and thus may lead to different consequences in terms of decision making based on these outcomes.

Most of the data analysis falls into three categories: learners' characteristics, learning resource association, and interaction behaviors. Learners' characteristics analysis is designed to detect learners' characteristics based on the data of learning behaviors. We can use students' data such as learning activities, learning path, and scores to analyze their characteristics, such as learning style, interests, and performance. Based on the analysis results, we can extract students' features to predict students' outcomes (Pardos and Heffernan 2010) and even detect student metacognitive planning processes (Montalvo et al. 2010). Various approaches, including text mining, semantic tagging, and content analysis, can be used to build the associations among learning resources. Salehi (2013) used Learner Tree (LT) to illustrate the explicit multi-attributes of learning resources and to discover their sequential patterns for improving e-learning resource recommendations for learners. Romero et al. (2010) implemented several rule mining algorithms to discover rare/infrequent learners' behaviors when using a LMS. Besides, interaction behaviors analysis can be used to find the relationship among learners, teachers, and resources. Social network analysis has also been widely used to discover the relationship among learners and teachers (Koulocheri and Xenos 2013; Hecking et al. 2014). Based on the interactive behavior such as ranking and reply-to, Li et al. (2013) proposed an approach to identify opinion leaders and their relationship with other learners.

The technologies, like educational data mining, machine learning, classical statistical analysis techniques, and social network analysis, are widely used to conduct analyses, while other qualitative methods can also be considered useful for providing useful information on reasons, e.g., interview or focus groups (Chatti et al. 2012). With the emergence of smart learning environments, today's learning environments are becoming more and more complex. Therefore, how to support a mixed utilization of approaches and integrate different analysis results becomes an important issue for LA.

Many learning analytics tools have been designed and developed to help learners, teachers, and institutions to achieve their analytics objectives without an extensive knowledge of the techniques underlying these tools. These tools can be divided into general-purpose tools and specific tools for LA. The general-purpose tools are the popular tools that can be used in statistics, text analysis, and social network analysis, such as SPSS (http://www.spss.com). Apache Mahout (https://mahout.apache.org/), and NetMiner (http://www.netminer.com/). Regarding the specific tools, some of them can be integrated into LMS. For instance, GISMO (Mazza and Milani 2004) and LA e-Rubric (https://docs.moodle.org/28/en/Learning_Analytics_Enriched_Rubric) are two plugin tools that can be integrated within Moodle. GISMO is a graphical interactive monitoring tool that provides visualization of students' activities in online courses. The LA e-Rubric (Learning Analytics Enriched Rubric) is an advanced grading method used for criteria-based assessment. Meanwhile, a few stand-alone specified tools have been developed to serve some specific purposes. For example, LOCO-Analyst (Jovanovic et al. 2008) is an educational tool aimed at providing teachers with feedback on students' learning process in a web-based learning environment, which can help them improve the content and the structure of their web-based courses. The project LeMo (Fortenbacher et al. 2013) also aims to develop a prototype of a web-based learning analytics application, which provides detailed information on user navigational patterns in learning management systems and identifies needs for enhancement and revision of the learning offering.

One of the major challenges LA researchers are facing is that there are no approaches available for evaluating their LA tools. There are neither theoretical guidelines nor publicly available datasets to evaluate the tools. As there is no common standard for LA tools, we cannot evaluate the effectiveness of LA tools.

The analysis results should be delivered to the users in an easily understandable and accessible manner. Appropriate forms of visualization, such as Gantt chart, interactive graph, trend chart, dynamic flow, etc., could make a significant contribution to understanding the large amounts of educational data. There are some data visualization solutions, which can be incorporated into the analytic tools to gain insights into the processes and relationships of teaching and learning. For example, AnyChart (http://www.anychart.com) is a flexible JavaScript (HTML5) based solution that allows you to create interactive and beautifully presented charts. Axiis (http://www.axiis.org/) is an open source data visualization framework designed for beginner and expert developers alike, which provides both pre-built visualization components as well as abstract layout patterns and rendering classes that allow users to create their own unique visualizations.

4.5 Optimizing Learning and Teaching

The application of LA can be oriented toward different stakeholders, such as students, teachers, tutors, administrators, and faculty decision-makers with different perspectives, goals, and expectations. Students would benefit from the analytics by reflecting on the report of their learning progress. Teachers could check the report of students' learning performance to find out the effectiveness of their teaching practices and adjust their teaching to cater to the different needs of students. Educational institutions can make use of analytics tools in their decision making, identify potential "at risk" students, improve student performance (i.e., student retention and graduation rates) (Campbell and Oblinger 2007), develop student recruitment policies, adjust course planning, determine hiring needs, or make financial decisions (EDUCAUSE 2010).

A few LA tools have been applied in many domains ranging from educational studies to teaching practices and commercial fields. Capella's (http://www.capella.edu/) competency map aims to inform students of their status and progress toward demonstrating specific competencies. Students can use their competency map to conceptualize their academic experience, communicate accomplishments, and plan their future studying. Another interesting application is Course Signals of Purdue University that can detect early warning signs and provide interventions to students who may not be performing to the best of their abilities before they reach a critical point. As a typical application in commercial field, Khan Academy (http://www.khanacademy.org/) provides the adaptive leaning path and the analysis of learning status. The BrightBytes Clarity platform (http://brightbytes.net/) translates complex analysis and cutting-edge research into fast actions to improve student learning. Moreover, Knewton (http://www.knewton.com/) is an adaptive learning technology provider that makes it possible for others to build adaptive learning applications.

It enables the company to perform "sophisticated, real-time analysis of reams of student performance data."

It is worth noting that all the quantitative analysis results are delivered to the stakeholders without considering pedagogic context (i.e., the practical scenario and possible related factors). LA designers and developers need to be aware that any algorithm or method they apply is reductive by nature in that it simplifies reality to a manageable set of variables (cf. Verbert et al. 2011). The analysis results could have possible unwanted or misleading consequences if not used with the necessary caution. In order to make LA an effective tool for educational practices, it is important to recognize that LA ends with the presentation of algorithmically attained results that require interpretation (Reffay and Chanier 2003; Mazza and Milani 2005). Expert advice, pedagogical theories, and learning scenarios should be considered before presenting the analysis results to stakeholders, aiming to enhance the effectiveness and credibility of analysis outcomes with more evidence and support.

4.6 Conclusion

Being considered as a powerful method for understanding and optimizing learning, learning analytics has attracted a great deal of attention from researchers, practitioners, and policy makers. By discovering useful and meaningful patterns and facilitating design and implementation of new instruments for educational practice, LA offers the potential to have new insights into learning processes. This paper proposes a process model of learning analytics with a focus on the inherent connections between the essential factors, i.e., learning process, environments, techniques, pedagogical context, and stakeholders. Furthermore, a comprehensive review of the existing LA studies is also included to provide a guide for the design of LA applications.

The emergence of smart learning environments brings forward more challenges for LA. It is argued that LA should address a number of issues, including online and offline data collection compatible with distributed data in diversified formats; unified and structured storage with overarching heterogeneity and system interoperability; real-time data analysis with more reliability; and integrated data presentation in a more user-friendly manner. Meanwhile, it is necessary to take into account the performance, scalability, and extensibility of LA tools in the design process. It is also important to point out that the methods to align learning analytics with pedagogical and organizational goals requires further research and demonstration of practical applications. Furthermore, there are substantial factors, like data privacy, ethics, and LA tool evaluation, which will determine the extent of the impact LA will have on the process of learning.

References

Baker, R. S. J. D., Gowda, S. M., & Corbett, A. T. (2011). Automatically detecting a student's preparation for future learning: Help use is key. In M. Pechenizkiy, T. Calders, C. Conati, S. Ventura, C. Romero, & J. Stamper (Eds.), *Proceedings of the 4th International Conference on Educational Data Mining* (pp. 179–188).

Campbell, J. P., & Oblinger, D. G. (2007). *Academic analytics* [White paper]. Retrieved from http://www.educause.edu/ir/library/pdf/PUB6101.pdf.

Chatti, M. A., Dyckhoff, A. L., Schroeder, U., & Thüs, H. (2012). A reference model for learning analytics. *International Journal of Technology Enhanced Learning, 4*(5), 318–331.

EDUCAUSE (2010). *7 Things you should know about analytics*. Retrieved from http://www.educause.edu/ir/library/pdf/ELI7059.pdf.

Elias, T. (2011). Learning analytics: Definitions, processes and potential. *Learning, 23*, 134–148.

Fortenbacher, A., Beuster, L., Elkina, M., Kappe, L., Merceron, A., Pursian, A., Schwarzrock, S., & Wenzlaff, B. (2013, September). LeMo: A learning analytics application focussing on user path analysis and interactive visualization. In *The 7th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS'2013)* (pp. 12–14).

Friesen, N. (2005). Interoperability and learning objects: An overview of e-learning standardization. *Interdisciplinary Journal of E-Learning and Learning Objects, 1*(1), 23–31.

Greller, W., & Drachsler, H. (2012). Translating learning into numbers: A generic framework for learning analytics. *Journal of Educational Technology & Society, 15*(3), 42–57.

Han, J., & Kamber, M. (2006). *Data mining: Concepts and techniques*. San Francisco, CA: Elsevier.

Hecking, T., Ziebarth, S., & Hoppe, H. U. (2014, March). Analysis of dynamic resource access patterns in a blended learning course. In *Proceedins of the Fourth International Conference on Learning Analytics and Knowledge* (pp. 173–182).

Jovanovic, J., Gasevic, D., Brooks, C., Devedzic, V., Hatala, M., Eap, T., & Richards, G. (2008). LOCO-Analyst: Semantic web technologies in learning content usage analysis. *International journal of continuing engineering education and life long learning, 18*(1), 54–76.

Koulocheri, E., & Xenos, M. (2013, April). Considering formal assessment in learning analytics within a PLE: the HOU2LEARN case. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 28–32).

Li, Y., Ma, S., Zhang, Y., & Huang, R. (2013). An improved mix framework for opinion leader identification in online learning communities. *Knowledge-Based Systems, 43*, 43–51.

Liu, B. (2006). *Web data mining*. Berlin, Heidelberg: Springer.

Mazza, R., & Milani, C. (2004, November). Gismo: a graphical interactive student monitoring tool for course management systems. In *TEL'04 Technology Enhanced Learning'04 International Conference* (pp. 18–19).

Mazza, R., & Milani, C. (2005, July). Exploring usage analysis in learning systems: Gaining insights from visualisations. In *AIED'05 workshop on Usage analysis in learning systems* (pp. 65–72).

Montalvo, O., Baker, R. S., Sao Pedro, M. A., Nakama, A., & Gobert, J. D. (2010, June). Identifying students' inquiry planning using machine learning. In *Educational Data Mining 2010*.

Pardos, Z. A., & Heffernan, N. T. (2010). Using HMMs and bagged decision trees to leverage rich features of user and skill from an intelligent tutoring system dataset. In *Proceedings of the KDD 2010 cup 2010 workshop knowledge discovery in educational data* (pp. 24–35).

Reffay, C., & Chanier, T. (2003, June). *How social network analysis can help to measure cohesion in collaborative distance-learning*. Paper presented at the computer supported collaborative learning conference (CSCL'2003), Bergen, Norway.

Romero, C., & Ventura, S. (2007). Educational data mining: a survey from 1995 to 2005. *Expert Systems with Applications, 33*(1), 135–146.

Romero, C., & Ventura, S. (2010). Educational data mining: a review of the state of the art. *IEEE Transactions on Systems, Man, and Cybernetics Part C: Applications and Reviews, 40*(6), 601–618.

Romero, C., Romero, J. R., Luna, J. M., & Ventura, S. (2010, June). Mining rare association rules from e-learning data. In *Educational Data Mining 2010*.

Salehi, M. (2013). Application of implicit and explicit attribute based collaborative filtering and BIDE for learning resource recommendation. *Data & Knowledge Engineering, 87*, 130–145.

Suthers, D., & Rosen, D. (2011, February). A unified framework for multi-level analysis of distributed learning. In *Proceedings of the 1st International Conference on Learning Analytic and Knowledge* (pp. 64–74).

Verbert, K., Drachsler, H., Manouselis, N., Wolpers, M., Vuorikari, R., & Duval, E. (2011, February). Dataset-driven research for improving recommender systems for learning. In *Proceedings of the 1st International Conference on Learning Analytics and Knowledge* (pp. 44–53).

Chapter 5
Design of Online Student Orientation with Conceptual and Procedural Scaffolding

Juhong Christie Liu and Andrea Adams

Abstract This article reports a study about the design and development of an orientation course to prepare students' readiness for online learning. Based on the Instructional Design Process Model, the research project applied the Analysis, Strategies, and Evaluation phases. The analysis identified the complexity of concepts and procedures to be addressed in preparing students and the technology affordance that could be utilized. The strategies of development focused on conceptual and procedural scaffolding that aligned with learning activities and assessment methods. The formative evaluation included collecting and analyzing data related to student performance in the course and students' reflections in online discussions. More than 600 students voluntarily participated in the course. The formative evaluation results demonstrated that over 95 % of those who completed the course gained technology competency, understood learning strategies, and identified characteristics of successful online learners. The applied thematic analysis of student reflection transcripts revealed that perceived usefulness, readiness for online learning, and effective design were the top three themes with frequent code co-occurrence. The key takeaways include the design and development process of an online orientation course from an instructional design perspective and the methods used for assessment.

Keywords Student support · Online learning · Orientation · Instructional design · Assessment · Scaffolding

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5.1 Introduction

Readiness for online learning requires preparation from multiple perspectives, including but not limited to technology access, skill training, and awareness of support resources that are relevant to the information and technology infrastructure of the higher education institution that offers the online courses or programs (Benson and Whitworth 2014; Simonson et al. 2012). In addition, students need to build their technology competency and understand the characteristics of successful online learners. More importantly, it is essential for students to have the basic knowledge to manage their time between study, work, and other commitments in the mix of physical and virtual social and learning environments (Crawley 2012; Lawanto et al. 2014). Professional standards and quality measures also state the expectations of providing student support for online learning at course and program levels (Quality Matters Program 2013; Shelton et al. 2014).

To prepare and support student engagement in online learning, orientation programs have been provided in various formats, as mandatory entry courses, supplemental to other online courses, or part of the admission process (Britto and Rush 2013; Jones 2013; Ullmann 2009). However, shared research regarding design, development, and administration of orientation programs is rare (Cho 2012).

This research presents the design and development of an orientation course to help students prepare for online learning. The course intends to provide scaffolding for students' acquisition of the conceptual and procedural knowledge to be successful online learners, online learning strategies, technology competencies, and essential technical skills (Dabbagh and Bannan-Ritland 2005; Stewart et al. 2013). In addition, this research applies major steps of an educational assessment project (Combs et al. 2008; Ohia 2011; Suskie 2010). The discussion of formative evaluation serves the purpose for future revision in instructional design (Richey and Klein 2007) and for improvement in assessment (Ohia 2011; Suskie 2010).

5.2 Project Overview

This design and development study was conducted in a public comprehensive university along the East Coast of the United States, with an enrollment of over 20,000 students pursuing bachelor's, master's, and doctoral degrees or professional certificates. Beginning in 2000, web-based courses were offered for credit at the institution. To support quality online teaching, a team of instructional design and technology professionals began providing training and support for faculty members to design and teach online courses. In addition, the same group of instructional technology professionals offered both face-to-face and online orientations to prepare students to be successful in the online learning environments. The orientation included both asynchronous components, which were delivered through the

Blackboard learning management system (LMS) and synchronous components, which were conducted through *Elluminate Live!*. In 2014 the institution adopted a new LMS, Instructure Canvas (Canvas), which prompted the design and development of a new orientation for student online learning readiness in Canvas.

Though directly triggered by the transition of the new LMS, this project was driven by professional expectations and quality standards, which guided the assessment perspective for the project. The Quality Matters Rubric (Quality Matters Program 2013) and Online Learning Consortium (OLC) Quality Scorecard (Shelton et al. 2014) were adopted by the university to guide and assess the quality of online course design and development. Using these standards, an instructional designer, one of the authors of this paper, began the redesign of the orientation as a fellow in the university's 2013 summer assessment fellowship program. Using the Quality Matters Rubric and OLC Quality Scorecard as the foundation, the orientation objectives were written and mapped to the rubric and scorecard. After identifying the goal and objectives of the orientation, the following phases of assessment were identified (Erwin 1991; Ohia 2011; Suskie 2010): (1) determining learning activities and assessment methods to fulfill the objectives; (2) measuring learning performance with direct and indirect methods; (3) collecting and analyzing data; (4) improving the orientation course based on the data results and interpretation (Combs et al. 2008; Ohia 2011; Suskie 2010).

In this instructional design and development project, the core problem to solve was how to prepare the readiness for online learning of college students with different backgrounds and from various disciplines. The proposed solution was an orientation course in Canvas, which is the same LMS where the students would take online for-credit courses. The decision to design the orientation in Canvas was made to maximize the convenience of access (Er et al. 2009; Ullmann 2009) and to optimize the use of LMS for teaching and learning activities (Benson and Whitworth 2014). Guided by the objectives identified in the assessment fellowship project, the instructional designer adopted the Instructional Design Process model (Gustafson and Branch 2002; Smith and Ragan 2005) for the course design.

This online orientation course was voluntary in nature; therefore, human involvement and access to supportive information would need to be flexible. Scaffolding strategies were used based on the technology affordance in the LMS (Dabbagh and Bannan-Ritland 2005; Reeves et al. 2005; Simonson et al. 2012). Student-content interaction was the primary method to engage student participation (Moore and Kearsley 2012). After the analyses of needs, context and learning tasks were conducted. Conceptual and procedural scaffolding were adopted as the development strategies to present and manage the instructional content and learning activities (Dabbagh and Bannan-Ritland 2005; Smith and Ragan 2005). To scaffold, content presentation and requirements for student-content interaction were provided directly and indirectly as embedded or linked materials and directions, which allowed students to access content and supportive materials as needed (Dabbagh 2003).

In the spring and summer of 2014, students who enrolled in summer online courses at the university were invited to voluntarily participate in the orientation.

Students who accepted the course invitation completed some or all of the activities in the course. The course participation data were collected as the basis for a formative evaluation. At the completion of the course, the students were also directed to submit an end-of-orientation questionnaire (EOQ), which was linked in Canvas from Qualtrics, an online survey software. EOQ had questions that were mapped to the objectives, as part of the assessment project, to measure the learning gained through the course. These collected data were analyzed for revision from an instructional design perspective (Richey and Klein 2007) and for improvement from an assessment perspective (Combs et al. 2008; Ohia 2011; Suskie 2010).

The parallel process with both instructional design and assessment principles and methods was intended to enable the sustainability of this project. Based on the mapped objectives, learning activities in alignment with assessment methods were designed and developed. Using Canvas and Qualtrics, the analytics of participation, completion, and feedback were documented with minimal human involvement. The results were easily analyzed and interpreted for improvement and revision for future iterations.

With the intentional design, mapped assessment methods, and available technology affordance (Combs et al. 2008; Reeves et al. 2005; Richey and Klein 2007; Suskie 2010), this design and development study explores answers to the following research question:

- How should an orientation course be designed and developed to prepare students' readiness for online learning?

In this exploratory research (Stebbins 2001), readiness for online learning refers to the cognitive awareness and maturity that a student develops to learn successfully in a web-based environment. This is demonstrated directly and indirectly with the attributes of recognizing the self-directed nature of online learning, formulating learning strategies, obtaining essential technology skills, and being open to seeking help (Cigdem and Yildirim 2014; Dray et al. 2011; Hung et al. 2010).

5.3 Literature Review

5.3.1 Student Orientation for Online Learning

An orientation program is primarily intended to prepare students' readiness for online learning (Britto and Rush 2013; Cho 2012; Dixon et al. 2012; Jones 2013; Stewart et al. 2013). According to Scagnoli (2001), online orientations should scaffold learning, which means that students can learn the concepts and procedures related to online learning with intentionally designed content that allows access as needed and gradually fades from direct presentation and/or support (Dabbagh 2003). Even when a teacher is not physically on site to provide support or guidance, students can learn to competently use online communication tools, socially interact in a virtual learning environment, participate in a learning community, obtain technical skills to set up their computers, and access help information (Dabbagh and Bannan-Ritland 2005). In the process of scaffolding, evoking and building technology competencies appear essential (Dray et al. 2011; Hung et al. 2010). In addition, awareness of support, access to help resources, and attitude toward seeking assistance are also important (Lawanto et al. 2014). More critically, concepts of academic and metacognitive competency related to characteristics of successful online learners, such as goal setting, self-regulation, study habits, and time management skills, rise as focal topics in student support (Lehmann et al. 2014).

5.3.2 Scaffolding in Open-Ended Online Learning Environments

Scaffolding is the "cognitive processing support that the instruction provides the learner, allowing them to learn complex ideas that would be beyond their grasp if they depended solely on their own cognitive resources, selectively aiding the learners where needed" (Smith and Ragan 2005, p. 130). Strategies of scaffolding are usually applied based on a clear understanding of the difficult levels of the learning content; accordingly, the content and support information are directly or indirectly presented with intentional arrangement. Instead of handholding and providing overly detailed presentations, scaffolding allows students to select what instruction they need immediately, what can be skipped, and whether they need to learn the target content with extra assistance (Dabbagh and Bannan-Ritland 2005; Dabbagh 2003). Online learning environments intuitively facilitate scaffolding with tools or conditions including external links, presentation with text or visual cues, content delivery customized to progress, and selectively directing learning activities for different learners (Delen et al. 2014). These tools and conditions set up flexible student-content interaction between learners and their guides. They can be used to present content explicitly and implicitly with gradual fading of support, which facilitates student self-regulated learning. With these tools and conditions, the design of instructional and support materials that students can access as needed becomes possible (Dabbagh 2003). Without the physical presence of a teacher, scaffolding can be used in online learning environments not only for learning, but also for nurturing the essential capability of seeking help and information (Delen et al. 2014; Lehmann et al. 2014).

A literature review indicates that orientations have used an existing LMS where other online courses are hosted in order to provide scaffolding for students in course-related online learning environments (Jones 2013; Ullmann 2009). By using an existing LMS, students can build their skills and apply computer configurations by conducting authentic tasks (Schank et al. 1999). Technology competency training and dissemination of technical support information can guide student operation step by step, as the procedures may be repeated during their course participation. In the same learning environment where online courses are offered, demonstration and explanation can help students determine if the procedure is required, complete the steps in the procedure, list the steps, and, as a synthesis, check the appropriateness of a completed procedure (Smith and Ragan 2005).

5.4 Design Framework and Research Method

The design and development research was built on the Instruction Design Process model, which includes the phases of analysis, strategies, and evaluation (Gustafson and Branch 2002; Smith and Ragan 2005). The analysis phase focused on the inquiry into the needs of both students and instructors in online learning, investigation into the possibilities and challenges of the learning environment, review of literature about online student orientation, and identification of learning tasks. The results suggested that the strategies of conceptual and procedural scaffolding should be selected for developing the course content at both the course and lesson levels (Smith and Ragan 2005). Methods of evaluation, which aligned with the analysis and strategies, informed the design of subsequent iterations (See Fig. 5.1).

Based on this framework, the design and development research (Richey and Klein 2007) was a case study with bounded context in the transition to a new LMS (Creswell 2013). The identified problem for instructional design was to explore the

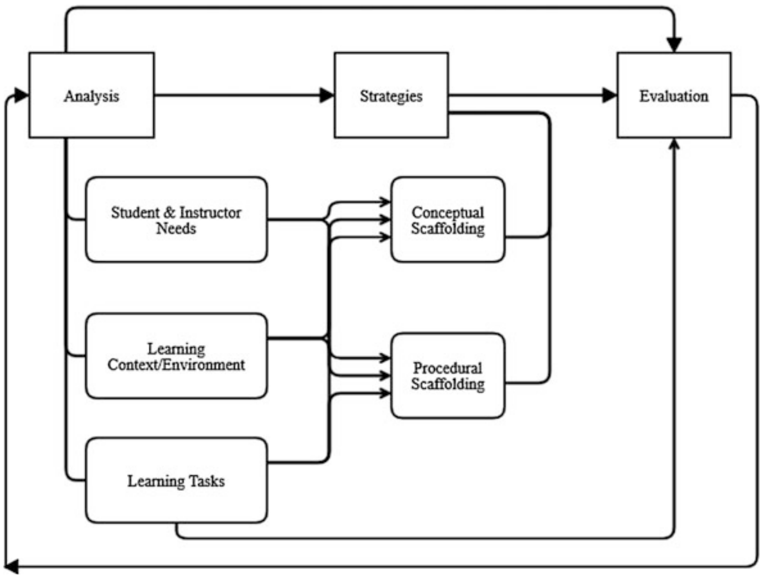


Fig. 5.1 Design framework

practicality of an orientation product that would prepare students' readiness for online learning. The proposed solution was the design and development of a course in the new LMS, Canvas, which was also where the other for-credit online courses were hosted at the university.

The case study was performed with a mixed-method approach, and data were collected from three major sources. First, according to Richey and Klein (2007), this type of instructional product development research required documentation of the design and development process, which was intended for evaluation and future development. Second, both quantitative and qualitative data from course participation and student feedback were collected at the completion of the course. These were analyzed with descriptive statistics and applied thematic analysis (Guest et al. 2011) to examine the usefulness of this instructional product for the users. Finally, an end-of-orientation questionnaire (EOQ) was developed based on the identified course objectives. The questionnaire was intended to capture student knowledge gained through participation in the orientation course. The descriptive statistics from the EOQ results also contributed to exploring answers to the research question: How should an orientation course be designed and developed to prepare students' readiness for online learning?

In the following sections, the research is presented as analysis for design, strategies for development, and formative evaluation for future revision. The article concludes with a discussion about the lessons learned through this design and development research.

5.5 Analysis for Design

This section presents an analysis of needs, learning context, and learning tasks. The design and development decisions were based on these analyses.

5.5.1 Analysis of Student and Instructor Needs

A needs analysis was conducted by collecting student and faculty responses using online questionnaires. The online needs analysis questionnaire was adopted from the Bozarth et al. study (2004) and deployed with Qualtrics, an online survey tool. Regarding the preparation for students' readiness for online learning, a question with the stem of "If you [/your students] could have learned something about online learning prior to beginning an online course, what would have been helpful?" included response options about online learning strategies, time management, instructional use of LMS functions, and technology support information. These aspects were included based on the literature review (Bozarth et al. 2004; Cho 2012). A total of 46 students from summer online classes in 2013 and 20 instructors

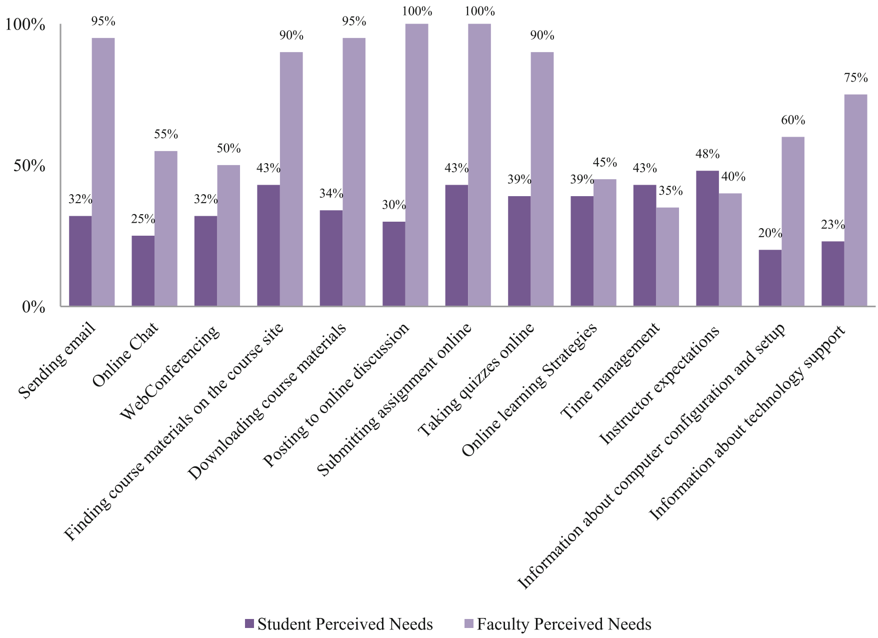


Fig. 5.2 Response comparison on perceived needs of preparing students for online learning

who had received instructional design training and previously taught online responded to the respective questionnaires for students and faculty.

As indicated by the results presented in Fig. 5.2, both students and faculty identified training topics needed in an orientation course. Noticeably, almost all faculty respondents selected the following technical aspects needed for online learning, including posting to online discussion (100 %), submitting assignment online (100 %), downloading course materials (95 %), finding course materials on the course site (90 %), and taking quizzes online (90 %). Similar to the results in the Bozarth, Chapman, and LaMonica study (2004), students responded to these specific technical training needs with much lower percentages.

Among the responses to the question of "top problem area that online students have encountered in an online class," faculty members responded with the highest frequency on five themes, including time management, technology preparation, awareness of course expectations, technology how-to training, and technical difficulties beyond human control. When asked "What frequently asked questions do you receive that are not within your expertise?" all instructor responses were related to students' lack of preparation for using technologies, lack of knowledge about contacting technical support, or technical issues beyond the control of either an instructor or a student. These themes would provide the framework for the main content in the orientation course and help determine the strategies of development.

In addition, "needs analysis and evaluation plans should be constructed simultaneously" (Smith and Ragan 2005, p. 43). Therefore, at this stage, the assessment methods were also identified.

5.5.2 Analysis of Learning Context

As the main technology context for online learning, Canvas is the LMS that the university adopted in 2014 to host the online courses. An LMS is a software that "centralizes course preparation; educational content and resources; the delivery and tracking of student activities, such as discussion and collaboration; the administration of assessment activities; and the accumulation and presentation of marks and grades" (Wright et al. 2014, para. 5). Recent research on LMSs indicates that an online learning system can respond to or direct teaching and learning needs and activities (Benson and Whitworth 2014). Instructional design plays the key role in optimizing the LMS functions for scaffolding and facilitating online learning (Benson and Whitworth 2014; Bigatel et al. 2012).

In the Canvas LMS, modules are representative containers for organizing course content (Instructure 2014). Instructors can use modules to display and connect any existing materials internal and external to the system, including but not limited to wiki pages, discussion forums, links to assignment submission, and multimedia content. Instructors can also set options with prerequisites or requirements for the components within a module or between modules so that the students' learning progress can be monitored by using the LMS built-in mechanism and guided by intentional instructional design. An example is demonstrated with a screenshot in Fig. 5.3. Module One in the Canvas course would be viewed by students only after they completed a prerequisite. Then, they would be able to access the three components in Module One. The module would only be completed after students viewed or conducted activities in the three components in the module in sequence.

With the technology affordance (Reeves et al. 2005), students are able to access the content and learn at their own pace, with minimal human intervention. More relevantly, an orientation course in the same LMS that hosts other for-credit online courses creates an authentic training environment to prepare student readiness. Students can also access the intentionally designed instruction and support as needed when they are taking online courses and need to seek help (Ullmann 2009). This context indicates that scaffolding is necessary for students to know the essential concepts covered in the modules, to be familiar with the course navigation for future access when online courses are happening, and to be aware of the essential operation and procedures in the course. However, students should not be inundated with too much content and participation requirements in this voluntary orientation course.

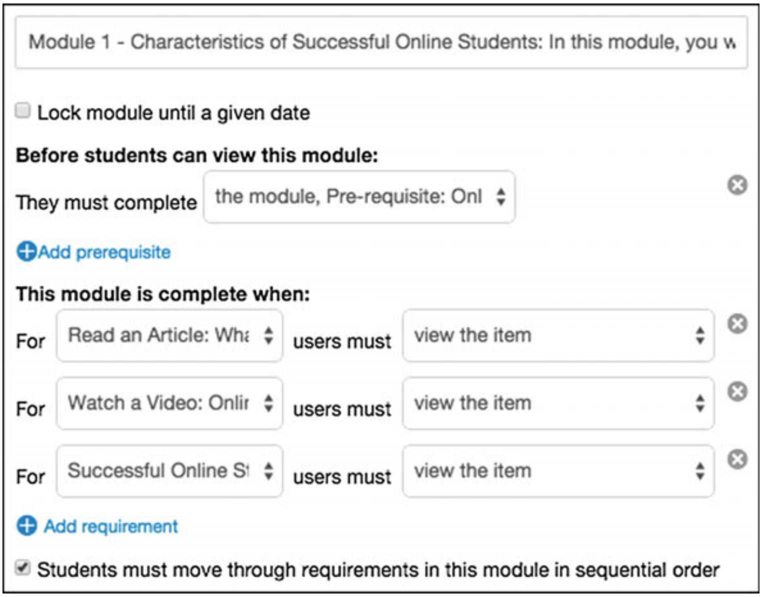


Fig. 5.3 Screenshot of module options

5.5.3 Analysis of Learning Tasks

The objectives of the orientation and identified needs were established from the learning task analysis. Based on the Student Support section in the Online Learning consortium quality scorecard for Online Programs (Shelton et al. 2014), five objectives were identified, as listed in Table 5.1. Accordingly, the learning tasks were identified and the assessment methods were aligned.

According to the objectives and the needs analysis results, some learning tasks could be optimally achieved with conceptualization, some should be learned by completing certain procedures in the real LMS, but the majority would involve conceptualization and procedural operation at the same time. In technology-enabled learning environments, learning task design is grounded in “how we can best take advantage of the potential of new technologies” (Richey and Klein 2007, p. 20). In an open-ended online learning environment, these tasks are further mapped as those in need of conceptual and/or procedural scaffolding (Hannafin et al. 1999).

The mapping in this project provided foundation for development decisions, such as whether a tutorial would be needed and how a student could progress in the course. To this end, conceptual and procedural scaffolding were adopted as development and delivery strategies to support students’ learning of the interdisciplinary content and skills in the online orientation course.

Table 5.1 Mapping with learning task analysis

Objectives	Scaffolding	Learning tasks	Assessment methods
O-1. Demonstrate metacognitive awareness regarding motivation and time commitment to online courses	Conceptual Procedural	Take a readiness survey Reading Watch video	Discussion posting on successful online student profile; EOQ items
O-2. Match the technical requirements from the program for the installation and facilitation on their own devices	Conceptual Procedural	Read a resource page	Quiz on tech support information and EOQ items
O-3. Identify representative characteristics of a successful online student	Conceptual	Read an article Watch a video	Reflection posting on discussion forum & EOQ items
O-4. Identify appropriate methods for contacting technical assistance and technical support staff.	Procedural	Read information about appropriate contacts for support	Discussion posting & EOQ items
O-5. Demonstrate knowledge of online learning management system by successfully completing the following tasks.	Procedural	Download time management worksheet template; Fill the worksheet and submit it to Canvas as assignment	Assignment submission of time management worksheet
	Conceptual Procedural	Create an online discussion entry	As in O-1, O-3 and O-4
	Procedural	Take an online quiz/survey	As in O-2
	Conceptual Procedural	Participate in a Blackboard Collaborate web-conferencing session	Recording of a Blackboard Collaborate session
	Procedural	Check grade	Feedback posting as discussion

5.6 Strategies in Development

In addition to the conceptual and procedural scaffolding strategies identified in the learning task analysis, the organizational strategy (Smith and Ragan 2005) of a linear flow was used to let students pace their own progress through the modules in this orientation course. As demonstrated in Fig. 5.4, there were six modules in the orientation course, (1) characteristics of successful online students; (2) time management skills; (3) university computing and support information; (4) LMS support; (5) synchronous class meetings with Blackboard Collaborate; and (6) checking grade and feedback.

At the level of each lesson in a module, the instructional content was developed along the flow of Introduction → Body → Conclusion → Assessment (Smith and Ragan 2005). Conceptual and procedural scaffolding strategies were applied in the

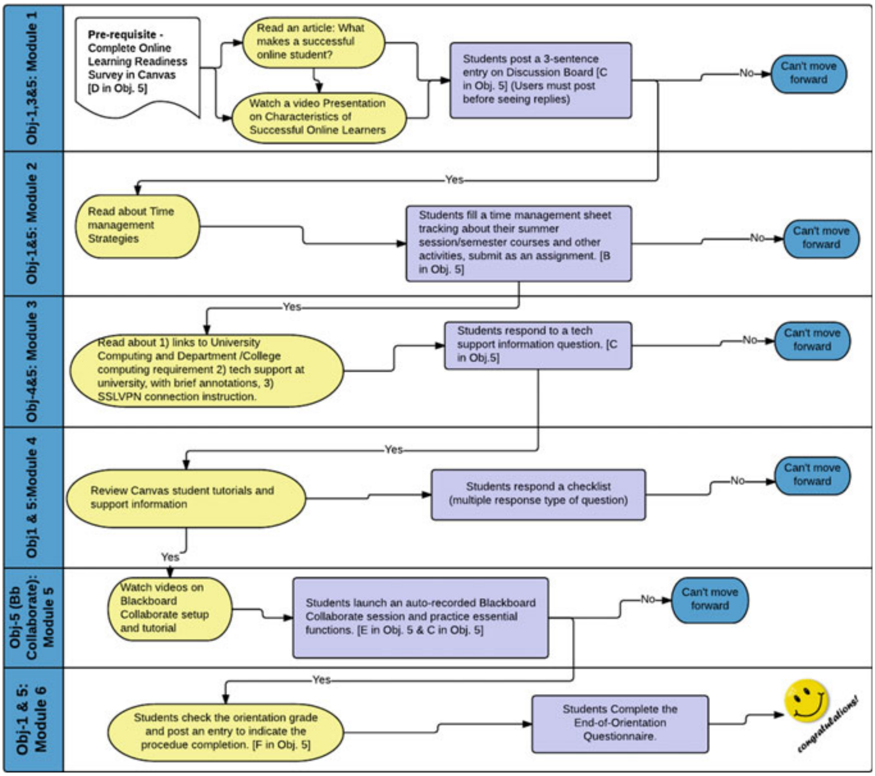


Fig. 5.4 Organization strategy at course level for the orientation

flow for managing learning activities. Each module started with a prompt stating the purpose of the module, what content a student was expected to learn, and how the learning would be assessed. Then, the body of the module presented the content in text or media format with conceptual and/or procedural scaffolding that a student could learn thoroughly or review briefly if she/he already had the knowledge or perceived competency. Each module concluded with an assessment to provide a transition anchor to the following module.

For metacognition concepts, such as characteristics of successful online students, conceptual scaffolding (Hannafin et al. 1999) was primarily applied as a development strategy (Smith and Ragan 2005). Selected readings and video clips were presented (Fig. 5.5). Then, following a tutorial about posting to an online discussion forum, the assessment was captured with a student reflection in a discussion posting about a successful online student profile. Blind posting to the online discussion was applied so that a student was required to think and post before reading peers' posts.

In most cases, conceptual and procedural scaffolding strategies were utilized simultaneously. This was distinct in developing the course so that learning tasks

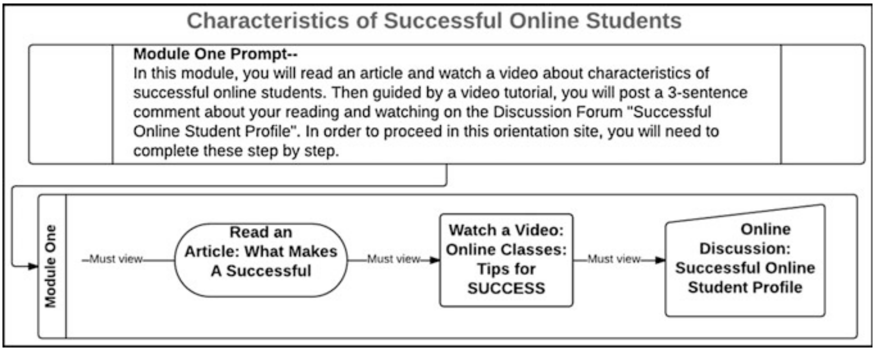


Fig. 5.5 Conceptual and procedural scaffolding in Module One

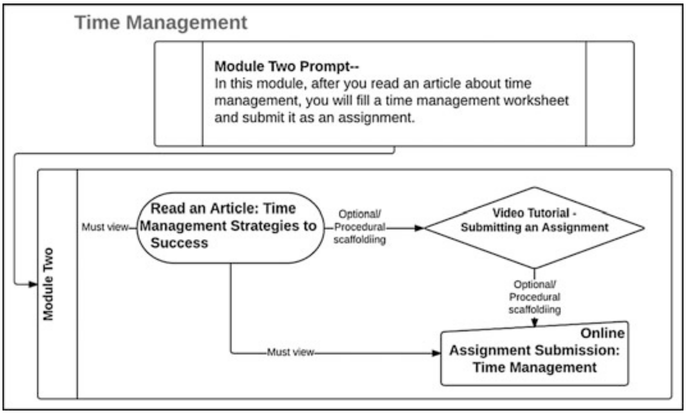


Fig. 5.6 Conceptual and procedural scaffolding in Module Two

focused on the orientation content rather than following how-to tutorials. In particular, this was highlighted in the time management module, as demonstrated with Fig. 5.6. In the module, students were required to read an article about the essential strategies needed to manage time. In the meantime, students were instructed to download a blank time management worksheet (Appendix A); save it to their computers; fill in their time distribution among study, summer work, and other commitments including social obligations; and submit the filled worksheet as an assignment. This was designed for students to perform a self reflection with the process of conceptualization about the importance and strategies of time management. It also provided a transition for students to internalize the concepts to their own scenarios. In the same module, procedural scaffolding was provided with an embedded video about downloading a file from Canvas and submitting an assignment.

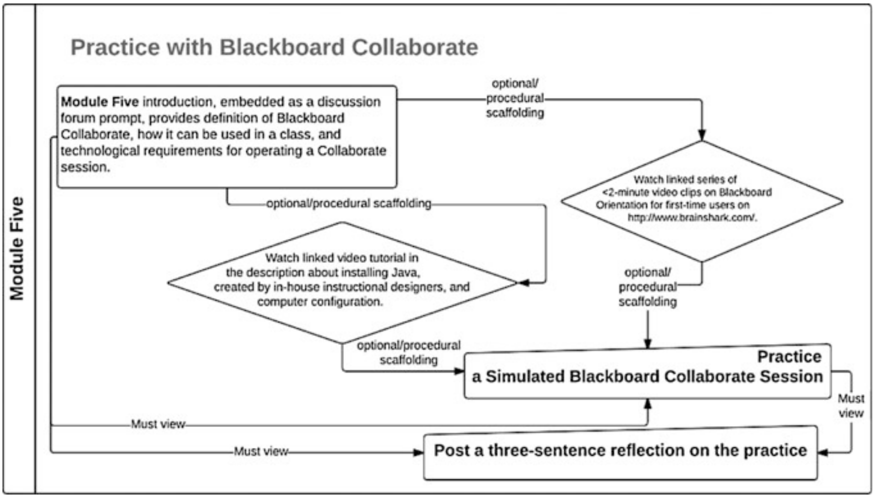


Fig. 5.7 Conceptual and procedural scaffolding in Module Five

Another simultaneous use of conceptual and procedural scaffolding was in Module Five, as in Fig. 5.7. The module started with conceptual scaffolding by presenting a definition of Blackboard Collaborate^{TM} (Collaborate), how it could be used for online learning, technical information, externally linked video tutorials about computer configurations, and a guide for synchronous meetings with Collaborate. If a student did not feel comfortable with the operation, the individual needs would encourage the student to review the configuration and how-to guides. The unit concluded with the student successfully launching a Collaborate meeting session, which was set as automatically recorded, as an assessment method. Typically, this unit fully utilized procedural scaffolding, which according to Hannafin et al. (1999) "emphasizes how to utilize available resources and tools. It orients to system features and functions, and otherwise aids the learner while navigating an online learning environment… Learners need not develop facility with all procedures until they have established, on an individual basis, the need for a given tool or resource" (p. 133). As an additional assessment method of this module, students were required to reflect on the process through an online discussion entry, which provided transfer for further application (Clark and Mayer 2011; Gagne et al. 2005).

5.7 Formative Evaluation

The formative evaluation of the orientation course consisted of an informal usability test by both students and faculty, student performance and participation in the course, and student feedback as online discussion entries. The measurement of learning was reflected in both student participation records in the course and the end-of-orientation questionnaire (EOQ) that was developed as part of the assessment project. In Module 6, students who completed the course were directed to the (EOQ) to assess their knowledge and perception (Appendix B). The EOQ items were mapped, as part of the assessment project, to the objectives of this orientation course (Appendix C).

5.7.1 Usability Testing

A group of five student employees of the university were invited to conduct the usability test. Two completed an online usability test form regarding time spent on the course site, ease of navigation, usefulness of content, and any issues encountered. The feedback from the students in both verbal and online formats was positive. All finished the course within 40 min and no issues were encountered.

Nine faculty members who completed training for online teaching, designed, and developed their online courses, and were ready to teach online courses during the summer of 2014 conducted an expert heuristic review synchronously online (Reeves et al. 2002). Knowing the general characteristics of the students in the institution, as well as having the knowledge to critique the quality of online courses (Reeves et al. 2002), the faculty members performed the learning tasks in the course and provided feedback with either synchronous verbal comments or through participation in the course. They thought that the orientation course would be useful to students in their summer online courses. They also expressed that they would recommend that their students complete the orientation course prior to starting the for-credit online courses.

5.7.2 Student Performance and Participation

In April and May of 2014, emails were sent to students who were enrolled in the 2014 summer online courses regarding the upcoming orientation course invitations from Canvas. A total of 2,098 students who registered for an online course were added in two enrollment groups, the first in April and the second in May, to the 2014 orientation course. During the 10 days after the initial enrollment, follow-up invitations were sent from Canvas every 3 days to the students who did not accept the course invitations. Between April and August, 1820 students accepted the course invitations. Among them, 883 voluntarily completed the first module, which included the Online Learning Readiness Survey; 634 students performed at least one learning task at their own individual pace; 486 students completed the whole course and provided feedback about the course in the final module.

Table 5.2 Participation in the orientation course

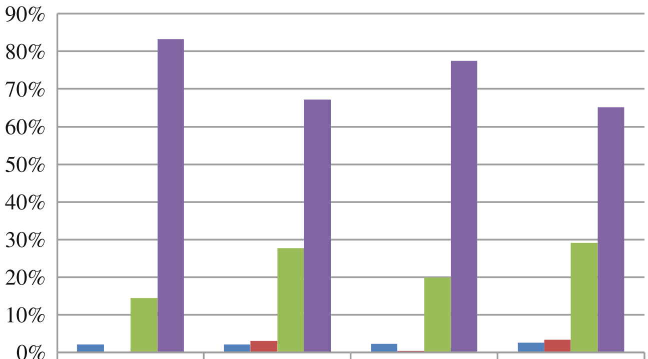
Learning activity	Number of completion	Completion rate (%)
Pre-requisite Online Learning Readiness—Ungraded Survey	883	49
Successful Online Student Profile—Online Discussion	581	32
Time Management Worksheet—Assignment Submission	441	24
Computer Configuration—Quiz	470	26
Bb Collaborate Training	510	28
Bb Collaborate Practice	144	8
Reflection of Using Bb Collaborate	525	29
University Computing Information—Online Discussion	554	30
Final Feedback—Online Discussion	486	27

The assessment was monitored with a combination of the LMS built-in automatic functions and human graders. The involvement of a human in the assessment, even though it demanded a substantial amount of grading time, was intended to provide an additional layer of evaluation and help detect any issues that the students might have and hence provide supportive guidance and scaffolding as needed. In each module, there was a learning activity that required students to use a procedural skill or reflect on conceptual information. The assessment was also used to track the completion status of each module. Table 5.2 demonstrates the completion rate of each module.

5.7.3 Knowledge of Online Learning Strategies

There were 10 questions in the EOQ that were mapped to student perception of online learning motivation, time commitment, knowledge of essential technical competency, and awareness of successful online learning tips. Among them, three Likert-scale questions included concepts and strategies for successful online learning. There were six knowledge questions about technical procedures and seeking information of technical support, and one open-ended question. The questionnaire permitted respondents to skip questions.

There were 603 responses to the question about motivation and time commitment to online course. Among them, 586 (97 %) responses selected “Strongly Agree” and “Agree” to the statement, *Making time commitment is important for success in online learning*; 585 (97 %) to *Successfully completing the online class is important to me*.



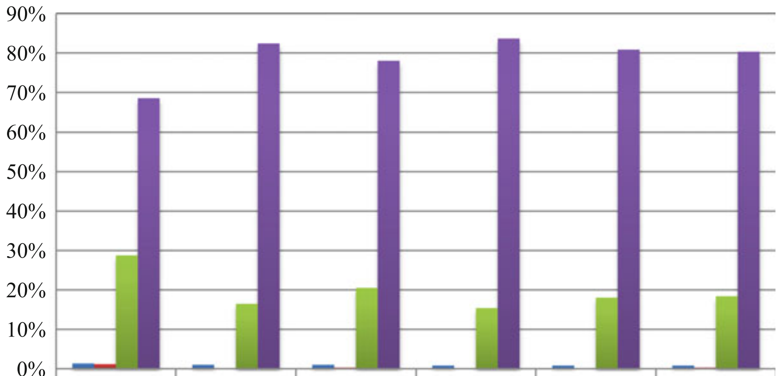
	time management	tracking my activities	clear online communication	need to be more self-directed
Strongly Disagree	2%	2%	2%	2%
Disagree	0%	3%	0%	3%
Agree	14%	28%	20%	29%
Strongly Agree	83%	67%	77%	65%

Fig. 5.8 Distribution of responses to the question about online learning strategies

To the question about online learning strategies, more than 95 % of the 603 responses indicated "Strongly Agree" and "Agree" to the statements, (1) …*time management is important for success in online learning;* (2) … *tracking my activities is important for time management;* (3) … *clear online communication is necessary for successful course completion;* (4) *I need to be more self-directed to be successful in online learning than in traditional classroom-based learning* (Fig. 5.8).

There were 570 responses to the question about tips for successful online students. Nearly 99 % of the responses "Strongly Agree" or "Agree" with the following statements (Fig. 5.9):

- *… proactive online communication is necessary for successful course completion.*
- *… a dependable computer is important for success in online learning.*
- *… a study space where I can concentrate is important for success in online learning.*
- *… reliable network connection is important for success in online learning.*
- *… not getting distracted with other social media when I'm participating in online courses is important for success in online learning.*
- *… being respectful in conversations with peers and instructor in online courses, including discussion postings, emails, and comments, is important for success in online learning.*



	proactive online communication	dependable computer	study space where I can concentrate	reliable network connection	not getting distracted	being respectful in conversations with peers and instructor in online courses
Strongly Disagree	1%	1%	1%	1%	1%	1%
Disagree	1%	0%	0%	0%	0%	0%
Agree	29%	16%	21%	15%	18%	18%
Strongly Agree	69%	82%	78%	84%	81%	80%

Fig. 5.9 Distribution of responses about representative characteristics of a successful online student

5.7.4 Perceived Usefulness

A core criterion for evaluating the development of an instructional product, like this orientation course, is to measure the perceived usefulness (Richey and Klein 2007). At the completion of orientation, students were required to check their grades and post a reflection as feedback, with a brief and open-ended prompt (Azevedo and Hadwin 2005). The transcripts of 498 online discussion posting entries with identifiers removed were coded. Applied thematic analysis (Guest et al. 2011) was performed with Dedoose, an online software for analyzing text or media data. The coding themes were generated based on the cross reference between literature review and repeated perusal of transcripts.

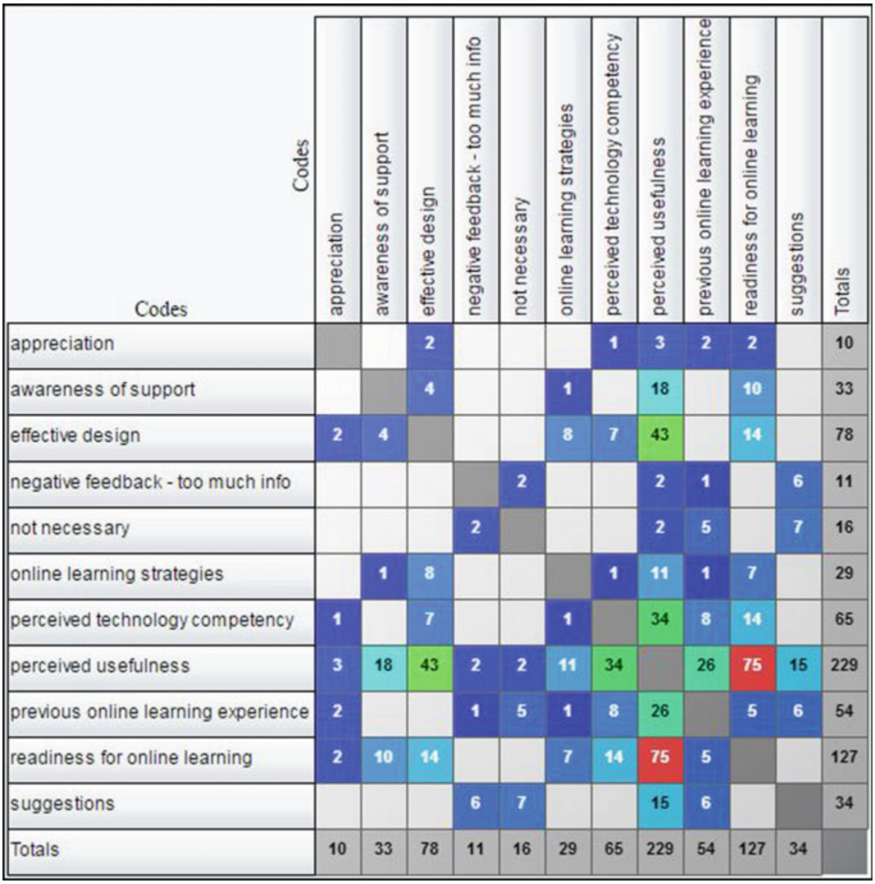
The code co-occurrence is used to present the distinguishing and overlapping themes (Fig. 5.10). "Code co-occurrence reports often provide helpful information in understanding how thematic domains, concepts, or ideas are distributed within a [qualitative] data set, beyond simple frequencies" (Namey et al. 2008, p. 145). The analysis found that 229 out of 686 coded excerpts were positive comments about perceived usefulness of the orientation course, 127 were about readiness for online learning, and 78 about effective design. These top three themes also overlapped each other, with 75 *perceived usefulness* excerpts of co-occurrence with those of *readiness for online learning*, and 43 excerpts of *perceived usefulness* co-occurring with those of *perceived effective design*. As evidenced in the review of literature, *perceived usefulness* co-occurred with *perceived technology competency* (34 excerpts), and with previous online learning (26 excerpts) (Wang et al. 2013). There was also some negative feedback about redundancy and lengthiness of content. This was especially true if a student took an online course previously and received training through similar orientations. In addition, some students with previous online learning experience provided suggestions about the content structure and the potential student population that this orientation would serve better. That is, students new to fully online courses would benefit more from completing the orientation course.

5.7.5 Technology Competency and Awareness of Tech Support Information

The essential technology competency was assessed with the following learning activities: (a) awareness of computer configuration terminology related to specific programs; (b) awareness of where to seek help and find support information; (c) ability to download a file from the orientation course site, save it locally on a computer or mobile device, and submit the completed file as an assignment; (d) ability to create multiple online discussion entries; (e) ability to take an online quiz; and (f) participation in a simulation using the Collaborate web-conferencing session.

Regarding computer configuration and technical support, several aspects that were identified as necessary in the needs analysis and literature review were developed in the course. Among the 594 responses to technical knowledge questions in EOQ, 95 % responded correctly about computer configuration for launching a Collaborate session; 59 % provided correct responses about computer hardware setup support; 75 % found the right place to ask Canvas-related questions; 79 % located the correct website about university computing resources; and 78 % knew the correct websites for tech support about questions related to Canvas and Collaborate.

The learning activities in the course were developed to scaffold student technological competency in accomplishing essential tasks in Canvas. Among the 1820 students who accepted the course invitation and performed voluntary participation, 32 % were able to post an entry to an online discussion, 24 % downloaded the time management worksheet and submitted the completed worksheet as an assignment, 26 % took the computer configuration quiz, and 27 % participated in the entire course and provided their reflection at completion.



Codes	appreciation	awareness of support	effective design	negative feedback - too much info	not necessary	online learning strategies	perceived technology competency	perceived usefulness	previous online learning experience	readiness for online learning	suggestions	Totals
appreciation			2				1	3	2	2		10
awareness of support			4			1		18		10		33
effective design	2	4				8	7	43		14		78
negative feedback - too much info					2			2	1		6	11
not necessary				2				2	5		7	16
online learning strategies		1	8				1	11	1	7		29
perceived technology competency	1		7			1		34	8	14		65
perceived usefulness	3	18	43	2	2	11	34		26	75	15	229
previous online learning experience	2			1	5	1	8	26		5	6	54
readiness for online learning	2	10	14			7	14	75	5			127
suggestions				6	7			15	6			34
Totals	10	33	78	11	16	29	65	229	54	127	34	

Fig. 5.10 Co-occurrence of student feedback at completion of orientation

With the practice of launching a simulated Collaborate session, scaffolding was further provided to help students build or become aware of technological competency for synchronous web-conferencing in online classes. A content analysis was conducted of the 168 launched and recorded Collaborate web-conferencing sessions, with identifiers removed first and then with coding of web-conferencing features. The results revealed that 53 % practiced VoIP audio; 35 % launched a live video session; 33 % tried to use whiteboard; and 19 % attempted the Raise Hand tool.

Based on the afore-mentioned analysis of the data collected from the coursework and EOQ, this orientation was found to be a solution to preparing student readiness for online learning. The results indicated that the students gained the essential conceptual and procedural knowledge about characteristics of successful online learners, online learning strategies, and technology competency, as well as performed learning activities with necessary technical skills.

5.8 Conclusion and Discussion

As the potential of technologies and a networked world are shaping education, support to students has become crucial to ensure successful learning in the online environments that are usually defined by the educational institutions (Benson and Whitworth 2014; Crawley 2012; Simonson et al. 2012). With the goal of designing an effective instructional product to prepare students' readiness for online learning, an orientation course was designed with conceptual and procedural scaffolding in the Canvas LMS. Although the study was limited to one case of instructional design and development in a specific LMS in one institution, the formative evaluation results indicated that the students who completed the course perceived its usefulness and gained readiness for online learning.

Based on the analysis of coursework performed by the students who voluntarily completed the orientation and data from EOQ, the formative evaluation results demonstrated that the course prepared students with conceptualization of successful characteristics of online students, cognitive preparation for online learning, and essential technology competencies. The assessment methods mapped with learning activities of conceptual and procedural scaffolding facilitated the students' ability to gain an awareness of essential concepts and competency and to acquire basic technology skills. Applied thematic analysis was conducted using the transcripts of student reflection entries on the online discussion at the completion of the course. The code co-occurrence revealed that the most frequently repeated themes in the coded excerpts were perceived usefulness, readiness for online learning, and effective design. These three themes also overlapped each other in the coded excerpts.

In addition to the results above, there were several lessons learned: (1) Module 3—University Computing and Support Information and Module 4—LMS Support could be combined into one unit. This would eliminate the negative feedback on repetitiveness of content. (2) An enrollment invitation could be based on previous online learning experience, which could be detected with the survey for analyzing the needs and comparison of enrollments in online courses in a sequence of years. (3) The orientation course was designed to develop online learning readiness for students enrolled in for-credit online classes in various disciplines. The students might have varied online learning experiences, technology competency levels, schedules, and study habits. With more and more technologies utilized in online courses of different disciplines, more customized orientation programs can be the design trend of future iterations (Cho 2012).

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Appendix A—Time Management Worksheet

Time Management Worksheet

This tool is to help you track the tasks and related activities when you take courses during summer sessions. Certainly study is of priority during the time; however, other personal activities, such as sleeping and maintaining social life, are also important. Successful completion of the compressed summer-session course(s) needs your plan and balance of different activities.

Remember—Total Hours Per Week: 168

Your Name:

Tasks	**Related Activities, including** • study • personal (travel, grooming, eating, sleeping) • job • leisure activities (idle leisure such as surfing with social media, watching movies, etc; social and relationship building time)	**Priority (High, Medium, or Low)**	**Hours on Task Per Week**
Example I: Reading	Study	High	20
Example II: FB friends in a different state	Leisure	Medium	4
Your Turn			

Appendix B—End-of-Orientation Questionnaire (EOQ)

1. Please respond to the statements below, using the scale indicated.

	Strongly Disagree	Disagree	Agree	Strongly Agree
Making time commitment is important for success in online learning.	❍	❍	❍	❍
Successfully completing the online class is important to me.	❍	❍	❍	❍

2. Please respond to the statements below, using the scale indicated

	Strongly Disagree	Disagree	Agree	Strongly Agree
• . …time management is very important for success in online learning.	❍	❍	❍	❍
• .… tracking my activities is important for time management.	❍	❍	❍	❍
• … clear online communication is necessary for successful course completion.	❍	❍	❍	❍
• . … I need to be more self-directed to be successful in online learning than in traditional classroom-based learning.	❍	❍	❍	❍

3. In order to contact the instructor about my questions related to the online course, I need to (Please check all that apply.)

❑ Search the instructor's contact information with the Campus Directory on the university homepage.
❑ Find the instructor's contact information by logging in MyMadison and locating the online course.
❑ Send a private message to the instructor with the Conversations Inbox in Canvas.
❑ Find the communication method recommended by the instructor in the online course syllabus.

4. In order to join an online synchronous class meeting with Blackboard Collaborate, I need to download and install the following plug-in (Please select the BEST answer.)

❍ Java
❍ Flash Player
❍ Adobe Acrobat Reader
❍ Quicktime Player

5. In order to set up or fix my computer hardware, I need to contact the university's (Please select the BEST answer.)

❍ HelpDesk
❍ CIT Support
❍ Learning Centers
❍ Student Success Program

6. If I have questions related to Canvas and Blackboard Collaborate, I need to contact the university's (Please select the BEST answer.)

❍ University IT Training Department
❍ HelpDesk
❍ CIT Support
❍ Learning Centers

7. If I want to find self-help resources about computing at JMU, I can use the following website (Please select the BEST answer.)

❍ http://cit.jmu.edu/
❍ http://www.jmu.edu/computing
❍ http://www.lib.jmu.edu
❍ http://www.jmu.edu/learning/

8. If I want to find self-help resources about Canvas and Blackboard Collaborate, I can use the following website (Please select the BEST answer.)

❍ http://cit.jmu.edu/
❍ http://www.jmu.edu/computing
❍ http://www.jmu.edu/computing/ittraining/
❍ http://sites.jmu.edu/citsupport/

9. Please respond to the statements below, using the scale indicated.

	Strongly Disagree	Disagree	Agree	Strongly Agree
• . … proactive online communication is necessary for successful course completion.	❍	❍	❍	❍
• . … a dependable computer is important for success in online learning.	❍	❍	❍	❍
• . … a study space where I can concentrate is important for success in online learning.	❍	❍	❍	❍
. … reliable network connection is important for success in online learning.	❍	❍	❍	❍
• . … not getting distracted with other social media when I'm participating in online courses is important for success in online learning.	❍	❍	❍	❍
• . … being respectful in conversations with peers and instructor in online courses, including discussion postings, emails, and comments, is important for success in online learning.	❍	❍	❍	❍

10. Please comment on the orientation course:

Appendix C—EOQ Items Mapping with Orientation Objectives

Objectives	Assessment methods	EOQ questions	Item#
O-1. Demonstrate metacognitive awareness regarding motivation and time commitment to online courses	End-of-Orientation Questionnaire (EOQ)	Online Learning Motivation	#1, 9
	End-of-Orientation Questionnaire (EOQ)	Time Commitment	#1, 2
	Canvas Orientation site track completion of self-assessment about online learning readiness		
O-2. Match the technical requirements from the program for the installation and facilitation on their own devices	Checklist or Tracking with Technologies		# 4,
	End-of-Orientation Questionnaire (EOQ)	Factual knowledge items about computer configuration	
O-3 .Identify representative characteristics of a successful online student	End-of-Orientation Questionnaire (EOQ)	Awareness of successful online learning tips	#2, 3, 9
	Post comments to online discussion forum after watching the recording		
O-4. Identify appropriate methods for contacting technical assistance and technical support staff.	End-of-Orientation Questionnaire (EOQ)	Factual knowledge items about appropriate contact for support	#5–8
O-5. Demonstrate knowledge of online learning management system by successfully completing the following tasks: A. Download a full-text article from the orientation course site and save it locally on a computer or mobile device; B. Submit an assignment, i.e. an uploaded article, to Canvas; C. Create an online discussion entry D. Take an online quiz/survey E. Check grades F. Participate in a Blackboard Collaborate web-conferencing session	Canvas progress moderating of task completion		

References

Azevedo, R., & Hadwin, A. F. (2005). Scaffolding self-regulated learning and metacognition–Implications for the design of computer-based scaffolds. *Instructional Science, 33*(5), 367–379.

Benson, A. D., & Whitworth, A. (2014). *Research on course management systems in higher education Charlotte*. NC: Information Age Publishing Inc.

Bigatel, P. M., Ragan, L. C., Kennan, S., May, J., & Redmond, B. F. (2012). The identification of competencies for online teaching success. *Journal of Asynchronous Learning Networks, 16*(1), 59–77.

Bozarth, J., Chapman, D. D., & LaMonica, L. (2004). Preparing for distance learning: Designing an online student orientation course. *Educational Technology & Society, 7*(1), 87–106.

Britto, M., & Rush, S. (2013). Developing and implementing comprehensive student support services for online students. *Journal of Asynchronous Learning Networks, 17*(1), 29–42.

Cho, M. (2012). Online student orientation in higher education: A developmental study. *Educational Technology Research and Development, 60*(6), 1051–1069.

Cigdem, H., & Yildirim, O. G. (2014). Effects of students' characteristics on online learning readiness: A vocational college example. *Turkish Online Journal of Distance Education (TOJDE), 15*(3), 80–93.

Clark, R. C., & Mayer, R. E. (2011). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. Hoboken, NJ: Wiley.

Combs, K. L., Gibson, S. K., Hays, J. M., Saly, J., & Wendt, J. T. (2008). Enhancing curriculum and delivery: Linking assessment to learning objectives. *Assessment & Evaluation in Higher Education, 33*(1), 87–102.

Crawley, A. (2012). *Supporting online students: A practical guide to planning, implementing, and evaluating services*. San Francisco, CA: Wiley.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications Inc.

Dabbagh, N. (2003). Scaffolding: An important teacher competency in online learning. *TechTrends, 47*(2), 39–44.

Dabbagh, N., & Bannan-Ritland, B. (2005). *Online learning: Concepts, strategies, and application*. Upper Saddle River, NJ: Prentice Hall.

Delen, E., Liew, J., & Willson, V. (2014). Effects of interactivity and instructional scaffolding on learning: Self-regulation in online video-based environments. *Computers & Education, 78*, 312–320.

Dixon, M., Beveridge, P., Farrior, C., Williams, B. A., Sugar, W., & Brown, A. (2012). Development of an online orientation for an instructional technology masters program. *TechTrends: Linking Research and Practice to Improve Learning, 56*(6), 44–48.

Dray, B. J., Lowenthal, P. R., Miszkiewicz, M. J., Ruiz-Primo, M. A., & Marczynski, K. (2011). Developing an instrument to assess student readiness for online learning: A validation study. *Distance Education, 32*(1), 29–47.

Er, E., Özden, M. Y., & Arifoğlu, A. (2009). LIVELMS: A blended e-learning environment: A model proposition for integration of asynchronous and synchronous e-learning. *International Journal of Learning, 16*(2), 449–460.

Erwin, T. D. (1991). *Assessing student learning and development: A guide to the principles, goals, and methods of determining college outcomes*. San Francisco, CA: Jossey-Bass.

Gagne, R. M., Wager, W. W., Golas, K. C., Keller, J. M., & Russell, J. D. (2005). *Principles of instructional design* (5th ed.). Belmont, CA: Wadsworth/Thomson Learning.

Guest, G., MacQueen, K. M., & Namey, E. E. (2011). *Applied thematic analysis*. Thousand Oaks, CA: Sage Publications Inc.

Gustafson, K. L., & Branch, R. M. (2002). *Survey of instructional development models* (4th ed.). Syracuse, NY: Syracuse University.

Hannafin, M., Land, S., & Oliver, K. (1999). Open learning environments: Foundations, methods, and models. In C. M. Reigeluth (Ed.), *Instructional design theories and models, vol. 2: A new* *paradigm of instructional technology*, pp. 115–140. Mahwah, NJ: Lawrence Erlbaum Associates.

Hung, M., Chou, C., Chen, C., & Own, Z. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education, 55*(3), 1080–1090.

Instructure, C. (2014). Canvas help center. Retrieved from http://guides.instructure.com

Jones, K. R. (2013). Developing and implementing a mandatory online student orientation. *Journal of Asynchronous Learning Networks, 17*(1), 43–45.

Lawanto, O., Santoso, H. B., Lawanto, K. N., & Goodridge, W. (2014). Self-regulated learning skills and online activities between higher and lower performers on a web-intensive undergraduate engineering course. *Journal of Educators Online, 11*(3), 1–32.

Lehmann, T., Hähnlein, I., & Ifenthaler, D. (2014). Cognitive, metacognitive and motivational perspectives on preflection in self-regulated online learning. *Computers in Human Behavior, 32*, 313–323.

Moore, M. G., & Kearsley, G. (2012). *Distance education: A systems view of online learning* (3rd ed.). Belmont, VA: Wadsworth Cengage Learning.

Namey, E., Guest, G., Thairu, L., & Johnson, L. (2008). Data reduction techniques for large qualitative data sets. In G. Guest & K. M. MacQueen (Eds.), *Handbook for team-based qualitative research* (pp. 137–162). Lanham, MD: Altamira Press.

Ohia, U. O. (2011). A model for effectively assessing student learning outcomes. *Contemporary Issues in Education Research (CIER), 4*(3), 25–32.

Quality Matters Program. (2013). *The Quality Matters higher education rubric*. Retrieved from https://www.qualitymatters.org/rubric

Reeves, T. C., Herrington, J., & Oliver, R. (2005). Design research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education, 16*(2), 96–115.

Reeves, T. C., Benson, L., Elliott, D., Grant, M., Holschuh, D., Kim, B., et al. (2002). Usability and instructional design heuristics for E-learning evaluation. *Proceedings of ED-MEDIA 2002 World Conference on Educational Multimedia, Hypermedia and Telecommunications: 14th Conference* (pp. 1615–1621).

Richey, R., & Klein, J. D. (Eds.). (2007). *Design and development research: Methods, strategies, and issues*. Mahwah, NJ: Lawrence Erlbaum Associates.

Scagnoli, N. I. (2001). Student orientations for online programs. *Journal of Research on Technology in Education, 34*(1), 19–27.

Schank, R. C., Berman, T. R., & Macpherson, K. A. (1999). Learning by doing. In C. M. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory*. Routledge. (pp. 161–181).

Shelton, K., Saltsman, G., Holstrom, L., & Pederson, K. (2014). *Quality scorecard 2014 handbook: Criteria for excellence in the administration of online programs*. Retrieved from (with Online Learning Consortium membership) http://onlinelearningconsortium.org/book/quality-scorecard/

Simonson, M., Smaldino, S., Albright, M., & Zvacek, S. (2012). *Teaching and learning at a distance* (5th ed.). Boston, MA: Pearson Education Inc.

Smith, P. L., & Ragan, T. J. (2005). *Instructional design* (3rd ed.). Hoboken, NJ: Wiley.

Stebbins, R. A. (2001). *Exploratory research in the social sciences*. Thousand Oaks, CA: Sage Publications Inc.

Stewart, B. L., Goodson, C. E., Miertschin, S. L., Norwood, M. L., & Ezell, S. (2013). Online student support services: A case based on quality frameworks. *Journal of Online Learning & Teaching, 9*(2), 290–303.

Suskie, L. (2010). *Assessing student learning: A common sense guide*. Hoboken, NJ: John Wiley & Sons.

Ullmann, J. (2009). Alternative uses for course management systems: They aren't just for classes any more. *Online Journal of Distance Learning Administration, 12*(3). Retrieved from http://www.westga.edu/~distance/ojdla/fall123/ullmann123.html

Wang, C., Shannon, D. M., & Ross, M. E. (2013). Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning. *Distance Education, 34*(3), 302–323.

Wright, C. R., Lopes, V., Montgomerie, T. C., Reju, S. A., & Schmoller, S. (2014). Selecting a learning management system: Advice from an academic perspective. *EDUCAUSE Review Online*, April 21, 2014. Retrieved from http://www.educause.edu/ero/article/selecting-learning-management-system-advice-academic-perspective

Chapter 6
Improving Learning in MOOCs Through Peer Feedback: How Is Learning Improved by Providing and Receiving Feedback?

Jianli Jiao, Yuqin Yang, Hongrui Zhong and Gaimei Ren

Abstract Massive Open Online Courses (MOOCs), as one type of disruptive technology, has been described as the "campus tsunami" that is purportedly poised to change the face of higher education. Peer assessment has been adopted as a strategy to stimulate students' active engagement in learning in MOOCs. While it is considered an effective pedagogical strategy to empower students and support learning by some, it is regarded as one of the main criticisms by others. It has been the focus of the dispute among developers of MOOCs in the field in the past few years. Based on a case of the MOOC entitled, The Red Chamber Dream, on Coursera, this study aims to explore the relationship between the perception of usefulness of peer assessment and the quality of learner assignments, and whether community knowledge is advanced in MOOCs facilitated by peer assessment. All notes related to learning in the discussion board were retrieved for further analysis. Notes indicating students' perceptions about peer assessment were downloaded for analysis. Finally, students' essays available on the course site were also saved in individual files for further analysis. Research found that there is no correlation between the quality of students' essay writing and note writing and the reported usefulness of providing feedback/grading to their peers. Results also suggest that no correlation exists between the quality of students' essay writing and note writing and the reported usefulness of receiving peer feedback. Meanwhile, results suggest that students were engaged in discussions and advanced their understanding.

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They produced a large number of explanations and knowledge building discourse, all of which involved knowledge advancement in each week. This improvement in knowledge may result in part from their expertise and in part from peer review of peers' work. However, we cannot identity improvement of students' work between different weeks.

Keywords Massive open online course · MOOC · Peer assessment

6.1 Introduction

Massive Open Online Courses (MOOCs), as one type of disruptive technology, have been described as the "campus tsunami"(Brooks 2012) that is purportedly poised to change the face of higher education (Grover et al. 2013). They are distributed and virtual classes that centralize activities on a single platform and last about 6–10 weeks at a time, emphasizing instructional videos and regular assessments (Kizilcec et al. 2013). MOOCs have attracted a large number of users with diverse goals, interests, backgrounds, and prior knowledge because of their distinguishing features such as low barriers to registration, asynchrony, lack of constraint on course content use (DeBoer et al. 2014), and no cost to entry or exit (Kizilcec et al. 2013). MOOCs have been defined as:

> A massive open online course (MOOC) is an online course aimed at large-scale interactive participation and open access via the web. In addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums that help build a community for the students, professors, and TAs (Teaching Assistants) (Wikipedia 2012).

The MOOC definition highlights its key components such as a distributed community of peers with diverse expertise and cultural backgrounds, and online courses harnessing large-scale active participation of and interaction among MOOC users. MOOCs have used peer assessment, especially in social science courses with open-ended assignments, well-facilitated discussion boards, and technologies such as some social media technologies to scaffold users' engagement and promote both individual and community knowledge building.

Peer assessment, defined as "an arrangement in which individuals consider the amount, level, value, worth, quality or success of the products or outcomes of learning of peers of similar status" (Topping 1998, p. 250), is considered an effective pedagogical strategy to empower students and support learning. It is of paramount importance in MOOCs due to the large number of users in a particular MOOC. MOOC users need to evaluate their peers' work and provide feedback because the course instructors often cannot assess such a large number of assignments in a very short time and provide feedback to learners.

In MOOCs, peer assessment can be used both summatively to provide grading when learners rate each other's performance and formatively to scaffold learning to help students improve their work and foster reflection. In the process of peer assessment, students work as both assessors and assessees. As assessors, MOOC learners review peers' work and may provide constructive feedback, whereas as assessees they receive feedback and may make improvements accordingly. Through such processes, they may advance both individual and community knowledge. Peer assessment has been proved to be an effective pedagogical strategy to improve students' learning in traditional learning contexts (Lee and Lim 2012; Tsai et al. 2002; Tseng and Tsai 2007; Woo et al. 2013). However, little is known about the effects of peer assessment in a MOOC context, though it has been adopted in most of the MOOCs. This study aimed to explore the relationship between the perception of usefulness of peer assessment and the quality of learner assignments, and how community knowledge is advanced.

6.2 Collaborative Inquiry in MOOCs, Peer Assessment, and Learning

MOOCs, as a new learning context supported by technology, have attracted a large number of learners with an extensive range of expertise and backgrounds. Therefore, it is important to harness the power of participatory media to engage them in productive communication and collaboration through a various of channels (Conole 2013), and to harness the power of MOOC learners' expertise and knowledge in order to advance learning. Knowledge in MOOCs is emergent and dependent on the collaboration and interactions among the diverse learners (Conole 2013). The learners may advance both individual and community knowledge when they are engaged in productive collaboration and interaction. Peer assessment, as a pedagogical method, has been used in many MOOCs to engage students in the learning process and to harness their expertise to help their peers improve learning outcomes. It may have great potential in helping MOOC learners to improve both their individual and collective knowledge.

Research on peer assessment has shown that it can benefit students' learning. For instance, Trautmann (2009) reported two experimental studies that examined the impacts of writing and receiving web-mediated peer reviews on revision of student research reports. A total of 77 undergraduate science students participated in the two experiments. In both rounds of the experiment, students engaged in the following activities: collaborating in small groups to design and conduct experiment, writing research reports with guidance, providing and/or receiving review with guidance, grading the reports, revising the research reports, and finally submitting them to an online system. Log data in terms of the numbers of corrections, additions, and refinements of research reports in the online system, the draft and final version of draft reports, the feedback and comments, and students' online questionnaires were used as data sources. Statistical analysis evidenced that providing and/or receiving reviews positively impacted students' research report writing.

Venables and Summit (2003a, b) found that computer science students' domain knowledge was improved because of the peer review, though students had initial reservations about peer assessment. Pope (2001) identified that peer assessment enhanced students' writing and reporting skills, particularly in the area of "spelling and grammar, referencing and logic" (p. 242). Peer assessment could produce benefits for both assessors and assessees in multiple ways, such as attention to crucial elements of quality work, constructive reflection, greater sense of responsibility, and accountability (Topping 1998).

General benefits of peer assessment have been frequently reported; however, whether learning is affected by students' dual role of being an assessor (reviewing peers' work and providing feedback) and assessee (receiving feedback from peers) is not clear (Li et al. 2010). Research results are mixed. For example, Trautmann (2009) found that giving reviews positively impacted students' research report writing, and receiving reviews exerted significantly greater impact on report revision than giving reviews. Tsai et al. (2002) found that students who provided more constructive and detailed comments and suggestions in evaluating their peers' work tended to progressively improve their own design. From the perspectives of the assessor, some research finds that the higher the qualities of the feedback students provide their peers, the greater the gains they receive. For example, in a study by Li and Steckelberg (2006), students acknowledged that it is helpful to "look at what others are doing," and some of them feel "inspired" by peers' work (p. 268). In another study, Li et al. (2010) examined the relationship between the quality of students' projects and the quality of peer feedback, and found that a significant positive relationship existed between the quality of students' own final projects and the quality of peer feedback that they provided for others based on hierarchical multiple regression. From the perspectives of assessees, the results are mixed. Though students recognize the value of peer feedback/comments, some complain about the poor quality of comments that they receive, and they call for more detailed and constructive feedback from peers (Li et al. 2010).

Peer assessment has produced great benefits for students' learning in traditional learning contexts (Lee and Lim 2012; Tsai et al. 2002; Tseng and Tsai 2007; Woo et al. 2013). Peer assessment has been adopted as a strategy to stimulate students' active engagement in learning. However, little is known about the effects of peer assessment in a MOOC context. This study aimed to explore the relationship between the perception of usefulness of peer assessment and the quality of learner assignments, and whether community knowledge is advanced in MOOCs facilitated by peer assessment. More specifically, this paper answers the following questions:

RQ1 Is there a relationship between the quality of individual knowledge and the extent of the usefulness of peer assessment perceived by the assessors and assessees, respectively?

RQ2 Is community knowledge advanced by MOOCs users facilitated by peer assessment?

6.3 Methods

6.3.1 Data Sources

This study investigated how MOOCs users improve their individual and community knowledge by using peer assessment. Specifically, this study aimed to examine how Chinese MOOCs used peer assessment to improve students' learning. In this study, we chose the Red Chamber Dream MOOC on Coursera as a case based on the following reasons:

- It was one of the best MOOCs provided in Chinese.
- Students produced large amount of postings on the discussion board.
- Some students had uploaded their essays to the course website.
- Some students shared their feelings and perceptions on peer assessment.

In this study, all notes related to learning (over 1000 notes) in the discussion board were retrieved for further analysis. In addition, notes indicating students' perceptions about peer assessment were downloaded for analysis. Finally, students' essays which were available on the course site were also saved in individual files for further analysis. In total, 39 students made their essays available for analysis.

6.3.2 Data Analysis

6.3.2.1 For the Analysis of Student Essays

The assessment criteria in each unit in the Red Chamber Dream MOOC were used to assess students' essays. The assessment criteria, in general, were the same, though there were some minor differences among the different units. The following were the assessment criteria in one unit:

(1) Word count requirement: 350 or 500 characters are required as appropriate, and the proportion of citations should be below 1/3.
(2) Rigorous data: The citations should be clear and precise. The plot or the precise chapters and sections should be given. In addition, the citations should be relevant to your argument.
(3) Pertinent capability/Ability to keep to the point: You should be sure to use the plot from *The Red Chamber Dream*, and give examples of "self."
(4) Reasoning ability: A clear position should be presented and advanced with well supported information and ideas. In addition, the information and ideas should be arranged coherently with no contradiction.

This study used a formula to calculate the overall score for each individual student's work (see Table 6.1). For the individual analysis, every student's

Table 6.1 The calculation formula for students' essays

Length (L)	Reference (R1)	Reference (R2)	Coherence (C)	Style (S)	Originality (O)	Exceptions (E)	Calculation	
(a) More than 350/500 characters are required, and (b) the proportion of citations should be below 1/3	(a) Citations should be clear, precise, and (b) relevant to your argument.	(a) Responds to the task/topic, and (b) presents a clear position with well supported ideas	(a) Arranges information and ideas coherently, and (b) there is a clear overall progression.	Writes beautifully and fluently.	Writes something new which develops the original.	(a) For Unit 3, all submitted essays will be given a score of 1.2 first, and (b) for I of Unit 5 and Unit 6, students should give an overall evaluation as well.	II, Unit 2	25 % L + 20 % R1 + 20 % R2 + 20 % C + 15 % S
							Unit 3	1.2 + 24 % L + 12 % S + 20 % R2 + 20 % O
							I, Unit 4	25 % L + 20 % R1 + 20 % R2 + 20 % C + 15 % S
							II, Unit 4	24 % L + 16 % R1 + 16 % R2 + 16 % C + 16 % O + 12 % S
							I, Unit 5	9 % L + 24 % R1 + 24 % R2 + 24 % C + 9 % S + 10 % E
							II, Unit 5	24 % L + 16 % R1 + 16 % R2 + 16 % C + 16 % O + 12 % S
							I, Unit 6	12 % L + 24 % R1 + 24 % R2 + 24 % C + 12 % S + 4 % E
							II, Unit 6	24 % L + 16 % R1 + 16 % R2 + 16 % C + 16 % O + 12 % S
							Notes	10 % R1 + 40 % R2 + 25 % C + 25 % O

assignments were quantitatively evaluated on 4–6 dimensions developed by the lecturers (see Table 6.1). However, some students' assignments could not be obtained from the Coursera, so the threads and notes in the forum were analyzed as alternative. As the notes were informal, the length and the style of writing were not considered in the evaluation.

The students were given a score between 1 and 5 (with 1 point as unit) to every assignment/note on each dimension above. For each student, all the individual scores of his/her assignments and notes were averaged and rounded to produce an Overall Band Score. Overall scores were reported to the nearest whole or half scale. The following rounding convention applied: if the average across the assignments and notes ended in 0.25, it was rounded up to the next half band, and if it ended in 0.75, it was rounded up to the next whole band.

6.3.3 For Analysis of Student Perceptions of Peer Assessment

In analyzing students' perceptions of peer assessment, different points were assigned to different students based on their description of the usefulness of peer assessment. If a student indicated that peer assessment is very helpful to his/her learning, four points would be assigned to his/her comments. Other points were assigned as follows: 3 points to "useful," 2 points to "kind of useful," 1 to "not useful," and 0 to "no indication of useful or not".

6.3.4 For Analysis of Students' Community Knowledge

For analyzing students' discussions related to learning, the discourse types developed by Lee et al. (2006) were adopted. These discourse types were developed to capture the characteristics of knowledge building inquiry and explanation, and to examine the changes or advancement of community knowledge over time in a knowledge building environment (Lee et al. 2006). These four patterns also explained and captured the unproductive and productive social dynamics that lead to the characteristics of the four patterns (See Table 6.2). Knowledge building processes in MOOCs share the same characteristics with knowledge building environments, such as collective cognitive responsibility, progressive problem-solving, knowledge advancement, and diverse ideas and expertise.

Table 6.2 Four types of discussion threads

Discourse patterns	Descriptions	Level
Information accumulation or Fragmented discourse	Information accumulation or Fragmented discourse was characterized by little discussion, short exchanges, or isolated notes. This type of discourse consisted of simple or factual questions, or questions that do not capture community interest	Level 1
Information sharing	Information Sharing was characterized by short and horizontal question-and-answer discussions, focusing on sharing of factual information, prior understanding, or relevant information. Various questions may be asked, but they require factual answers rather than explanations. Discussions were shallow and short, fraught with unelaborated facts, disjointed personal opinions, and information copied from somewhere. Generally, there is not a clear problem to tackle and not much effort to move the inquiry to deeper level	Level 2
Explanation	Explanation discourse is characterized by explanation development through problem-solving, usually followed with ideas, explanations, and follow-up questions. In this type of discourse, students also generated multiple and diverse ideas and alternative explanations apart from explanation-seeking questions. It is a productive form of discourse. In the process of problem-solving, learners examined the validity of explanations or ideas, asked follow-up questions to deepen their understanding, made incremental contribution to their existing explanations, and advanced their understanding	Level 3
Knowledge building	Knowledge building was characterized by cyclical explanations, emergent inquiry, and knowledge advancement process. It captured all the characteristic acts of the 'Explanation' type; but it also involved a progressive and emergent process of knowledge improvement, consisted of synthesis, rise-above, and progressive problem-solving. It was much more sustained than explanation type discourse. In the process, students move towards yet a higher-level of understanding and knowledge construction	Level 4

6.4 Results and Findings

6.4.1 The Effects of Providing Grading/Feedback on the Quality of Writing

Figure 6.1 shows that there was no correlation between the extent of reported usefulness of providing peer grading/feedback and the quality of MOOCs users' writing, including assignments and notes on the discussion board in each unit. When we qualitatively analyzed students' posts in terms of benefits of providing grading and feedback, we found that some students reported that providing peer grading/peer feedback could benefit them a lot. In the following excerpts from learners' posts after they had finished the job of reviewing five peers' assignments, learners talked about how providing peer grading/feedback benefitted them:

Student A: Personally, I think peer review is very useful. From peer review, we can see other angles of thinking in tackling the problems, find the problems I have ignored, find some good books from others' reading list and enrich our reading experience. I am really inspired by my peers' writing. "In addition, I have a better understanding on how to address the assignments and express my ideas after peer review. I find peer review really is not bad."

Student B: "I think peer review is pretty good. After peer review, I know more about my own writing and other peers' thought. Really help me."

From the above excerpts, we found that students could benefit from seeing things from different angles and reflecting on their own ideas, strengths, and

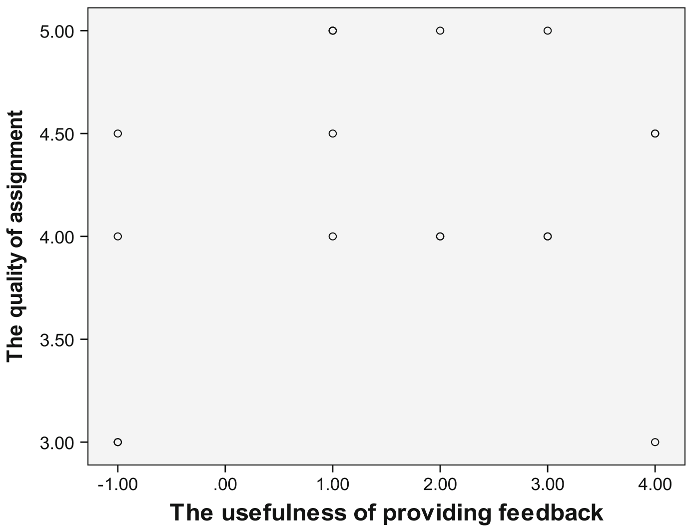


Fig. 6.1 The relationship between the quality of writing and the reported usefulness of providing feedback

weaknesses in the essay or note writing in the process of peer review. However, some students complained that they learned little from peer review. For instance, Student C wrote that:

I find there is no point to review other peers' essay. The point to use peer review is to improve our understanding in the interaction. However, I feel that the chance of being benefitted is very slim based on my past experience.

From the posts, we found that whether students benefitted or not from peer review and to what extent it benefitted them was based on the quality of their peers' essay.

6.4.2 The Effects of Receiving Feedback on the Quality of Writing

Figure 6.2 shows that no correlation exists between the extent of reported usefulness of receiving peer grading/feedback and the quality of MOOCs users' writing, including essay writing for the assignments and note writing on the discussion board in each unit. When we qualitatively analyzed students' posts in terms of benefits of receiving feedback, we found that most students did not think peer review could help them. They also thought they deserved higher grades than what was given by their peers. For instance, Student C wrote that:

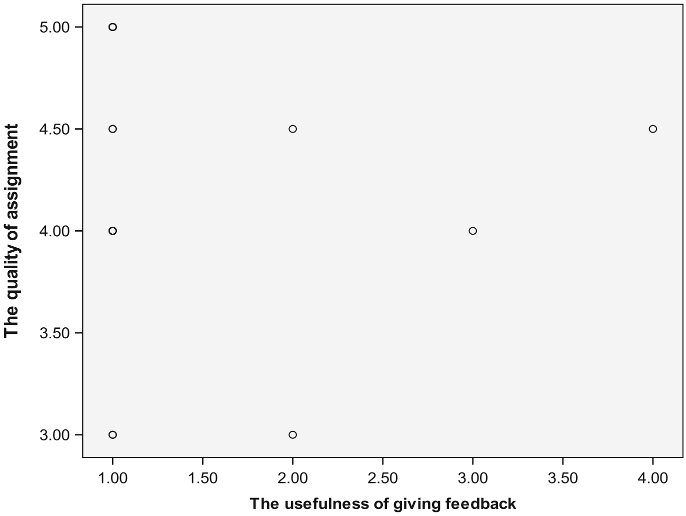


Fig. 6.2 The relationship between the quality of writing and the reported usefulness of receiving feedback

…our course teacher does not read what we have written and submitted in person. We have spent so much time to prepare the assignment, however they are reviewed by our peers who even read little the work of the Red Chamber Dream. So what is the point…

From the excerpt, we found that students did think their peers could provide valuable comments to them. In most peer reviews, students just received grades from their peers with few comments. Some students said that they hoped to receive many valuable comments from their peers. Only a few learners wrote that peer comments could motivate them and they found the peer comments useful. For example, Student D said that:

I found that all the five peer reviewers had given me comments. Very good job. They were very good and to the point…I think it is a good way to learn from each other. When reading the comments, I find that I just write very few comments to our peers. Next time, I will do my best when doing peer review…

This excerpt shows that the student valued and benefited from their peers' comments. He/she also reflected on his/her own comments writing and planning to do better next time. He/she was motivated by their peers.

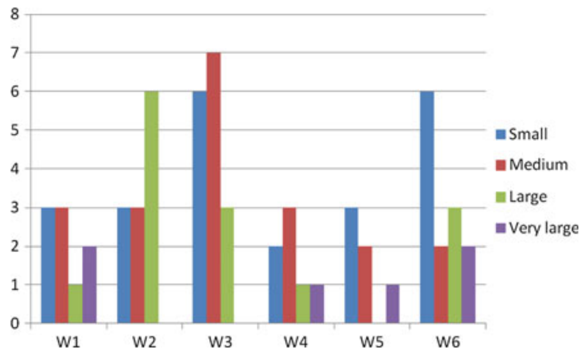
6.4.3 Community Knowledge

Students posted 1016 notes relevant to content learning in the whole process of course learning. They contributed to 23 small discussion threads (2–5 notes), 20 medium (6–20 notes), 14 large (21–40 notes), and 6 very large (over 40) discussion threads (see Fig. 6.3).

In the whole process of course learning, students discussed 39 topics in 63 discussion threads (see Fig. 6.4).

Figures 6.3 and 6.4 suggest that students were engaged in the discussions. They produced a large number of notes and many discussion threads and half of them involved knowledge advancement. Both explanation and knowledge building discussion threads involved knowledge improvement. When the threads were

Fig. 6.3 Differences in size of discussion thread in each week



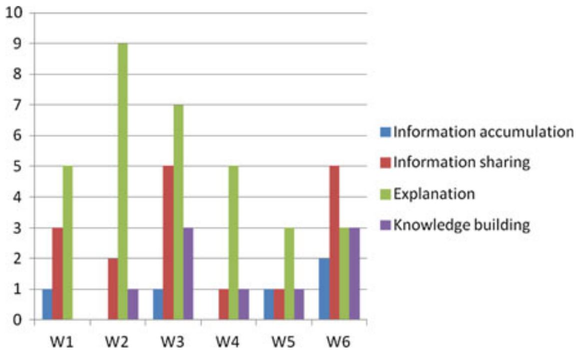


Fig. 6.4 Types of discussion threads in each week

qualitatively analyzed, knowledge advancement could be identified in some of the discussions. We just chose part of a string of notes of knowledge building discussion thread and elaborated on how students collectively advanced their understanding. The transcript (notes or excerpt of notes) below are presented in chronological order. In addition, all names appearing in the following notes are pseudonyms.

Discussion topic: A story about Xiaohong, proposed by Patrick
Note 1, posted by Amy
I am puzzled why Xiaohong's status is not high. She is a butler's daughter, so she should be the first-class servant's girl.
Note 2, posted by Patrick
Starting from this point, Liu Xinwu demonstrated that Qin Keqing and Qin (Lin) Zhixiao were political offenders avoiding misfortunes.
Note 3, posted by Gorge
I suppose that the character was not crafted well, kind of inconsistent. She was described as a very common character at her debut, but we were informed that she was the daughter of Zhixiao when she was required to do something by Wang Xifeng. Zhang Ailing also wrote some comments about this kind of paradox, refer to http://yizitong.com/common/content.php?poetry_id=1774&content_id=47&o=%E5%80%AA%E4%BA%8C&l=3. Posted by Gorge
Note 4, posted by Angela
I think that Zhang Ailing's argumentation was strong. I also think that the character seems kind of inconsistent in various occasions. Another question also comes out: why Wang Xifeng can not read? Wang Xifeng's status was higher than Li Wan, but she can not read even one word while Li Wan has read some.
Note 5, posted by Gorge
The Lady Dowager (Baoyu's grandmother) cannot read as well. She described that she was a heavy naughty girl when young. So Wang Xifeng may be the same as the Lady Dowager. Maybe she was punished by the teacher when wondering in class, so she may swear not to come to school any more. In

addition, there may be no good learning environment in her family… I think that it may be very interesting to writing something about Xifeng's farce in class…

These five notes focused on the family background of Xiaohong (one of the servants in the Red Chamber Dream) and the reasons why Wang Xifeng (a very important character in the Red Chamber Dream) cannot read. Note 1 posed an inquiry-the inconsistency of Xiaohong's status, and explained why she thought it was inconsistent. Note 2 deepened the inquiry topic proposed in Note 1 by providing some evidence: Liu Xinwu (a very famous author in China) claimed Xiaohong's father belonged to the big family of Qin and renamed his family name in order to avoid political misfortunes. Note 3 reasoned the inconsistency by contrasting the petty and low description at Xionghong's debut and detailed description of her father's status in the Jia Family, making some conceptual progress. Note 4 elaborated on the reasons of inconsistency and posed an inquiry question: Why could Xifeng not read? This showed a significant improvement on Note 3. Note 5 made some conceptual advancement by addressing the emergent, authentic inquiry in Note 4.

6.5 Discussion and Implications

This study investigated how the role of assessor and assessee in peer assessment impacts MOOCs users' learning, and whether community knowledge is advanced in MOOCs facilitated by peer assessment. Two research questions were: (1) Is there a relationship between the quality of individual knowledge and the extent of the usefulness of peer assessment perceived by the assessors and assessees, respectively? and (2) Is community knowledge advanced by MOOCs users facilitated by peer assessment? For the first question, results suggest that there is no correlation between the quality of students' essay writing and note writing and the reported usefulness of providing feedback/grading to their peers. Results also suggest that no correlation exists between the quality of students essay writing and note writing and the reported usefulness of receiving peer feedback/comments.

There might be two possible explanations for these results. One, the data may not be sufficient to indicate whether the role of assessors or assessees in peer assessment in MOOCs learning contexts impacts MOOC learners' learning. In this study, only students' whose essays and notes were available on the course site, and only their comments indicating the usefulness of providing and receiving feedback, were analyzed. Only 20 students met these criteria, because only 39 students had uploaded their essays online and only some of them expressed their ideas on the effects of peer assessment. Our original research plan aimed to examine the correlation between the quality of peer feedback/comments provided by MOOCs learners and the quality of their essay and notes, and the correlation between the quality of peer feedback received and the quality of essay and note writing. However, we could not get students' comments that they provided to their peers and received from their peers. Therefore, we analyzed the available data to see whether could find something interesting. In fact, it is a dilemma for MOOCs researchers, MOOCs practitioners, and MOOCs policy makers: researchers cannot get useful data to analyze from the practitioners, and the practitioners cannot get valuable advice from researchers. In the future, more resources and mechanisms should be provided to facilitate productive collaboration between researchers and practitioners.

Two peer assessment were used in a summative way. From the notes, we find that many students just received grades from their peers, but only a small number of students got valuable comments. This result also indicates that many students do not prepare the feedback for their peers in peer review. Therefore, very few students reflected on the comments that they received and provided, and further revised their essays. In peer assessment, students need to reflect on the comments and make further plans to improve work, which is the key to maximize the function of peer assessment. However, in this study peer assessment was just used to provide peer grades.

For the second question, results suggest that students were engaged in discussions and advanced their understandings. They produced a large number of explanations and knowledge building discourse, all of which involved knowledge advancement in each week of the course. This improvement may result in part from the students' expertise and in part from peer review of peers' work, for students who claimed that they were inspired by their peers' writing. However, we cannot identity improvement of students' work between different weeks. This may again be caused by the summative use of peer assessment.

In most peer assessment studies, students play the roles of assessor and assessee, and learning gains have been frequently reported in literature (Li et al. 2010). However, the learning gains rely on students' active involvement in assessing peer's work and taking agency in reflecting on the feedback/comments provided and received and improving their work. That means students must use the information in the peer assessment to improve their work and also to improve their metacognitive skills, such as reflection. In most of MOOCs, peer assessment is mainly used in a summative way, providing peer grading. Therefore, researchers and practitioners should pay attention to how to engage students in using peer assessment in a formative way to improve their learning in MOOC contexts.

Appendix

Information Accumulation Discussion Thread

Surprisingly, I agree with the teacher this time.

Zeng Yong: In the fifth week, the teacher's argument was reasonable. [However,]It was not necessary to demonstrate with the Chin-yen Chai's annotation, and the novel text in itself was enough. There was no direct correlation between Charpter 34 and Charpter 74, and Xiren was not the informant. At least, Cao Xueqin did not specify it. Though Baoyu had some doubts once, it only took a minute.

Obviously, the silly decision to perquisition in Daguan Gardens came from the calumny of Wang Shanbao's wife and some people hating the girls, such as the old housemaids.

I noticed a view that Xiren was Baochai II and Qingwen was Daiyu II. Considering the character, it really made sense. Baochai may imputed blame to Daiyu, but Xiren did not mean to frame Qingwen. Because Baoyu's servant girls were nice.

I did not agree with the teacher in a detail. It was far-fetched to compare Miss Deng to Xiren.

Wei Di: Shake hands! I do have the same feelings. It is infrequent for me to agree with the teacher.

Du Jiaping: Yep! The part on Miss Deng is really far-fetched. Cao Xueqin made many clerical errors, for example, the description of Qingwen's birth in the previous part was different from the later one.

Information sharing discussion thread

The Red Chamber Dream has many versions in the market. Which one is the best? Expect your recommendation.

Y.F.Cherry: I am in need of learning, communication and development. Welcome you guys!

Yin Ci: What the Prof. Ou uses in this course is the Gengchen version, which gets a perfect balance between integrity and the original intention of Cao Xueqin. You can choose this one for the course.

The Revised Gengchen Version of the Story of the Stone with Chin-yen Chai's Second Annotation.

Feng Jingguang: The version from the People's Literature Publishing House is the Gengchen version as well. You can buy it from dangdang.com.

Ji Xiang: The Red Chamber Dream with Chin-yen Chai's Annotation from Yuelan Publishing House. It based on the Gengchen version, and there was Chin-yan Chai's annotation. I learned a lot from it. However, there was only 80 chapters in it.

lvy liu: I suppose that you can choose the version revised by Zhou Ruchang for the general use. If you would like to compare various kinds of versions, you can choose the Version Compilation of the Story of the Stone.

Lu Di: I suppose you should consider the publishing house. I will recommend Yuelan Publishing House and Zhonghua Book Company.

Shu Jingye: My book is The Story of the Stone with Chin-yen Chai's Annotation revised by Huo Guoling and Zijun. There is Qi Liaosheng's preface in this version.

Happy man on the brink

When I was an undergraduate, I have read the Story of the Stone with Chin-yen Chai's Second Annotation in the library. I cannot remember the publishing house. It is based on the Gengchen version, and has some textual criticis. I really like it, but I cannot buy it on the Internet. Now what I bought is The Revised Gengchen Version of the Story of the Stone with Chin-yen Chai's Second Annotation. I suppose it is great.

Explanation Thread

Comments on the argument method in On Imputation

Ella wang: No matter what's the intention of the imputation, there is something wrong in the teacher's argument method:

1. There is a logical problem. The teacher said "No disaster, no imputation." First of all, excuse is not in need if there is no "disaster." Baochai knew that "once a cornered person do something desperate, it will makes trouble and I will be embarrassed." Second, imputation refers to imputing blame to others, regardless of the results. For instance, A killed somebody, and imputed blame to B. Accidently, B was not punished. Was this not a case of imputation?
2. There is a analogical problem. The teacher warned us not to make wrong analogy. However, she made such a mistake. The teacher took two strong examples to demonstrate Daiyu's immunity. These two examples did not violate the elders' intentions. In contrast, Baochai's escape by strategy may contract enmity from the elders. They are different.

Lovita: I agree with you. Imputation depends on whether the perpetrator realizes the disaster, rather than whether the victim suffers some real disaster. In fact, I can sympathize Baochai's subconscious imputation, because both of them would be embarrassed if Xiaohong saw her eavesdroping by the window…impute blame to others was the best choice for her. Regarding of the target, I agree with the teacher that she just came from Xiaoxiang Pavilion and Daiyu was the first person she could remind…

Ella wang: I agree with you absolutely. I do not think Baochai's behavior is on purpose as well. However, there is a definite distinction between the behavior of and the result of the imputation.

Anonymous: I agree with the above. I suppose the case is different from others…

Zeng Yong: I agree with you. There must be logical problem in teacher's argument. The process is problematic, how about the conclusion?

Scarlett Law: I agree with Ella Wang's opinion partially…

I suppose the aim of teacher's argument was not to retionalise Baochai's action, but to highlight that the word "imputation" was a bit of an overstatement. Even though Daiyu confront with embarrassment, it was not a disaster. Baochai imputed something to Daiyu, but not a disaster. It is not similar to the murder.

However, I cannot agree with the teacher that she concluded from the story that Baochai was not a scheming girl. I think this part just reflects her scheming. She did not want to confront the embarrassment, and leave it to Daiyu…

Knowledge Building Discussion Thread

Can you post your follow-up writings in week 3?

Wanlu Shi: It is disappointed to find a dozen works are about Grandma Liu. Finally I read a story about Zhen Baoyu in the forum and learn a lot. Can you post your works for discussions?

1. Patrick Yeh: A story about Jia Yun, Xiaohong, and Qianxue.

   A. Liu Ning: Haha, Qianxue is there as well. A good idea.
   B. Wanlu Shi: I am puzzled that why Xiaohong's status is not high. Because she is the butler's daughter, she should be the first-class servant girl.
   C. Patrick Yeh: Starting from this point, Liu Xinwu demonstrated that Qin Keqing and Qin (Lin) Zhixiao were political offenders avoiding misfortunes.
   D. Chung-chi Tien: I suppose that the character was not integrated well. Until Wang Xifeng ordered her to do something, the author told us that she was not a common character, but Lin Zhixiao's daughter. I found Zhang Ailing's views toward the paradox as well. http://yizitong.com/common/content.php?poetry_id=1774&content_id=47&o=%E5%80%AA%E4%BA%8C&l=3
   E. Wanlu Shi: Zhang Ailing's argument was strong. I also think that the character was not integrated well among various versions.
   I have another question: why Wang Xifeng can not read?
   Wang Xifeng's status was higher than Li Wan. However, Li Wan read some classics and Wang Xifeng can not read any word.
   F. Chung-chi Tien: Mrs Jia can not read as well. She remembered that she was naughty when she was a child. Maybe Wang Xifeng was the same to Mrs Jia and did not read anymore when she was punished by the teacher. Moreover, there was not an educated and reasonable atmosphere in Wang's family to nurture her.

It would be more interesting if I had written on Wang Xifeng's farce in class.

2. Anonymous: A story about Grandma Liu.
3. Chung-chi Tien: One assignment was about Daiyu's death. Since the aim of Daiyu's appearance was to return tears, the author wrote that she died in front of Baoyu with profound affections but no complains.

The other was about Xiangling's death. It developed the verse that "The soul of the beauty returns to her hometown" which was ignored by Gao E.

Both the two works gave some good changes to Gao E's version.

Referring to Daiyu's death, I suppose that Gao E borrowed Cao Xueqin's technique of contrast. In the same chapter, Daiyu died in absolute solitude, but Baochai lived with all the glories in the world.

As Gao E took the story to extremes, Baoyu and Daiyu died with regrets that they burned the manuscript and the handkerchief because of mistakes.

You would find his extreme in contrast with Qingwen's death. Though Qingwen died in loneliness, there were some tender scenes, such as she exchanged underwear with Baoyu and bit off the fingernail.

The mistake was out of place, because they had communicated smoothly for long. I suppose that the classmate rewrited the story with the same opinions.

A. Anonymous: Dayu's death, before the story, I would like to introduce some inferences of mine as the context: First of all, Daiyu must died because she knew Baoyu would marry Baochai. Secondly, it is not Mrs Jia but Baoyu's mother who wanted Baoyu to marry Baochai. In the previous 80 chapters, both Mrs Jia and Wang Xifeng wanted Baoyu to marry Daiyu. Thirdly, Baoyu's mother went against Mrs Jia's wishes because Mrs Jia had been dead and Wang Xifeng had lost power and influence. Fourthly, Baoyu's mother must had visited Princess Yuan and persuaded her to decree the marriage. Fifthly, Princess Yuan did not die before the wedding, so the emperor would not exterminate Jia family. In conclusion, I suppose that the marriage and Daiyu's death were not Mrs Jia and Wang Xifeng's conspiracy. Baoyu was obliged to follow the superior's will as a childe. Daiyu sympathized Baoyu's dilemma, so she would show pity for the marrige but not hatred. Daiyu would put Baoyu's interest first. However, the decision overwhelmed the sickly girl and made her burst into tears. In this accident, she cried until she returned all the tears and died.

A story about Daiyu's death.

B. Anonymous: Your inferences make sense. I suppose that many clues could be found in the text [Some evidences]. A netizen gives many evidences to demonstrate that Baoyu's mother did not like Daiyu. For instance, the netizens provides two other evidences: Zhiyan Zhai ordered the author to delete the chapter about Tianxiang Pavilion…
C. Patrick Yeh: Splendid! I suppose there is another possibility, i.e., Daiyu had been dead for other reasons in early time and Baoyu had no choice but to marry Baochai. In this case, it did not matter whether Mrs Jia was dead or not. Since I cannot explain all that in just a few words, I will write another post elsewhere. First of all, I want to review the opinions of Tianxiang Pavilion above …Zhiyan Zhai ordered Qinxi to delete it in the name of Jihusou…
D. Anonymous: The views above are enlightening. In addition, I am very interesting about your opinion on Daiyu's death and looking forward to your further argument.
E. Liu Ning: All the inferences are good. However, I persevered that Jihusou is not Yanzhi Zhai…
F. Patrick Yeh:https://class.coursera.org/rcd-001/forum/thread?thread_id=250—comment-980 …I have written some words in other place about the conclusions that Daiyu died for other reasons and Baoyu couldn't marry him anymore. So I will not repeat my argument. The following are my views on Daiyu's death…

References

Brooks, D. (2012). *The campus tsunami*, *The New York Times*. Retrieved from http://www.nytimes.com/2012/05/04/opinion/brooks-the-campus-tsunami.html?_r=1&ref=davidbrooks

Conole, G. (2013). *MOOCs as disruptive technologies: strategies for enhancing the learner experience and quality of MOOCs*. http://eprints.rclis.org/19388/

DeBoer, J., Ho, A. D., Stump, G. S., & Breslow, L. (2014). Changing "course": reconceptualizing educational variables for massive open online courses. *Educational Researcher, 43*(2), 74–84.

Grover, S., Franz, P., Schneider, E., & Pea, R. (2013, June). *The MOOC as Distributed Intelligence: Dimensions of a Framework for the Design and Evaluation of MOOCs*. Paper presented at the 10th International Conference on Computer Supported Collaborative Learning, Madison, WI.

Kizilcec, R. F., Piech, C., & Schneider, E. (2013, June). *Deconstructing disengagement: analyzing learner subpopulations in massive open online courses*. Paper presented at the Proceedings of the Third International Conference on Learning Analytics and Knowledge, New York, USA

Lee, E. Y. C., Chan, C. K. K., & van Aalst, J. (2006). Students assessing their own collaborative knowledge building. *International Journal of Computer-Supported Collaborative Learning, 1*(1), 57–87. doi:10.1007/s11412-006-6844-4.

Lee, H.-J., & Lim, C. (2012). Peer evaluation in blended team project-based learning: what do students find important. *Educational Technology & Society, 15*(4), 214–224.

Li, L., Liu, X., & Steckelberg, A. L. (2010). Assessor or assessee: How student learning improves by giving and receiving peer feedback. *British Journal of Educational Technology, 41*(3), 525–536. doi:10.1111/j.1467-8535.2009.00968.x.

Li, L., & Steckelberg, A. (2006). Perceptions of web-mediated peer assessment. *Academic Exchange Quarterly, 10*(2), 265–269.

Pope, N. (2001). An examination of the use of peer rating for formative assessment in the context of the theory of consumption values. *Assessment & Evaluation in Higher Education, 26*(3), 235–246.

Venables, A., & Summit, R. (2003a). Enhancing scientific essay writing using peer assessment. *Innovations in Education and Teaching International, 40*(3), 281–290.

Topping, K. J. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research, 68*(3), 249–276.

Trautmann, N. M. (2009). Interactive Learning through Web-Mediated Peer Review of Student Science Reports. *Educational Technology Research and Development, 57*(5), 685–704.

Tsai, C. C., Lin, S. S. J., & Yuan, S. M. (2002). Developing science activities through a networked peer assessment system. *Computers & Education, 38*(1), 241–252.

Tseng, S. C., & Tsai, C. C. (2007). On-line peer assessment and the role of the peer feedback: A study of high school computer course. *Computers & Education, 49*(4), 1161–1174. doi:10.1016/j.compedu.2006.01.007.

Venables, A., & Summit, R. (2003b). Enhancing Scientific Essay Writing Using Peer Assessment. *Innovations in Education and Teaching International, 40*(3), 281–290.

Wikipedia. (2012). Massive open online course. from https://en.wikipedia.org/wiki/Massive_open_online_course

Woo, M. M., Chu, S. K. W., & Li, X. (2013). Peer-feedback and revision process in a wiki mediated collaborative writing. *Educational Technology Research and Development, 61*(2), 279–309. doi:10.1007/s11423-012-9285-y.

Chapter 7
Emerging Technology: Instructional Strategies for Nailing Jell-O to a Tree

J. Ana Donaldson

Abstract Trying to keep current with the ever increasing numbers of emerging technologies has been compared to nailing Jell-O to a tree: frustrating and often unproductive. As students are continually exploring these innovative tools, it is critical that educators adopt instructional strategies that will facilitate learning and take advantage of new possibilities. This paper presents the past 10 years of the *NMC Horizon Report* predictions and compares the predictions to today's reality. It also discusses using Merrill's First Principles of Instruction and Keller's ARCS Model as a framework for instructional approaches that align with an experiential immersion methodology for learning about the new technology.

Keywords First principles of instruction · ARCS model · *NMC horizon report* · Emerging technology · Learning engagement · Instructional strategies

7.1 Aiming at a Moving Target

Instructional Technology innovations have certainly changed how we learn, teach, and interact with the world. One of the real challenges that many of us face as instructors is aiming at a moving target as the technology tools are constantly being introduced, rapidly evolving, or in some cases, even disappearing. In my own journey as a faculty member and instructional designer/developer, I have mourned the loss of Authorware, affordable versions of Hot Dog for easily taught web development, and Director that each came with the promise that it would solve all development challenges. I now observe Google Glass falling by the wayside as the latest and greatest new iPhone Watch has the tech world in a buzz.

The reality of trying to keep current with each new emerging technological tool can be compared to the metaphor of nailing Jell-O to a tree. Not only is it an exercise in frustration but normally requires less time before the next bowl of Jell-O

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needs to be nailed. At today's growing rate of innovation and aggressive marketing, the single nailed tree quickly becomes a forest, and the hammer's ineffectiveness increases one's dwindling motivation and engagement in the task.

One of the real challenges is trying to identifying the emerging technologies that are heading our way. A brief look at the last 10 years of the *Horizon Report* provides some insight in what has been predicted compared to the reality of what has occurred.

7.1.1 Emerging Technologies

One of the recognized leading authorities on emerging technologies has been the New Media Consortium's annual *Horizon Report* (http://www.nmc.org/) for Higher Education. The combined reports for the last 10 years are shown on Table 7.1. The chart provides predictions and adoption trends for three time frames: 1 year or less, 2–3 years, and 4–5 years from the date of publication (Johnson et al. 2009, 2010, 2011, 2012, 2013, 2014, 2015; The Horizon Report—2008 [CSD5320.pdf (application/pdf Object)] 2008; 2007 Horizon Report 2006 by Educause, New_media_consortium, 2007; 2006 Horizon Report [EDUCAUSE] 2006).

For me, the most difficult part of the initial review of the chart is the matter of shifting semantics. Terminology seems to be evolving as the technology and strategies are more widely accepted. *Social computing* (2006) reappears in 2007 as *Social networking*, followed by *Social operating systems* in 2008 with a 4–5 year adoption prediction. I am not sure where Facebook fits into these three choices but think that if you tweak your interpretations of the terms, it probably fits all three. Massively Open Online Courses (MOOCs) did not make the list until 2013. While many consider MOOCs to represent the wide spectrum of socially supported learning (Hollands and Tirthali 2014), here it exists as a later addition. Another example is *Educational gaming* (2006—2–3 years out). The following year it was moved to 4–5 years out with the modifier of *Massive multiplayer educational gaming* and then reappeared in 2011 and 2012 as *Game-based learning* for 2–3 years out. The final related entry on the table is G*ames and gamification* (2013—also 2–3 years out). These are just a few examples of how the perspectives and labels have been constantly shifting.

Viewing the progression of the chart shows a transition, especially in 1 year or less, from technology tools to more instructional strategies or even recommendations. The best example for me is the shift from 2013 to the last 2 years. A focus on MOOCs and Tablet computing for 1 year or less evolved into the much broader observations of the *Growing ubiquity of social networking* and *Integration of online, hybrid and collaborative learning* for 2014 and *Advancing cultures of change and innovation* and *Increasing cross-institution collaboration* for 2015. The terms for very specific items have gone through a process of academic wordsmithing that appears to be more of a plea for what needs to happen than a prediction of what will be present.

Table 7.1 NMC Horizon Reports for Higher Ed—2006–2015

Year	One year or less	Two to three years	Four to five years
2006	Social computing	Phone in their pocket	Augmented reality and enhanced visualization
	Personal broadcasting	Educational gaming	Context-aware environments and devices
2007	User created content	Mobil phones	New scholarship and emerging forms of publishing
	Social networking	Virtual worlds	Massive multiplayer educational gaming
2008	Grassroots video	Mobile broadband	Collective intelligence
	Collaboration webs	Data mashups	Social operating systems
2009	Mobiles	Geo-everything	Semantic-aware applications
	Cloud computing	The personal web	Smart objects
2010	Mobile computing	Electronic books	Gesture-based computing
	Open content	Simple augmented reality	Visual data analysis
2011	Electronic books	Augmented reality	Gesture-based computing
	Mobiles	Game-based learning	Learning analytics
2012	Mobile apps	Game-based learning	Gesture-based computing
	Tablet computing	Learning analytics	Internet of Things
2013	Massively Open Online Courses (MOOCs)	Games and gamification	3D Printing
	Tablet computing	Learning analytics	Wearable technology
2014	Growing ubiquity of social networking	Rise of data-driven learning and assessment	Agile approaches to change
	Integration of online, hybrid and collaborative learning	Shift from students as consumers to students as creators	Evolution of online learning
2015	Advancing cultures of change and innovation	Growing focus on measuring learning	Increasing use of blended learning
	Increasing cross-institution collaboration	Proliferation of open educational resources	Redesigning learning spaces

My final concern is with what I have identified over the years as the emerging technologies that are impacting us today. The two I perceive as having a long-term effect are Open Educational Resources (OERs) and Learning Analytics. On the table, open content is first shown in 2010 but does not appear again until 2015 under the heading of 2–3 years out. Also, learning analytics appears in 2011–2013 and then disappears. I believe that both examples do not represent the reality of the acceptance and implementation of both escalating concepts.

This brief exploration is intended to demonstrate that keeping current with emerging technologies and trends is a challenging exercise. It is interesting to see which predictions on the chart had their moment in the spotlight and then disappeared from the chart. Examples include *Virtual Worlds* (2007), *Geo-everything* (2009), and *Electronic books* (2011). This may be due to being considered already *emerged* or to losing favor with the masses after one entry. If we can agree that identifying and predicting emerging technologies is challenging, then the next step is to explore ways to approach teaching with and about these tools: making the most effective difference in our students' learning.

7.2 Instructional Strategies

The two key components engaging students in learning anything are motivation and instructional planning. Aligning a student's interest with the learning objectives is often where the skill of teaching becomes an art form. My father-in-law, Dr. George Donaldson, always said that he had never taught anyone anything they did not want to learn. Once you have the learner's attention, you can move into the instructional component. This is especially true when dealing with emerging technologies, the bright new shiny objects of our profession.

7.2.1 Motivation

The standard for our field of Instructional Design is Keller's ARCS Model (2010). The four components of the model (Attention, Relevance, Confidence, and Satisfaction) have long been the foundation of developing instruction strategies that engage the learner. A simplified version of this is labeled WIIFM or *What's In It For Me?* This is especially true for today's generation who *want to learn what they want to learn when they want to learn it.*

The first two items of the ARCS model, Attention and Relevancy, set the tone for engaging students in learning about new technologies or strategies. Using YouTube videos, animations, demonstrations, and first-person testimonials are all effective methods for gaining attention. Relevancy can be incorporated into the introduction of the learning objective by having the students discuss how this item could be used to enhance their own learning or lifestyle. Facebook is a good example of what was once an innovative idea that quickly gained adoption as many of us re-contacted with long lost friends and gained new acquaintances.

Confidence when discovering new technologies may be a generational characteristic. Anyone who has spent time watching a 5 year old on a laptop knows the true meaning of engagement and exploration. The digital natives in our classrooms have grown up with computers as a ubiquitous part of their lives. It is us immigrants who usually tend to shy away from grabbing at the newest or shiniest *toy*. It has taken me a few decades to learn from my students that it is acceptable to have them know more than me about the latest and greatest technology. The teacher in the room does not always need to be the one standing in the front.

Satisfaction is the ultimate goal of any formal or informal learning experience. There is a sense of accomplishment when new experiences result in a sense of satisfaction. In a world where instant gratification takes too long, it is important to keep in mind that sometimes delayed satisfaction will be the result. After months of walking into walls in Second Life, I learned to navigate enough not to embarrass myself. My greatest level of satisfaction came when I found my avatar on a horse riding along a beach. This had always been one of my fantasies and even though virtual, it created a feeling of accomplishment and freedom that I had not expected.

When viewing the four ARCS elements, it is interesting to see how they align with Merrill's First Principles of Instruction (2008). This reinforces my own belief that any successful learning experience begins with an engaged student and engaged teacher (Conrad and Donaldson 2012).

7.2.2 Merrill's First Principle of Instruction

Merrill's First Principles of Instruction was his response to the existing multitude of instructional theories. His observation was that the "underlying principles for all of those theories are fundamentally the same" (Merrill 2008, p. 55). He further clarified that the principles are not so much a model but rather the relationship between the components.

After Merrill reviewed a variety of instructional design models, the following basic five principles were identified:

- The *demonstration* principle: Learning is promoted when learners observe a demonstration.
- The *application* principle: Learning is promoted when learners apply the new knowledge.
- The *task-centered* principle: Learning is promoted when learners engage in a task-centered instructional strategy.
- The *activation* principle: Learning is promoted when learners activate relevant prior knowledge or experience.
- The *integration* principle: Learning is promoted when learners integrate their new knowledge into their everyday world. (Merrill 2008, pp. 43–44).

The five elements can even be simplified down to an instructional cycle. The problem to be solved or Task is the focal point, followed by the introductory step of Activation, then progressing to Demonstration, followed by Application, and finally Integration (refer to Fig. 7.1).

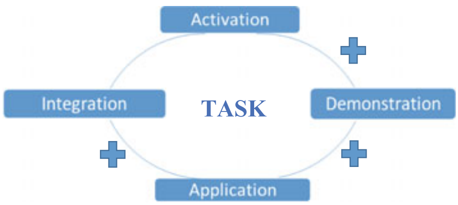


Fig. 7.1 The four-phase cycle of instruction (Merrill 2008)

7.3 Task-Centered Principle

The core of this model is an instructional strategy that is focused on the task to be learned. In our example, this is learning about a specific emerging technology or strategy. The process builds upon the idea of hierarchical component skill teaching efforts that moves forward from a "simple—to—complex progression of whole tasks" (p. 49). As the complexity of the task increases, the learning guidance should decrease. Mastery of individual skills increases until the most complex of the learning objectives are met. This is often when we as instructors must reassure students that they need to have all the individual puzzle pieces in place before the full picture can be viewed. It is critical that the learning task is authentic and shown to be relevant to the student as identified by the ARCS model. Plus the learning experience needs to be something the student is interested in learning, allows for hands-on experiences to build levels of satisfaction, and provides a positive outcome to reinforce confidence.

7.4 Activation Principle

The initial step of the process is for learners to share prior knowledge or experiences (Merrill 2008). Instructors can assist students in identifying effective frameworks for how they have organized new knowledge in the past. This framework should be based on prior student knowledge and then used as the foundation for the remaining phases. During the subsequent Demonstration Cycle, the framework helps relate prior general knowledge to specifics and new learning. In the Application phase, "coaching should help students use this structure to facilitate their use of the newly acquired skill to complete new tasks" (p. 53). The final Integration phase includes a reflection component for students to review how they acquired new knowledge within the structure of the framework (Merrill 2008). Several of the ARCS elements can be identified in this principle. Recalling prior experiences helps with directing a learner's attention (ARCS). Finding familiarity in a new learning task with past successes aids in encouraging the learner to explore areas that are a step beyond past experiences. If a student has created a text-based 3D image, then the idea of learning about a 3D printer might not be that daunting.

7.5 Demonstration Principle

For my own learning style, *show me don't tell me* works best. Merrill (2008) discusses the diversity of the component skills that are demonstrated in this step: "Show several specific examples [kinds of], Show the procedure in several different situations [how to]. Show the process in several different situations [what happens]" (p. 45). Collaborative peer interaction and student demonstrations are also suggested for the most effective teaching strategy. The demonstration begins with the simplest of steps and progresses to the most complex total process. Supportive media is important when the purpose is instructional and not just decorative. Mayer (2001), Clark and Mayer (2003) suggest that audio narration is much more effective than words shown in text format on a screen for demonstrations. Begin with a demonstration and discussion of the types of emergent technology examples that are available. Present the tools from the simplest examples to the most complex. YouTube videos are often a good resource for demonstrating a variety of emerging technology tools from different perspectives and applications. This process is also another way to reinforce the relevance (ARCS) to a student's life outside of the formal learning setting.

7.6 Application Principle

This is the step where talk turns into action. Learning is the intended outcome when students have the opportunity to apply the new knowledge through the application process. Merrill (2008) discusses the application principle as appropriate for general knowledge and skills: "Generalizable knowledge and skills are applied when learners use them to solve a new problem or complete a different task from the one that was used to demonstrate" (p. 48). The key instructional strategies that are needed include feedback, coaching, and peer collaboration.

Feedback is critical during the application process. Students need to recall and apply what they learned and discussed in the two previous steps. Understanding the consequences of incorrect choices assists the learner in improving the quality of her or his actions. Feedback also allows discussions to determine if the learners' predictions of the outcomes were accurate. The term *guide on the side* is activated through the instructor's role as a coach. The goal is for the instructor to provide substantial assistance during the beginning, simpler steps. As the steps become more complex, the instructor's involvement lessens. The final emphasis is on peer-collaboration: "…learners must first come to some solutions on their own and then interact with fellow learners to describe, discuss, and defend their solution in an attempt to come to some agreed solution" (Merrill 2008, p. 49). This application focus can be condensed to: student with task (with feedback), student with instructor (phasing back as complexity increases), and then student with peers. This phase is where a student's confidence (ARCS) is reinforced by being able to demonstrate her or his capability in completing and defending the learning task.

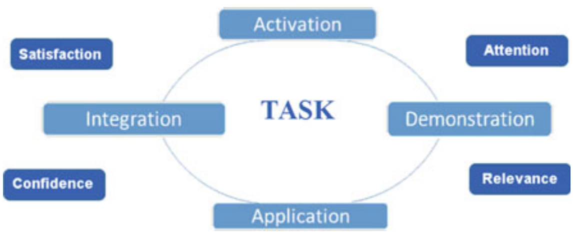
7.7 Integration Principle

The final phase comes down to *so what?* "Learning is promoted when learners integrate their new knowledge into their everyday world" (Merrill 2008, p. 44). This process requires an element of transformative reflection. This involves determining how this new skill or knowledge fits as a puzzle piece into the larger picture of an individual's emergent tools that have been determined to be personally beneficial. If the element of satisfaction (ARCS) is missing from the learning, then the new skill will quickly be forgotten. Being able to defend and describe the positive elements within a peer critique setting also reinforces the integration process. As might be deducted by the label, the integration of the new skill into personal use and then the public sharing of this skill is important. "When learners know that they will have an opportunity to demonstrate their newly acquired skill to significant others in their world, then their motivation to perform in an effective way is significantly increased" (Merrill 2008, p. 54). This is the reason that I urge instructors to include a final celebration at the end of each class in order for students to share their productions and reflect upon the learning experience. My favorite final reflective question: *What is the difference in what you know today from the first day of our course?*

7.8 Conclusions

So, now I can share the trick to nailing Jell-O to a tree. My suggestion is to look at this problem-centered task from a new perspective. By literally thinking outside of the box, anyone can nail a *box* of Jell-O to a tree. In our rush to get to the final outcome, students tend to start solving problems without have a plan in place. By following Merrill's First Principle of Instruction (2008) and emphasizing the ARCS Model (Keller 2010) during each step of the way, an effective instructional plan can be implemented. Figure 7.2 illustrates the integration of both models into an instructional strategy.

Fig. 7.2 Combined first principles and ARCS model



As students are continually exploring with emerging innovative tools, it is critical that educators adopt instructional strategies that will enhance skill and knowledge instruction and take advantage of the possibilities. Using Merrill's First Principles of Instruction and Keller's ARCS Model as a framework for instructional approaches that align with an experiential immersion methodology for the integration of new technology, the learning experience is enhanced.

There are three certainties in our modern life: death, taxes, and emergent technologies. If you sometimes find yourself standing on the edge of an instructional cliff, consider this recommended instructional approach as providing the wings to help you and your students to soar. Embrace the possibilities and encourage the discoveries to be found.

References

Clark, R. C., & Mayer, R. E. (2003). *e-Learning and the science of instruction*. San Francisco, CA: Jossey-Bass Pfeiffer.

Conrad, R., & Donaldson, J. A. (2012). *Continuing to engage the online learner: Activities and resources for creative instruction*. San Francisco, CA: Jossey-Bass.

Hollands, F. M., & Tirthali, D. (2014). MOOCs: Expectations and reality. Full report. Center for Benefit—Cost Studies of Education, Teachers College, Columbia University, NY. Retrieved from http://cbcse.org/wordpress/wp-content/uploads/2014/05/MOOCs_Expectations_and_Reality.pdf.

Horizon Report [EDUCAUSE] (2006) http://nmc.org/pdf/2006_Horizon_Report.pdf.

Horizon Report (2006) by Educause, New_media_consortium. http://nmc.org/pdf/2006_Horizon_Report.pdf.

Johnson, L., Levine, A., & Smith, R. (2009). *The 2009 Horizon Report*. Austin, Texas: The New Media Consortium.

Johnson, L., Levine, A., Smith, R., & Stone, S. (2010). *The 2010 Horizon Report*. Austin, Texas: The New Media Consortium.

Johnson, L., Smith, R., Willis, H., Levine, A., & Haywood, K. (2011). *The 2011 Horizon Report*. Austin, Texas: The New Media Consortium.

Johnson, L., Adams, S., & Cummins, M. (2012). *The NMC Horizon Report: 2012 higher* (Education ed.). Austin, Texas: The New Media Consortium.

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., & Ludgate, H. (2013). *NMC Horizon Report: 2013 higher* (Education ed.). Austin, Texas: The New Media Consortium.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). *NMC Horizon Report: 2014 higher* (Education ed.). Austin, Texas: The New Media Consortium.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). *NMC Horizon Report: 2015 higher* (Education ed.). Austin, Texas: The New Media Consortium.

Keller, J. M. (2010). *Motivational design for learning and performance: The ARCS model approach*. New York: Springer.

Mayer, R. E. (2001). *Multimedia learning*. Cambridge, UK: Cambridge University Press.

Merrill, D. M. (2008). First Principles of Instruction. In C. M. Reigeluth & A. A. Carr-Chellum (Eds.), *Instructional-design theories and models: Building a common knowledge base (Volume III)* (pp. 41–56). New York, NY: Routledge.

The Horizon Report—2008 [CSD5320.pdf (application/pdf Object)] (2008) by New M. Consortium, Educause L. Initiative. https://net.educause.edu/ir/library/pdf/CSD5320.pdf.

Chapter 8
Utopian and Dystopian Futures for Learning Technologies

Marcus D. Childress

Abstract This paper details how learning technologies and media continue to change and augment the way we learn. The paper begins with accepted definitions and a brief history of technological utopianism, ultimately leading to learning technologies and utopian and dystopian views for the future.

Keywords Dystopian · Future · Learning · Technology · Utopian

8.1 Introduction

For many years, scholars have documented the benefits and perils of technology and its impact on our society. Some writers take a dystopian view of technology, some take a utopian view, while others have a view that falls somewhere in-between. In this paper, I will extensively address a utopian viewpoint of learning technologies, briefly address concerns made by the dystopian camp, and ultimately (I hope) make a case for some middle ground that we can used to make informed decisions on the use of learning technologies.

8.2 Utopia and Dystopia Defined

According to the Merriam-Webster Dictionary, Utopia is "an imaginary place in which the government, laws, and social conditions are perfect." Conversely, a dystopia is "an imaginary place or state in which everything is unpleasant or bad, typically a totalitarian or environmentally degraded one" (Merriam-Webster 2014). Originally addressed in 1516 in his book, Utopia, Sir Thomas More described his fictional island society Utopia (Sullivan 1983). The utopian idea began long before

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More, however. Plato presented the first recorded utopian plan in his Republic (Reeve 1988). Citizens were categorized into “golden,” “silver,” “bronze,” and “iron” socioeconomic classes and were ultimately trained to become “philosopher-kings.” The Islamic and Judeo-Christian notions of heaven may be described as utopias. These heavens provide a state of bliss and enlightenment. Similarly, many consider the Hindu concept of Moksha (Rao 2014) and the Buddhist concept of Nirvana (Fowler 2012) as forms of utopia, not as a physical place but as a state of mind.

Utopian literature in China. Because this conference is hosted in China, I searched for examples of utopian literature in China. Perhaps the best example of Chinese utopian literature can be found in “Peach Blossom Spring” (桃花源记—Táohuā Yuán). In this fable by Tao Yuanming, written in the year 421, the author describes a fisherman’s encounter with a forest consisting of blossoming peach trees. After squeezing through a passage, he discovers an isolated and ethereal utopia (Columbia University, n.d.).

Science and technology utopias. Science and technology utopias have been documented in science fiction titles, such as *Star Wars* (Lucas 2004), *Star Trek* (Alexander 1994), and *Lost in Space* (Allen 1965), where science and technology are used to enhance living conditions. There are also examples of science and technology dystopias portrayed in literature, such as *Brave New World* (Huxley 1969), *1984* (Orwell 1949), *Fahrenheit 451* (Bradbury 1953), *Neuromancer* (Gibson 1995), and most recently *The Hunger Games* (Collins 2008).

Today’s technology utopian thought took root in the “dot-com” culture of the 1990s, more specifically in the Silicon Valley area of California. This most recent form of technology utopianism reflects a belief that technological change revolutionizes human affairs and that the Internet and digital technology will increase personal freedom by liberating the individual from the rigid embrace of bureaucratic big government. “Self-empowered knowledge workers” would render traditional hierarchies redundant; digital communications would allow them to escape the modern city, an “obsolete remnant of the industrial age” (Borsook 2001).

8.3 The Future of Learning Technologies: A Utopian Model

Accurately predicting the future path of education and learning technologies is a difficult task. Fortunately, several substantial reports make an attempt to plot a positive, if not utopian, course for learning technologies. A framework or model for learning technologies can be built from these reports.

When attempting to construct a model of a utopian future for learning technologies, one might first identify the major factors of change and a vision for the future of learning. After major factors are identified, the forces and influences likely to affect education in the future may be recognized. Once those forces are known, the next step is to distinguish the key shifts and changes that will likely come from those forces. Once those shifts are identified, they must then be addressed by the supporting learning technologies and the organizations that will ultimately adopt the learning technologies. The result will be the application and use of those learning technologies by the learners, either individually or through their organizations (institutions).

Key factors for change. As part of the European Commission's Joint Research Centre (JRC), the Institute for Prospective Technological Studies, commissioned a report on *The Future of Learning: Preparing for Change* (Redecker et al. 2011). The report identifies key factors for change and creates a vision of the future of learning, including solutions to challenges and strategies to support the vision. The core elements of their vision of the future of learning are:

- Personalisation
- Collaboration
- Informalisation

Personalisation addresses ways of learning that are learner-centered: tailor-made and targeted; active and constructive; motivating and engaging. *Collaboration* involves ways of learning that are social: peer-learning; sharing and collaborating in communities. *Informalisation* (informal learning) involves ways of learning that are life-wide: anywhere, anytime; blending virtual and real; combining sources/providers. These three core elements may well form the basis for a learning technologies utopia.

Forces. The Forces section of our model of a utopian future for learning technologies (see Fig. 8.1) addresses the forces and influences that are likely to create a need for change. In their latest futures forecast KnowledgeWorks Foundation and the Institute for the Future extended their *2006–2016 Map of Future Forces Affecting Education* report with their *2020 Forecast: Creating the Future of Learning*. The report identifies forces that will affect the future of learning: Pattern Recognition, The Maker Economy, A New Civic Discourse, Platforms for Resilience, Amplified Organization, and Altered Bodies (KnowledgeWorks Foundation 2009).

Pattern Recognition addresses the ever-increasing proliferation of information in society. New tools for visualizing data will require new skills for identifying patterns of data. The Maker Economy describes personal fabrication technologies and open-source principles that will democratize production and design. A New Civic

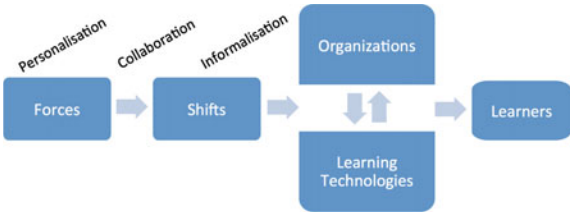

Fig. 8.1 Utopian future for learning technologies model

Discourse describes a future that is redefined by participatory media, dispersed populations that share common roots and identities, and grassroots sharing of resources, all in a global society. Platforms for Resilience will enable organizations and institutions to change their focus from resisting change, disruption, and the status quo to embracing responsive flexibility, distributed collaboration, and transparency through innovation, adaptation, and openness. Amplified Organization describes the remaking of organizations by amplified individuals. Using their highly social, collective, and improvisational abilities, these organizational "superheroes" will remake organizational models. Altered Bodies describes the intersection of environment and performance.

Shifts. The Shifts section of the model addresses the key shifts that will be driven by the major forces. As part of a focus on practical applications of technology to large problems, the annual Symposium on the Future was launched in 2009 to explore how emerging technologies might be impact a wide range of issues of global importance. One of the most promising roadmaps to the future of learning technologies can be found in the Institute for the Future's (IFTF) report, *From Educational Institutions to Learning Flows* (2013). Using what it describes as "forecasting methodologies," including workshops, interviews, data, and signals analysis, IFTF created a map to emphasize emerging learning technologies that will likely influence learning in the next 10 years. IFTF supports the notion that as network and mobile technologies spread, content proliferates and becomes increasingly available through open sources. We are moving away from organized and stable learning (schools, colleges, universities) to "a new environment in which learning is best conceived of as a flow, where learning resources are not scarce but widely available, opportunities for learning are abundant, and learners increasingly have the ability to autonomously dip into and out of continuous learning flows" (p. 1). This transformation from educational institutions to learning flows can be described as disruptive, thus creating shifts in learning environments.

Shifts in learning environments. Seven key shifts in learning environments form the foundation for the map. (1) From episodic to continuous learning: Learning opportunities are embedded in everyday life, both in the classroom and outside the classroom. (2) From assigning to enticing with content: Ubiquitous information and knowledge resources challenge educators to shift from conveying resources to attracting learners to participate and share in the resources at their disposal. (3) From content conveyors to content curators: In an environment where the amount of information continues to increase at an alarming rate, curation is the ability to find, consolidate, and deliver needed information and learning resources at the right time and in the right context. (4) From working at one scale to working up and down the scale: Connective technologies provide opportunities for organizations to reconsider scale. (5) From degrees to reputation metrics: Platforms for individuals to share opinions and reviews are rapidly growing. (6) From grades to continuous feedback mechanisms: Big data and advanced analytics will provide opportunities for mastery and continuous improvement, instead of grades. (7) From lecture halls to collaborative spaces: Collaborative spaces, such as learning spaces, will promote project-based learning, collaboration, mentoring, and coaching.

Organizations. Once Forces and Shifts have been identified, we now explore their effect on learning Organizations and institutions. In addition, we must consider the interplay between organizations and learning technologies. In the John D. and Catherine T. MacArthur Foundation report on *The Future of Learning Institutions in a Digital Age*, Davidson et al. (2009) present their future of learning. The report lists Ten Principles for the Future of Learning that could serve as the foundation for applying emerging learning technologies into organizations.

(1) Self-Learning: The online self-learner interacts with the information itself, forming relations and exploring new pathways and threads of information. (2) Horizontal Structures: Learning strategies shift from information-seeking (learning what) to finding reliable sources (learning how). (3) From Presumed Authority to Collective Credibility: Making wise choices based upon the information at hand. These choices are based upon complex and collaborative learning environments and interactions with others. (4) A De-Centered Pedagogy: The use of collective and collaborative sources of knowledge. (5) Networked Learning: Socially networked collaborative learning that goes beyond individual learning by providing learners the opportunity to solve problems through cooperation, partnering, and mediation. (6) Open Source Education: The sharing of processes, products, and content. (7) Learning as Connectivity and Interactivity: The connectivity and interactivity afforded by digitally connected devices and applications. (8) Lifelong Learning: The need to continually acquire new knowledge and skills through all stages of life in order to address a rapidly changing world. (9) Learning Institutions as Mobilizing Networks: The need for learning institutions to move from weighty and assertive organizations to light and enabling (nimble) bodies. (10) Flexible Scalability and Simulation: The ability of digital technologies to bring learners together to work collaboratively, not only as small groups but also as large anonymous groups of collaborators. Organizations and institutions must adapt to and encourage the use of these technologies and at the same time influence the continued development of those learning technologies.

Learning technologies. Two influential reports help shape the landscape of future learning technologies. The Institute for the Future's (IFTF) report *From Educational Institutions to Learning Flows: Mapping the Future of Learning* (2013) describes six emerging themes, providing specific examples of resources and tools supporting each of the themes. In addition, the New Media Consortium's (NMC) series of annual Horizon Reports attempts to identify emerging technologies likely to influence learning, teaching, and creative inquiry (New Media Consortium 2014a). The NMC reports typically identify six key trends, six significant challenges, and six emerging technologies that are likely to affect teaching and learning.

With shifts in learning environments come new and emerging themes. The IFTF report calls these themes "future stories." These emerging themes or stories may shape the landscape of learning in the future. The emerging IFTF themes include: (1) Content Commons: The Internet provides a wealth of open digital resources including text, simulations, audio, video, images, maps, and other learning resources. These tools permit users to create and share media-rich products. (2) Embedded and Embodied Learning: Information is removed from the classroom and embedded into real-world, everyday experiences. (3) Human-Software Symbiosis: Smart machines and software are used to extend human capabilities, enabling individuals to accomplish tasks that were previously inconceivable. (4) Socialstructed Work: Social work flows such as (a) microcontributions, small contributions by hundreds and thousands to create a greater whole, (b) hive mind, crowd-sourced expertise, and (c) task routing, in which tasks are routed to individuals based on skills, feedback, and performance. (5) Global Learning Arbitrage: Learning providers including global tutors and mentors and organizations that create new pathways for obtaining a college degree (or its equivalent), certification, and accreditation.

The New Media Consortium's *Emerging Technology Initiative* focuses on recognizing emerging technologies that will likely affect creative inquiry and learning (New Media Consortium 2014b). Like its overarching initiative, the Horizon Report attempts to identify emerging technologies likely to affect learning, teaching, and creative inquiry (New Media Consortium 2014a). The reports seek to identify six key trends, six significant challenges, and six emerging technologies that are likely to affect teaching and learning. These trends, challenges, and technologies are spread across three "adoption horizons" ranging from 1 to 5 years. Members of the Horizon Report expert panel participate in a Delphi-based selection process to identify trends and technologies. The process also includes tracking technologies in seven categories (or lenses): (1) Consumer Technologies: Solutions not initially designed for educational purposes. (2) Digital Strategies: Innovative ways of using applications and devices to support teaching and learning, both formally and informally. (3) Internet Technologies: Digital tools and applications that allow learners to seamlessly interact with networks. (4) Learning Technologies: Resources and tools developed exclusively for the education sector. (5) Social Media Technologies: Tools developed primarily for consumer social purposes. (6) Visualization Technologies: Tools developed for infographics and sophisticated visual data analysis. (7) Enabling Technologies: Innovative technologies that have the potential to transform our everyday lives and eventually the way we teach and learn.

Learners and the future. The many technologies and tools described above must be honed and further developed, keeping in mind the most important piece of our utopian future for learning technologies model: the Learners. How will learning technologies support these core elements and future learning strategies, keeping the learners in mind? The numerous reports and forecasts presented in this chapter illustrate rather diverse visions of the future of education and learning technologies. Even with these varied visions, several common themes emerge. The European Commission's JRC report ties the themes together with its core elements of personalisation, collaboration, and informalisation to provide a solid future vision of learning technologies (Redecker et al. 2011).

Considering those core elements, in the utopian future of learning technologies: Everyday life will be integrated with ubiquitous, mobile, high-quality, accessible, adaptable, and user-friendly applications and services. Because of changes in interaction and communication patterns and skills, communication, collaboration, negotiation, and networking skills will become critical for all learners (and educators). Personalized lifelong learning opportunities will become commonplace because of learning technologies' ability to provide engaging, dynamic, and adaptable learning environments. Personalized (smart) learning environments will deliver an array of learning opportunities.

In the utopian future learning technologies will facilitate and support the above major themes in a learner's world, a world that is personalized, agile, mobile, globally interconnected, environmentally conscious, information-rich, open, social, and collaborative. As learning technologies are developed, they will undoubtedly affect the above themes, just as those themes and visions drive the development of learning technologies and their integration into learning organizations and institutions. Technologies will continue to act as disruptors, while the learning system or organization will be the disruptees (Christensen 1997). Successful (or unsuccessful) adoption and implementation of these learning technologies will likely determine the success (or failure) of the learning systems and organizations of the future.

8.4 The Future of Learning Technologies: A Brief Dystopian View

In his chapter for the *Wiley Handbook of Learning Technology*, Selwyn argues for a more dystopian view or a refocusing view of learning technology as an always positive and disruptive project to more realistic expectations (Selwyn 2016). In this chapter, Selwyn identifies six recurring dystopian themes about learning technologies:

1. The displacement of the teacher
2. The deprofessionalism of the teacher
3. The disengagement of the learner
4. The dumbing-down of younger generations
5. The devaluation of knowledge
6. Increased surveillance and accountability.

Selwyn claims that we should "make good use" of dystopian visions of learning technologies and that they should be used in the continued development of learning technologies. Selwyn provides us with a fitting quote from Dienstag (2006) that I believe should help guide scholars and educators in the research and development of new learning technologies:

> In the right hands, pessimism can be—and has been—an energizing and even liberating philosophy. While it does indeed ask us to limit and eliminate some of our hopes and expectations, it can also provide us with the means to better navigate the bounded universe it describes. (p. ix)

For a further expansion of the themes in this chapter, please see my contribution to the *Wiley Handbook of Learning Technology,* titled "Utopian Futures for Learning Technologies" (Childress 2016).

References

Alexander, D. (1994). *Star Trek creator: The authorized biography of Gene Roddenberry*. New York: Roc.

Allen, I. (1965). *Lost in space.* Los Angeles: 20th Century Fox Home Entertainment.

Borsook, P. (2001). *Cyberselfish: A critical romp through the terribly libertarian culture of high-tech*. New York: Public Affairs.

Bradbury, R. (1953). *Fahrenheit 451*. New York: Simon & Schuster.

Childress, M.D. (2016). Utopian futures for learning technologies. In N. Rushby & D. Surry (Eds.), *Wiley handbook of learning technology.* New York: Wiley.

Christensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Watertown, MA: Harvard Business School Press.

Collins, S. (2008). *The hunger games*. New York: Scholastic.

Columbia University (n.d.). *Peach blossom spring.* Retrieved from http://afe.easia.columbia.edu/ps/china/taoqian_peachblossom.pdf.

Davidson, C. N., Goldberg, D. T., & Jones, Z. M. (2009). *The Future of learning institutions in a digital age*. Cambridge, MA: MIT Press.

Dienstag, J. F. (2006). *Pessimism: Philosophy, ethic, spirit*. Princeton NJ: Princeton University Press.

Fowler, J. D. (2012). *The Bhagavad Gita: A text and commentary for students*. Eastbourne, UK: Sussex Academic Press.

Gibson, W. (1995). *Neuromancer*. New York: Ace.

Huxley, A. (1969). *Brave new world*. New York: Harper & Row.

Institute for the Future. (2013). *From educational institutions to learning flows.* Retrieved from http://www.iftf.org/uploads/media/SR-1580-IFTF_Future_of_Learning_01.pdf.

KnowledgeWorks Foundation. (2009). *2020 forecast: Creating the future of learning.* Retrieved from http://www.futureofed.org/forecast/.

Lucas, G. (2004). *DVD commentary for Star Wars episode IV: A new hope.* Los Angeles: 20th Century Fox Home Entertainment.

Merriam Webster. (2014). *Dictionary and thesaurus.* Retrieved from http://www.merriam-webster.com/dictionary/utopia.

New Media Consortium. (2014a). *The NMC horizon report: 2014 higher education edition.* Austin TX: New Media Consortium. Retrieved from http://www.nmc.org/publications/2014-horizon-report-higher-ed.

New Media Consortium. (2014b). *Emerging technologies initiative.* Austin TX: New Media Consortium. Retrieved from http://www.nmc.org/about/initiatives/emerging-technology-initiative.

Orwell, G. (1949). *1984*. London: Penguin Classics.

Rao, C. (2014). *Dharma and Dhamma: An overview of Dharma and Dhamma, and how to apply them in daily life.* [Amazon digital version]. Retrieved from Amazon.com.

Redecker, C., Leis, M., Leendertse, M., Punie, Y., Gisbers, G., Kirschner, P., Stoyanov, S., & Hoogveld, B. (2011). *The Future of learning: Preparing for change.* Seville: JRC Scientific and Technical Reports. Retrieved from ftp.jrc.es/EURdoc/JRC66836.pdf.

Reeve, C. D. C. (1988). *Philosopher-kings: The argument of Plato's Republic*. Princeton, NJ: Princeton University Press.

Selwyn, N. (2016). The dystopian futures. In N. Rushby & D. Surry (Eds.), *Wiley Handbook of Learning Technology.* New York: Wiley.

Sullivan, E. D. (Ed.). (1983). *The utopian vision: Seven essays on the quincentennial of Sir Thomas More*. San Diego, CA: San Diego State University Press.

Chapter 9
Open Educational Resources (OER)-Based Flipped Classroom Practice in an Undergraduate Course

Yan Li, Muhua Zhang, Curtis J. Bonk, Wenjun Zhang and Yuqing Guo

Abstract The purpose of this study was to explore the process and effectiveness of Open Educational Resources (OER)-based flipped classroom practice in an undergraduate course named "Internet and Distance Education." The course was taught in Winter Semester, 2013 at the Zhejiang University, China to 15 undergraduate students majoring in education. The course was designed as a Web-based and blended course, which mainly included two parts. In the first 5 weeks of the course, students were invited to take a Coursera course named "Emerging Trends & Technologies in the Virtual K-12 Classroom." In the last 6 weeks of the course, students were invited to learn Sakai-based course chapter contents and complete an OER-related assignment. Flipped classroom practices were utilized during the whole course. Data analysis found that participating students generally progressed through four stages in the OER-based flipped classroom: (1) being unfamiliar, (2) understanding, (3) adapting, and (4) becoming skilled. At the same time, students emotionally shifted from excitement and nervousness to relaxation, happiness, and confidence. Diary analysis and a general e-learner satisfaction survey found that students were generally satisfied with the OER-based flipped classroom practice. In their diaries, some students also put forward several suggestions for this form of instruction. Based on the findings, several suggestions to improve OER-based flipped classroom practices are offered.

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Keywords Open educational resources (OER) · Flipped classroom · Massive open online courses (MOOCs) · Higher education · e-learning satisfaction

9.1 Introduction

Open Educational Resources (OER) is one of the most excited and promising educational innovations emerging in the higher education arena in the twenty-first century. According to a popular definition put forward by Organization for Economic Cooperation and Development (OECD), OER are "digitized materials offered freely and openly for educators, students, and self-learners to use and reuse for teaching, learning, and research" (OECD 2007, p. 10). The worldwide OER movement started when MIT launched its Open Courseware (OCW) project in 2001. This movement toward placing course contents freely on the Web became more influential after the introduction of massive open online courses (MOOCs) and the later offering of online programs based on MOOCs by several world first-class universities in 2011 and 2012 such as Stanford, MIT, and the University of Michigan.

MOOCs are online courses aimed at unlimited participation and open access via the Web (Wikipedia 2014). Different from OCW that is characterized by free online course syllabus, reading materials, and lecture videos, MOOCs provide interactive user forums that help build a community for students, instructors, and teaching assistants. Since 2011 MOOC projects and platforms have increasingly been put forward, and Coursera, edX, and Udacity are three pioneers. Among them, Coursera is currently the most well-known with 116 higher education institutions (HEIs) as partners, offering more than 975 courses to over 11,780,000 registered users (as of March, 4, 2015).

OER and MOOCs are expected to transform ways and patterns of knowledge production and consumption not only in traditional school systems but also in continuing education settings. In effect, OER and MOOCs could possibly challenge the higher education knowledge transmission model by offering cheaper and better-qualified solutions for learners with Internet access around the world (Dillahunt et al. 2014). The boundaries of the higher education market are now rapidly expanding. As this occurs, for-profit companies and alternative educational ventures are attempting to grab market share from what used to be a closed market but with a goal of excessive profits.

China's higher education institutions (HEIs) are also inevitably affected by this emerging trend. Since 2001, the Chinese government has put forward three nationally sponsored OER projects: (1) the Chinese Quality Course (CQC) Project led by Chinese Ministry of Education; (2) National Cultural Information Resources Sharing Project led by Chinese Ministry of Culture; and (3) the Science Data Sharing Project led by Chinese Ministry of Science and Technology. Among these three projects, the CQC Project is the most influential, and it has significantly impacted higher education reform and development in China.

Since MOOCs emerged, China's top HEIs have experienced an urgent need to build capacity to construct, administer, and publicize MOOCs with unique Chinese features and potentially massive reach. Under the technical and financial supports from the Ministry of Education (MOE), Chinese universities have started to set up experimental MOOCs to join the world trend. As one of the leading universities in China, since October 2013, Tsinghua University has launched courses on edX and its own MOOCs platform (www.xuetangx.com), using edX's open-source code. At the same time, another prominent university in China, Peking University, is actively launching new MOOCs on its platform (mooc.pku.edu.cn).

Although competition between traditional higher education service providers and MOOCs enterprises seem harsh, a paradigm or vision for both sides to cooperate has begun to emerge. According to American Council on Education's (ACE) 2013 report, integrating MOOCs into higher education may open the MOOC 3.0 era. Martin (2012) advocated using flipped classrooms as a strategy for hybrid learning concerning MOOCs. Flipped classroom is a pedagogical approach characterized by allowing students to watch online video lectures before class and to participate in interactive activities such as problem solving, discussions, and debates during the in-class sessions (Davies et al. 2013). Researchers found that, compared with traditional lecture-dominated classrooms, the flipped classroom approach provides better opportunities for instructors to create student-centered learning environments (Kong 2014).

As growing numbers of colleges and universities have experimented with MOOC integration, they have come up with diverse approaches regarding MOOC adjustment, integration, and research (Sandeen 2013). Researchers and teachers have attempted to investigate MOOC users' behaviors and satisfaction in multiple ways (Bonk and Khoo 2014; DeBoer et al. 2014; Rizzardini et al. 2014). Some studies have applied quantitative methods with big data that learners left behind as digital traces (e.g., Breslow et al. 2013). Although meaningful and significant insights were obtained on users' online learning behaviors, this set of analytic methodologies focuses basically on the macro level of the entire learning community of a course, which is less suitable for understanding smaller clusters of users. In addition, Rizzardini et al. (2014) and other researchers borrowed various scales and assessment schemes to better understand the impact and outcomes of MOOCs. These measures included the Computer Emotion Scale (CES) (Kay and Loverrock 2008), Intrinsic Motivations Measure (IMM) (Tseng and Tsai 2010), and system usability scale (SUS) (Brooke 1996; Bangor et al. 2008).

Such measures provide a paradigm for looking into participation in MOOCs as part of a community at the institutional level. Nevertheless, research using more open-ended measures was noticeably lacking. As a result, the authors failed to provide a panoramic view of how all MOOC users responded when it came to their learner satisfaction, motivation, and so on. Zutshi, O'Hare, and Rodafinos' (2013) study on a MOOC in Latin America searched learners' blogs for content analysis to identify feelings that they expressed after participating in a course on a MOOC platform. However, in their study, the blog posts were collected from random MOOC users, instead of a learning community with a clear boundary.

There have been some studies in western countries that focused on the integration of MOOCs and other OER resources in higher education. In comparison, limited research has been done in China. This study aimed to do an experimental instructional activity on OER-based flipped classroom practice in a Chinese undergraduate course. Quantitative and qualitative methodologies mentioned above were used in the study.

9.2 Purpose and Objectives of the Study

The purpose of this study was to explore the process and effectiveness of OER-based flipped classroom practice in an undergraduate course named "Internet and Distance Education." Specifically, the study had three primary objectives:

(1) Describe participating students' perceptions about OER and MOOCs before the course;
(2) Describe participating students' learning processes in an OER-based flipped course through three aspects: self-reported degree of familiarity over weeks, self-reported changes in general feelings over weeks, and students' online diaries; and
(3) Examine students' general e-learning satisfaction after the course.

9.3 Description of Instructional Approaches

The course "Internet and Distance Education" was a 2-credit course taught in Winter Semester, 2013, at the Zhejiang University (ZJU) in Hangzhou, China. It was taught twice per week with three lessons each time. The course aimed to introduce distance education theory and practice under an international perspective. Since OER is an important trend in the distance education arena, the course instructor spent significant time introducing OER-related contents.

9.3.1 Course Format and Organization

In previous semesters, the course was taught chapter by the instructor in a traditional classroom with set time. In the OER-based flipped classroom practice, the course was designed as a Web-based and blended course, which mainly included two parts. In the first 5 weeks of the course, students were invited to take a MOOC. Considering content relevance, time arrangement, and students' language proficiency, a Coursera course named *Emerging Trends and Technologies in the Virtual K-12 Classroom* (http://www.coursera.org/course/k12virtualtrends) was selected by the instructor for students to go through. The MOOC was carried out from November 11 to December 13, 2013 and was taught by Melissa Joell Loble from the University of California, Irvine. For the latter part of the course, the instructor set up a Sakai-based online learning platform (http://ocw.zju.edu.cn/portal). Each chapter's content was videotaped in advance and put on the platform. Students were invited to learn chapter contents through a Sakai learning platform and to complete an OER-related assignment through group activities. Another key step involved the collection of OER-related resources and academic publications in the learning platform.

During the course, flipped classroom practices were utilized. In the first lesson of each class, the students carried out Web-based self-study (WBSS), and the instructor organized discussion and guided students' assignment accomplishment during the second and third lessons in each class. For some weeks, the discussion was topic-specific, such as "sharing and discussing MOOC's peer assessment assignment." For a few other weeks, the instructor and two teaching assistants simply answered every student's specific questions. Figure 9.1 recaps the course timeline and major activities.

9.3.2 *Course Evaluation Design*

The instructor employed a continuous evaluation method to assess students' overall performance in the course. As displayed in Fig. 9.2, to successfully complete the course, the students needed to complete the following assignments: (1) finish one Coursera course and obtain a course certificate of completion; (2) draft a proposal based on a comparison study and then make a presentation in the class; (3) finish the assigned course quizzes; and (4) actively participate in course discussions, group activities, and writing an online diary. In terms of the second requirement, based on a comparative study about one selected national and international OER project, students were asked to generate a proposal for the Chinese Ministry of Education (MOE) or for ZJU about Chinese OER development and application. At the beginning of the course, students were informed about these course assignments and criteria of evaluation.

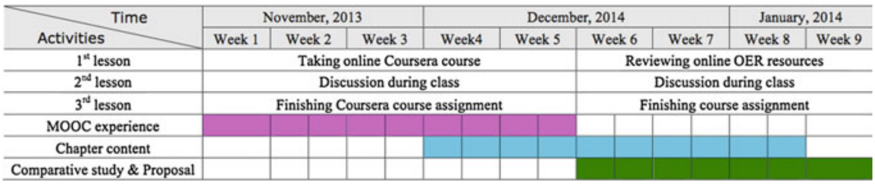

Fig. 9.1 Course timeline and major activities

Assignments	Descriptions	Criteria	Form	Due time	Score
Task 1: MOOC experience	Taking Coursera course "Emerging Trends & Technologies in the Virtual K-12 Classroom"	Finishing Coursera course, getting course certificate	Individual or group activity	5^{th} week	40
		Online diary	Individual activity	5^{th} week	10
Task 2: Comparative study & Proposal	Based on comparative study about one selected national and international OER project, making a proposal for MOE or ZJU about Chinese OER development and application	2-3 pages, having key points, having references, well written	Group activity	9^{th} week	20
	Making a presentation about your proposal	Clear presentation, well organized, good time control, well done in Q&A			10
Quiz	Five True/False questions per chapter	Finishing Quiz	Individual activity	9^{th} week	10
Participation	Performance in discussion and group activities	Writing course diary, active participation	Individual activity		10
Total					100

Fig. 9.2 Description of course assignments and criteria

9.4 Methods

This research employed both quantitative and qualitative methodologies to collect data. A survey and students' diary analysis were employed to measure the effectiveness of the course. Descriptive statistics were used to describe the results.

9.4.1 Participants

Participants in this study include one instructor, two teaching assistants, and 15 undergraduate students enrolled in the "Internet and Distance Education" at Zhejiang University, Hangzhou, China, during the winter semester of 2013. During the first week, 21 students participated in the class, and all of them took the pretest. In the second week, when students needed to decide whether or not to actually choose the course, 16 students continued with the course. During the course time, one student experienced a long-term illness, and, therefore, was unable to attend most of course activities. In the first class, the instructor introduced the nature and purpose of the experimental instructional activity.

9.4.2 Data Collection Instrument

Data were collected through a survey and students' online diaries. The survey instrument consisted of three parts: (1) general e-learning satisfaction, (2) self-reported degree of familiarity with course contents over the weeks, and (3) self-reported changes in general feelings over weeks.

(1) General e-learning satisfaction

Arbaugh's (2000) general e-learner satisfaction was adopted as a major instrument to measure students' satisfaction after class. The instrument consisted of six statements. A sample statement was "I am satisfied with my decision to take this course via the Internet." A 7-point Likert scale was utilized to indicate student attitudes toward these statements. The Cronbach's Alpha for the general e-learning satisfaction was 0.910.

(2) Self-reported degree of familiarity with course contents over weeks

Based on their personal experiences about possible stages of familiarity with a new material, the instructor and two teaching assistants developed a table to measure students' self-reported degree of familiarity about the course contents over 9 weeks. Two faculty members and two graduate students majoring in Educational Technology were invited to review the contents of the table to ensure its validity. The horizontal column of the table listed the 9 weeks one by one, and the vertical column described four different stages of familiarity, namely (1) unfamiliar, (2) understand, (3) adapted, and (4) skilled. Students were allowed to choose only one word to describe their degree of familiarity in each week.

(3) Self-reported changes in general feelings over weeks

Based on their personal experiences about possible feelings during a course, the instructor and two teaching assistants developed another table to measure students' self-reported changes in general feelings over 9 weeks. Two faculty members and two graduate students majoring in Educational Technology were invited to review the contents of the table to ensure its validity. The horizontal column of the table listed the 9 weeks of the course one by one (from the 1st week to the 9th week), and the vertical column listed six adjectives that might describe students' feelings. The listed words include excited, nervous, relaxed, happy, confident, and satisfied. A blank column was left to allow students to list other feelings that they might have in some weeks. Students were allowed to choose more than one word to describe their main emotional status in each week.

Students' online diaries were designed as part of students' performance evaluation. On the Sakai platform, blogs were created for every student. At the end of each course section (i.e., three lessons), students were required to write an online diary in their individual blog space. Importantly, they could type their diary in Chinese or in English. The instructor did not give a word limit for each student's diary post. Once logged into the platform, the instructor, teaching assistants, and peers could review and make comments on every student's diary contents. Content analyses were utilized to analyze participating students' diaries.

9.4.3 Data Collection and Analysis

Data collection was conducted at the end of the course. A survey was carried out with 15 students in January 2014. Data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS20.0). Descriptive statistics were used to describe each variable.

9.5 Findings

9.5.1 Objective 1: Describe Participating Students' Perceptions About OER and MOOCs Before the Course

For Objective 2, in the pre-class survey, the teacher asked students to indicate their general familiarity with OER and MOOCs. Table 9.1 shows that, among the 21 participating students, 5 indicated that they were not familiar with the concept of OER at all, 15 were a little familiar with the concept, and one did not answer the question. In addition, in regards to MOOCs, 12 students were not familiar with MOOCs at all, 8 were a little familiar with MOOCs, and one did not answer the question.

9.5.2 Objective 2: Describe Participating Students' Learning Process in OER-Based Flipped Course Through Three Aspects: Self-reported Degree of Familiarity with Course Contents Over Weeks, Self-reported Changes in General Feelings Over Weeks and Their Course Journals

As Table 9.2 shows, most of participating students experienced substantive changes in the degree of familiarity with course contents over the 9 weeks of the course, from being unfamiliar to understanding, adapting, and being skilled. Not surprisingly, there were individual differences in regard to the timing of such changes. Simply put, some students required more weeks to experience such a change than

Table 9.1 Participating students' familiarity with OER and MOOC before the course

	Not at all	A little familiar	Very familiar
Are you familiar with the concept of OER?	5	15	0
Are you familiar with MOOCs?	12	8	0

Table 9.2 Participating students' self-reported degree of familiarity with course contents over weeks (n = 15)

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
S1	1	2	2	3	3	4	4	4	4
S2	1	2	3	4	4	–	–	–	–
S3	1	1	2	3	3	3	3	4	4
S4	1	2	2	3	3	3	2	4	4
S5	1	2	2	3	3	4	4	4	4
S6	1	2	3	3	3	2	4	4	4
S7	–	–	3	–	–	4	4	4	–
S8	1	2	3	4	4	4	4	4	4
S9	1	2	3	4	4	4	4	4	4
S10	1	2	3	3	4	4	4	–	4
S11	–	–	3	3	3	3	–	3	3
S12	1	1	2	–	4	4	3	3	3
S13	2		3	4	–	–	–	–	–
S14	1	1	2	3	3	3	3	3	–
S15	–	–	2	3	3	4	4	4	4

Note 1 = unfamiliar; 2 = understand; 3 = adapt; 4 = skilled

other students. In the last 2 or 3 weeks, most students indicated that they were skilled at OER-based flipped course. By the last week, all participating students indicated that they were skilled. Such changes signal that a flipped classroom can provide the needed skills established by the curriculum and instructor.

Table 9.3 shows the results of participating students' self-reported changes in general feelings over weeks in the OER-based flipped classroom. The table indicates that, in the first week of the course, most of students felt excited about the innovative format and content of the course. In the first 5 weeks–when students mainly focused on MOOC course experience–there were six or seven students constantly experiencing nervousness. Such feelings might be due to their initial

Table 9.3 Participating students' self-reported changes in general feelings over weeks (n = 15)

	Excited	Nervous	Relaxed	Happy	Confident	Satisfied
1st week	13	6	1	3	–	–
2nd week	9	7	2	2	1	–
3rd week	–	7	8	3	3	–
4th week	–	6	8	2	2	2
5th week	–	6	7	3	5	1
6th week	2	3	9	5	1	3
7th week	–	2	9	5	4	2
8th week	–	3	5	3	6	7
9th week	–	4	8	4	2	6

experiences with a totally online English course taught by an American instructor. While as the weeks went on, some of these initially nervous students became more relaxed, happy, confident, or satisfied. During the last 4 weeks, most of participating students indicated that they were relaxed, happy, confident, and satisfied.

At the end of course, the online blog space accumulated 231 students' diaries. In the following analysis, each diary is recorded by student's information (named S1, S2…S15) and the date when it was written. Diary analyses revealed that students felt certain pressure from MOOC at the beginning of the course, and they experienced dramatic changes in their self-perceived competence during the OER-based flipped classroom. Students' diaries also indicated that they had a general positive attitude toward this kind of nontraditional instruction, including course format, instructor guidance, interaction with peers, and course evaluation. In addition, some students also put forward some suggestions for improving the quality of the course.

As to experience about the OER, especially the MOOC experience, at the beginning of the course, students felt excited about the open and free international educational resources available online, while many of them felt that they met a major challenge by taking the bilingual Web-based course, especially enrolling in a typical MOOC from a worldwide well-known university, which was a totally online course and taught in English by an American instructor.

> This is my first time to try an English online course. Frankly speaking, I feel big pressure. Firstly, I am not so confident about my English and reviewing those course materials would be a challenge for me. Secondly, there are deadlines for assignments in every module and there are many assignments waiting for me. What's more, I need to explore how to utilize online communication tools (S9, Nov. 19th, 2013).
> The instructor in the Coursera course spoke English too fast and it was a little hard for me to catch up with her speed. I need time to practice my English, especially in reading, listening, and comprehension. I feel such online course in English is challengeable and happy task for me (S8, Nov. 19th, 2013).
> It is so cool to have classmates from all over the world. We have different background according to age, career, culture, and etc. Having chance to assess international peers' assignments broaden my field of view and I learned a lot from it (S2, Dec. 12th, 2013).

Several students mentioned that they could understand the contents of lectures on the MOOC if they reviewed them carefully. Still, it was somewhat difficult for them to recall the key points of those lectures after watching the videos. Some reflected and summarized that such a phenomenon might result from the primarily asynchronous nature of the MOOC as well as limited interaction between instructor and students.

> I found that, although I finished watching lecture videos and quiz for every module, it is hard for me to get the key points of each lecture and to summarize what I've got in these lessons. I feel the major reason behind such outcomes lies in the fact that I followed the pace of the video and had not time to think about learning contents in a further and deep step and, after class, I did not reviewed the key points of those lectures for another time. At the same time, lack of interaction with others may be another possible reason behind having no impression about the learning contents (S5, Dec. 24th, 2013).
> Why did what I've learned from lecture videos only leave an obscured image in my mind? Maybe too much information in the course websites distracts our attention. Perhaps we

> need to adjust our learning methods when studying online. Learning knowledge through watching videos is so different from learning knowledge from traditional face-to-face classroom. Multimedia information in online course, like water, flows away freely but quickly and it takes time for us to catch it up and to comprehend it (S6, Jan. 2nd, 2014).
> During discussion session, I noticed that I had few questions and also I have not paid attention to some questions my classmates proposed about the lesson contents. It seems that I missed some important points during the lesson. I suspected my traditional learning strategies in this Web-based course. Maybe I need to adjust them. I need to pay more attention to some minor things (S12, Dec. 10th, 2013).

To deal with the issues related to recalling content and other challenges mentioned above, some students figured out and mentioned in their diaries that making notes would be a valuable learning strategy that would help them master knowledge more effectively.

> I feel taking notes is very important for me to better understand the lectures. At the same time, notes would let me record some questions I proposed and some thoughts I made, which would remind me what I have learned and what I still wondered (S3, Jan. 2nd, 2014).

As to the experience about the flipped classroom format, most of students expressed that they appreciated this form of instructional delivery since it emphasized self-directedness and self-control of learning process by the learners. It was the first time for all students to engage in a flipped classroom situation. Therefore, students took some time to be familiar with such a novel learning format.

> Flipped classroom is very interesting! (S15, Nov. 19th, 2013).
> I feel flipped classroom is better than traditional classroom because I can control the learning pace. I like such self-paced learning format (S2, Dec. 12th, 2013).
> I like flipped classroom because I am a person liking freedom. Such kind of self-directed learning is suitable for me (S2, Jan. 7nd, 2014).
> The course gave me several 'first try': I took MOOC for the first time, I took flipped classroom practice for the first time, I did my first instructional design in English, I assess peer's assignment for the first time……during the course, I have decided to take another Coursera course which is about playing Guitar (S7, Dec. 17th, 2013).

One student indicated that she was not used to attending discussion sessions in the flipped classroom course even though she was thinking about improving her communication skills in the course. More students indicated that the instructor's timely feedback and proper guidance/help are important for their successful experience and positive attitude toward the flipped classroom practice.

> In today's discussion session, I still kept quiet because I didn't know what to say. Late I reflected about my previous learning style for a while. I felt that I am used to listening in traditional course, instead of putting forward questions and thinking issues in a deeper way. I need to change my learning methods and learn to communicate more with others (S7, Dec. 31st, 2013).
> Today my group members and I discussed with the instructor about the final proposal (because we had little idea about what it was about and from which perspectives we should make proposal). It was very helpful and thank instructor! (S1, Dec. 31st, 2013).
> After reading my draft about my instructional design, the instructors gave me many suggestions. Comparatively, I felt that my initial thoughts about instructional design were too simple and too traditional. I need to improve both the contents and the format of the

instruction. Based on the instructor's advisor, I revised my draft dramatically (S2, Dec. 3rd, 2013).
During the presentations on the peer assessment assignment, the instructor gave everyone a careful and encouraging feedback, which made us understand the strengths and weakness of our assignments (S13, Dec. 17th, 2013).

At the same time, most of the students expressed in their diaries that online and offline peer-to-peer interactions were vital for students to get help, including timely feedback as well as the courage to participate, especially when attempting to complete an assignment.

Discussing with my group mates is very helpful, just like an old saying: you have an apple and I have an apple, each of us still has one apply when we exchange ours apples. However, when you have a thought and I have a thought, both of us have more than one thought after exchanging them. My group mates gave me some good suggestions, which keep me improve my assignment (S1, Nov. 28th, 2013).
During class discussion, classmates gave me many good corrections and suggestions, which would improve my instructional design (S3, Dec. 3rd, 2013).
Today, instructor guided us to share our peer assessment assignment during discussion session. I felt lucky to have such opportunities because I got good advice from my peers and from the instructors (S6, Dec. 12th, 2013).

In their diaries, students also reported that there are some aspects that this OER-based flipped classroom may improve. One is about technical issues. Another related to setting up and engaging in discussion sessions. Still another concerned presentation styles of the instructors doing the lectures.

We cannot try such social media as Facebook and Twitter, which limited our communication with the international instructor and classmates in the MOOC (S6, Nov. 19th, 2013).
Sometimes the speed of Internet is not so satisfactory (S4, Dec. 19th, 2013).
These days, because of poor Internet and browser, I cannot reach the course content, which resulted that I lagged behind the schedules (S9, Dec. 26th, 2013).
I strongly suggest that instructor could put discussion session behind assignment doing session because we would have more questions to discussion after we do our assignment for a while (S2, Jan. 2nd, 2014).
Wiki was not used well for group assignment because groups members were always together during the course and we still preferred to face-to-face communication instead of online communication (S3, Jan. 2nd, 2014).
I felt that PPTs in Coursera course were full of words and reading them slide by slide was quite boring and also it was hard for me to acknowledge the key points from so many words. So I suggest that instructors to make PPT in a more concise way. (S11, Nov. 19th, 2013).

9.5.3 Objective 3: Examine Students' General e-Learning Satisfaction After the Course

As shown in Table 9.4, participating students' general e-learning satisfaction was at a moderate level (M = 5.33, SD = 0.88). All students agreed or strongly agreed

Table 9.4 Participating students' general e-learning satisfaction about the course

	N	Mean	SD	Min	Max
General perceived e-learner satisfaction	15	5.33	0.88	3.83	6.83
(1) I am satisfied with my decision to take this course via the Internet	15	5.47	0.92	4	7
(2) If I had an opportunity to take another course via the Internet, I would gladly do so	15	5.40	1.06	4	7
(3) My choice to take this course via the Internet was a wise one	15	5.40	1.50	1	7
(4) I was very satisfied with the course	15	5.47	1.06	3	7
(5) I feel that this course served my needs well	15	5.47	0.99	4	7
(6) I will take as many courses via the Internet as I can	15	4.80	1.21	3	7

Note 1 = Strongly Disagree; 4 = Neutral; 7 = Strongly Agree

with these three statements: "I am satisfied with my decision to take this course via the Internet," "If I had an opportunity to take another course via the Internet, I would gladly do so," and "I feel that this course served my needs well." Most of students agreed or strongly agreed with these three statements: "My choice to take this course via the Internet was a wise one," "I was very satisfied with the course," and "I will take as many courses via the Internet as I can." At the same time, there was one student who chose to disagree or strongly disagree with these thee statements.

9.6 Conclusions and Suggestions

This study investigated an experimental OER-based flipped classroom practice in a Chinese undergraduate course. Before taking the course, none of participating students indicated that they were very familiar with OER and MOOCs. Some were slightly familiar with these two concepts, and others did not know them at all.

During the OER-based flipped classroom course, students experienced substantive changes in the degree of familiarity with the course contents, from being unfamiliar to understanding, adapting, and eventually being skilled. As to self-reported changes in general feelings over weeks, six or seven students reported being nervous in the first 5 weeks when students mainly focused on MOOC. Such tension might have been due to their first time experiencing a MOOC taught by an American instructor. As the weeks went on, the students as a whole became more relaxed, happy, confident, or satisfied.

There were a plethora of student blog reflections during the course. In total, students made 231 diary postings, which recorded their experiences from being anxious and excited to being happy and satisfied. At the same time, analysis of students' diaries found that they had a positive attitude toward OER utilized in the course as well as the self-directed, self-controlled, and flipped course format, including Web-based course design, instructor's guidance, and interaction with peers. In their diaries, some students also put forward some suggestions for improving the quality of the course, including various technical issues, the handling of the discussion sessions, and the instructor presentation styles in the recorded videos. At the end of the course, the student surveys indicated that students' general e-learning satisfaction was at moderate level.

Due to time and other contextual limitations, the study only explored a small group of Chinese college students majoring in the field of education at a comprehensive university. Further research should be carried out to explore college students' perceptions and usages of OER with a larger and more diverse population or among some specific educational groups or types of institutions, such as students from research-oriented universities, normal universities, community colleges, and vocational colleges. Also, self-reported instruments utilized in the study seem a somewhat subjective and lacking in extensive theoretical support. Of course, other factors such as personality traits, cognitive styles, and motivation might provide additional insights into the benefits of the flipped classroom and participant changes over time.

Based on the above findings and reflection about the limitations of the study, the authors of the study made three suggestions. First, the instructor may pay more attention to interaction design in such Web-based and flipped classroom courses, including the types and forms of face-to-face and online interaction. Second, the instructors may prepare optional plans when unexpected situations emerge during flipped classroom practice. For example, if students who are used to traditional courses indicate that they lack the necessary skills for self-directed and independent learning (especially at the beginning of the course), or they are not active in discussions or Q&A section, the instructors may need to provide some suitable scaffolding for those needing help. They might also adjust their predesigned activities with alternative strategies that may engage more passive students. Third, a more accurate and objective instrument specifically considering flipped classroom practice might be needed to assess students' actual perceptions about their experiences.

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References

Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. *Journal of Management Education, 24*(1), 32–54.

Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An empirical evaluation of the system usability scale. *International Journal of Human-Computer Interaction, 24*(6), 574–594.

Bonk, C. J., & Khoo, E. (2014). *Adding some TEC-VARIETY: 100 + activities for motivating and retaining learners online*. Bloomington, IN: Open World Books.

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom: Research into edx's first MOOC. *Research & Practice in Assessment, 8*, 13–25.

Brooke, J. (1996). SUS: A "quick and dirty" usability scale. In P. W. Jordan, B. Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development, 61*(4), 563–580. http://dx.doi.org/10.1007/s11423-013-9305-6.

DeBoer, J., Ho, A. D., Stump, G. S., & Breslow, L. (2014). Changing "course": Reconceptualizing educational variables for Massive Open Online Courses. *Educational Researcher, 43*, 74–84.

Dillahunt, T., Wang, Z., & Teasley, S. D. (2014). Democratizing higher education: Exploring MOOC use among those who cannot afford a formal education. *International Review of Research in Open and Distance Learning, 15*(5), 177–196.

Kay, R. H., & Loverock, S. (2008). Assessing emotions related to learning new software: The computer emotion scale. *Computers in Human Behavior, 24*(4), 1605–1623.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education, 78*, 160–173. doi:10.1016/j.compedu.2014.05.009.

Martin, F. G. (2012). Will massive open online courses change how we teach? *Communications of the ACM*, *55*(8), 26–28. Retrieved November 14, 2014, from http://cacm.acm.org/magazines/2012/8/153817-will-massive-open-online-courses-change-how-we-teach/fulltext.

OECD. (2007). *Giving knowledge for free. The emergence of open educational resources*. Paris: OECD Publishing. Retrieved from http://www.oecd.org/edu/ceri/38654317.pdf.

Rizzardini, R. H., Gütl, C., Chang, V., & Morales, M. (2014). MOOC in Latin America: Implementation and lessons learned. In Uden, L., Tao, Y.-H., Tang, H.-C, & Ting, I.-H. (Eds.), *Proceedings of the 2nd International Workshop on Learning Technology for Education in Cloud* (pp. 147–158). Kaohsiung, Taiwan: Springer Netherlands.

Sandeen, C. (2013). Integrating MOOCS into traditional higher education: The emerging "MOOC 3.0" Era. *Change: The Magazine of Higher Learning, 45*(6), 34–39.

Tseng, S. C., & Tsai, C. C. (2010). Taiwan college students' self-efficacy and motivation of learning in online peer assessment environments. *The Internet and Higher Education, 13*(3), 164–169.

Wikipedia (2014). Massive open online course. http://en.wikipedia.org/wiki/MOOCs.

Chapter 10
Tracking Students' Activities in Serious Games

Jina Kang, Sa Liu and Min Liu

Abstract A Serious Game (SG) is a virtual process designed for the purpose of real-world problem-solving. In SG analytics studies, learning processes are tracked using diverse techniques to support the personalization of instruction. However, it is a challenge to find potential meanings of each parameter of the tracking logs and define an appropriate indicator for a user's behavior. Game tracking logs often only provide limited information regardless of a game context. Therefore, research such as combining game data analysis with visualization techniques is needed to provide a holistic view of the gaming process and player behaviors. This study focused on the learning analytics of students' activities in a 3D immersive SG environment called Alien Rescue (AR, http://alienrescue.edb.utexas.edu), which is designed for middle school science learning. The goal of this study was to understand the relationship between students' activities—as shown in log data—and their performance in the environment. Students' activity logs and their performance scores were analyzed using both statistics and visualization techniques. The findings on SG tracking variables, learning paths based on different performance groups, and the most frequent learning path are reported in this paper.

Keywords Serious games analytics · Visualization · Learning path

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10.1 Introduction and Related Literature

Learning Analytics (LA) originally stemmed from various disciplinary fields such as statistical analysis and business intelligence for multiple purposes (e.g., consumer behavior and spending trends analysis) (Johnson et al. 2014). With the growing research interest in LA, as well as the rapid development of software and analytics methods, researchers and educators have recognized that the purpose of using LA can be different for different stakeholders. In education, LA allows teachers or school administrators to collect data directly related to students' academic performance (e.g., assignment completion rates and test scores) and their extracurricular activities (e.g., online forums posts and social media interaction), which are typically not used for traditional assessment. Such collected data can help teachers generate close-to-real-time instruction, improve the teachers' time used for managing classrooms, and also help administrators adjust school policies. Consequently, students can be motivated by the real-time personalized experience (Johnson et al. 2012, 2014).

Serious Games (SGs) are a type of game that includes simulated events or virtual processes designed for the purpose of real-world problem-solving (Djaouti et al. 2011; Rieber 1996). Although SGs can be fun and entertaining, their main purposes are to train, educate, or change users' attitudes in the real-world situations. In studies involving SG analytics (Linek et al. 2008; Reese et al. 2013; Scarlatos and Scarlatos 2010), the learning processes of individual students have been tracked using diverse techniques in order to support the personalization of instruction. The game tracking data usually includes multiple parameters such as number of clicks, frequency of tool use, and duration of interaction, which can be interpreted as a specific behavior indicator that includes subjective meaning (Linek et al. 2010). Linek et al. (2010) provided the potential meaning of behavioral indicators. For example, different types of player activity (e.g., confusion or nervousness versus enthusiasm) can be interpreted according to the rate of mouse-clicks.

Researchers also reported some constraints of log data, which provides only limited sophisticated information for examining dynamic user behavior within the educational applications (e.g., Johnson et al. 2014). For example, Loh and Sheng (2013, 2014) measured behavioral differences between novice and expert learners using String Similarity Index in single-solution SG environment and a new metric, Maximum Similarity Index, to deal with multiple expert solutions in a SG environment. Recent literature offered the possibility of using LA with various data visualization techniques to overcome the limitations (Cybulski et al. 2015; Wallner and Kriglstein 2013). Other approaches have been attempted to deliver a holistic view of the learning process and credible information of user behavior such as the combination of game data analysis and qualitative data analysis such as surveys and observations (Drachen and Canossa 2009; Linek et al. 2010).

10.2 Research Questions and Context

The SG environment under investigation is called Alien Rescue (AR, http://alienrescue.edb.utexas.edu). A development team in the Learning Technologies Program at the University of Texas at Austin designed and developed AR, directed by a design-based research framework (Brown 1992; Cobb et al. 2003). Over the years, AR has been used as part of the science curriculum by over a dozen of middle schools in Central Texas, as well as by schools in at least twenty-nine states and four countries.

AR integrated a problem-based learning (PBL) pedagogy, in which students with different expertise (e.g., expert and novice problem solvers) can approach problems in various ways (Glaser 1991). A variety of cognitive tools are provided in AR to support students' problem-solving process. These cognitive tools align with Lajoie's (1993) four conceptual categories (see Table 10.1): tools sharing cognitive load, tools supporting cognitive process, tools supporting otherwise out-of-reach activities, and tools supporting hypothesis testing. In a previous study conducted using AR on a similar topic, it was found that students accessed more frequently and spent more time with six of the twelve tools that are most important for solving a central problem (Liu et al. 2015). These tools included Alien Database, Solar System Database, Notebook, Probe Design, Probe Launch, and Mission Control (see Table 10.1). Building on the previous research, this study focused on these six tools.

AR is designed for sixth-grade students to use as their science curriculum unit for over approximately 15 days of 50 min each class period. Teachers, however,

Table 10.1 Descriptions of selected cognitive tools provided in AR

Tool categories		Tool functions
Tools sharing cognitive load	Alien Database	Provides descriptions of six aliens' home planets and the characteristics of each species with 3D visuals
	Solar System Database	Provides (incomplete) information on our solar system that allows students to collect information as species' habitat
Tools supporting cognitive process	Notebook	Allows students to take notes during solving the problem for collecting, summarizing, and integrating information
Tools supporting otherwise out-of-reach activities	Probe Design Center	Provides an interactive tool for students to design probes to send to gather information on planets and moons in our solar system
	Probe Launch Center	Provides a place for students to review designed probes and make launch decisions within their remaining budget
Tools supporting hypothesis testing	Mission Control Center	Allows students to review data from launched probes and to integrate information to test hypotheses

can adjust the recommended days based on their specific situation. The previous research (Liu et al. 2004, 2009) showed there are four conceptual stages of the problem-solving process in AR based on the cognitive processes in Bloom's taxonomy (Anderson et al. 2001): (a) days 1–2: understanding the central problem, (b) days 3–7: identifying, gathering, and organizing information, (c) days 8–10: integrating information, and (d) days 11–13: evaluating the process and outcome.

Given the focus on students' activities in a SG environment in this study, we examined the log data and employed data visualization techniques to represent research findings. The goal was to understand the relationship between students' activities as shown in log data and their performance in the environment. We asked two research questions:

1. Which tracking data variables correlate significantly with student performance in this SG environment?
2. How do the learning paths of students with different learning performances differ?

10.3 Method

10.3.1 Participants

The 61 sixth graders from a school in the southwestern part of the United States were engaged in a complex central problem by watching an introductory video in class. These students then used the SG environment as their science curriculum individually for about 3 weeks in the spring of 2014.

10.3.2 Data Sources

10.3.2.1 Log Files

The SG environment logged students' actions into a data file, which contained the student's ID, tools accessed, timestamp on each tool, and texts explaining students' solution. These data were calculated for inclusion in the analysis: the number of times a student accessed each tool, the time spent on each tool, and a count of the words for the solution by each student. While solving the problem in AR, students could submit multiple solutions. Therefore, each student's solution texts were matched with their log, and the log of students who did not submit a solution was removed from the final dataset. Because this study was conducted in the actual classroom setting, not every student submitted a solution. The final dataset of log files of 61 students consisted of 7404 lines.

Table 10.2 Rubric used for grading solution form

Description	Points awarded
Recommends an inappropriate home for the alien species	0
Recommends an appropriate home without any reason to describe their choice	1
Recommends a suitable home with reasons to describe their choice; the student is awarded one point for each reason	2–7

10.3.2.2 Performance Score

Among the multiple submitted solutions by each student, only the last submitted solution was chosen to evaluate the student's performance as presented above. The student's performance was evaluated by how successfully a student solved the central problem of finding an appropriate home in our solar system for each alien species. A 7-point rubric was used to evaluate students' solutions (see Table 10.2). To ensure inter-rater reliability, two researchers evaluated five solutions together against the scoring rubric to ensure that the same criteria were applied during scoring. Then the two researchers scored the rest of solutions individually.

10.4 Analyses and Findings

Students' activity logs and their performance scores were analyzed using both statistics and visualization techniques. We selected *Tableau* Desktop (tableausoftware.com) and *D*3 (d3js.org) as our visualization tools, since the tools enable the representation of multidimensional data or multiple layers of information in a single view. To answer the first research question, we selected fifteen tracking variables, including the number of clicks of each tool, the time spent on each tool, and a count of the solution texts (see Table 10.3). This complete dataset was imported into SPSS to conduct a correlation analysis. To address the second questions, we used *Tableau* and *D*3 to visualize the students' learning paths.

10.4.1 Correlations of Tracking Variables with Students' Performance

To examine the significance of 15 tracking variables (see Table 10.3) as indicators of student performance within the game, a simple correlation analysis of each variable with student solution score was conducted. Three of these variables showed a significant correlation with the solution score ($p < 0.05$) (see Table 10.3). The count of words in the solution demonstrated a medium effect size ($r = 0.485$) with 24 % of the variance in the solution score. Among six cognitive tools, only

Table 10.3 Results of bivariate correlations of tracking variables with student performance score

Variable	Pearson's r	Pearson's r^2	p
Total frequency of Tools	0.015	0.00023	0.708
Frequency of Alien DB	0.2	0.04	0.027*
Frequency of Solar DB	−0.097	0.00941	0.286
Frequency of Notebook	−0.014	0.0002	0.884
Frequency of Probe Design	0.019	0.00036	0.836
Frequency of Probe Launch	0.054	0.00292	0.5553
Frequency of Mission Control	0.045	0.00203	0.624
Total time spent on Tools	0.038	0.00144	0.356
Time spent on Alien DB	0.238	0.05664	0.008*
Time spent on Solar DB	−0.051	0.0026	0.574
Time spent on Notebook	0.092	0.00846	0.324
Time spent on Probe Design	−0.014	0.0002	0.88
Time spent on Probe Launch	0.14	0.0196	0.123
Time spent on Mission Control	0.107	0.01145	0.242
Words count in solution form	0.485	0.23523	0.00*

(*$p < 0.05$)

Alien Database (DB) showed a significant relationship with the students' performance. Both Alien DB-related tracking variables (frequency and time spent) showed a weak effect size ($r < 0.3$). No significant relationships were found for other cognitive tools.

Bivariate correlation should not be merely interpreted as causation for prediction purposes (Agudo-Peregrina et al. 2014). Therefore, to further interrogate potential correlation trends between the variables, radar plots were developed as shown in Fig. 10.1. We selected a radar plot as the representation of tool use patterns (i.e., average frequency and duration of the selected tools) between different performance groups, since it enables the representation of multivariate data in a form of a two-dimensional plot, in which each variable is represented on each axis. To compare high and low performance groups, only low-scoring (score 0) and high-scoring (scores 5 and 6) students were selected for the radar plots. Along with the correlation results, the radar plots indicated that the high performance-score students used the tool, Alien DB, longer than the low performance-score students (see Fig. 10.1d). The low-scoring students used Probe Design and Mission Control tools more often (see Fig. 10.1a). But, both groups used these tools for similar amount of time (see Fig. 10.1b, d).

10.4.2 Learning Path

According to Linek et al. (2010), the sequence of materials can be interpreted to determine whether a student approximates a solution or is disoriented. A learning

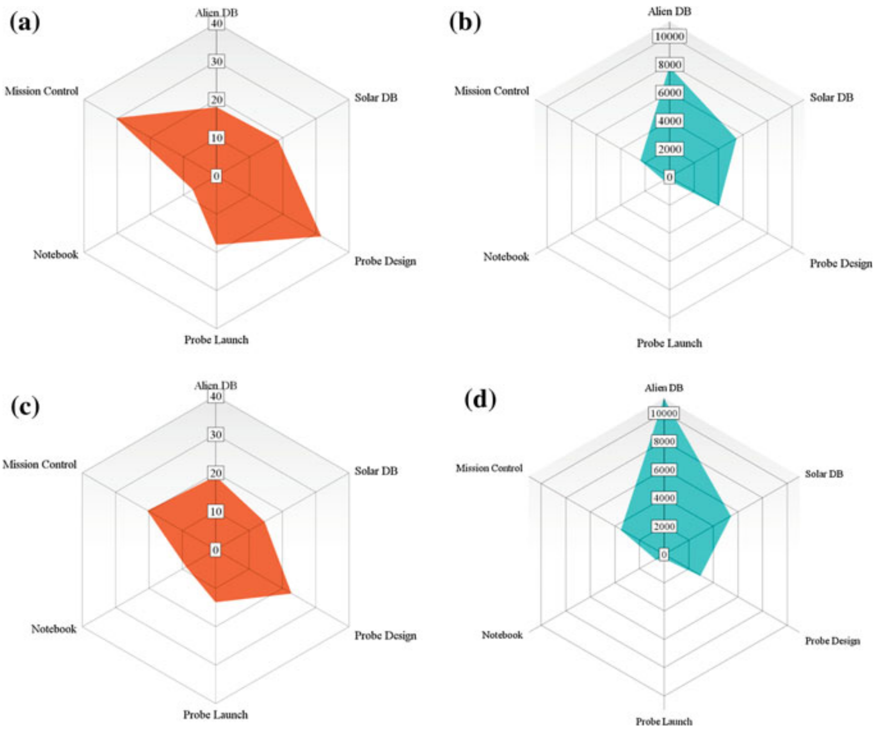

Fig. 10.1 Radar plots of selected tracking variables by high and low student performance scores. **a** Tool use pattern using average frequency for performance score = 0. **b** Tool use pattern using average duration for performance score = 0. **c** Tool use pattern using average frequency for performance scores = 5 and 6. **d** Tool use pattern using average duration for performance scores = 5 and 6

path was developed to examine the sequence of tools a student used in the game, and to explore any patterns existed in a given student's performance. Using the solution scores, the students were divided into seven groups. In Fig. 10.2, the X-axis provides the chronological order of clicks that a student made to access a tool. The Y-axis indicates the student groups based on the solution scores, and the selected six tools. This analysis revealed students who scored higher showed shorter learning paths and used the tools less frequently. That is, these students arrived at the solution faster than other groups.

Our previous research on students' problem-solving in AR has shown that during the beginning stages of the problem-solving process students are expected to use tools supporting cognitive load and cognitive processes (i.e., Alien DB, Solar System DB, Notebook) to understand the problem and gather and organize information (Liu and Bera 2005; Liu et al. 2015). The tools supporting out-of-reach activities and hypothesis testing (i.e., Probe Design, Probe Launch, Mission Control) are intended to be used for the later stages. Building upon our previous research, we were interested in finding out the most frequent learning path in order

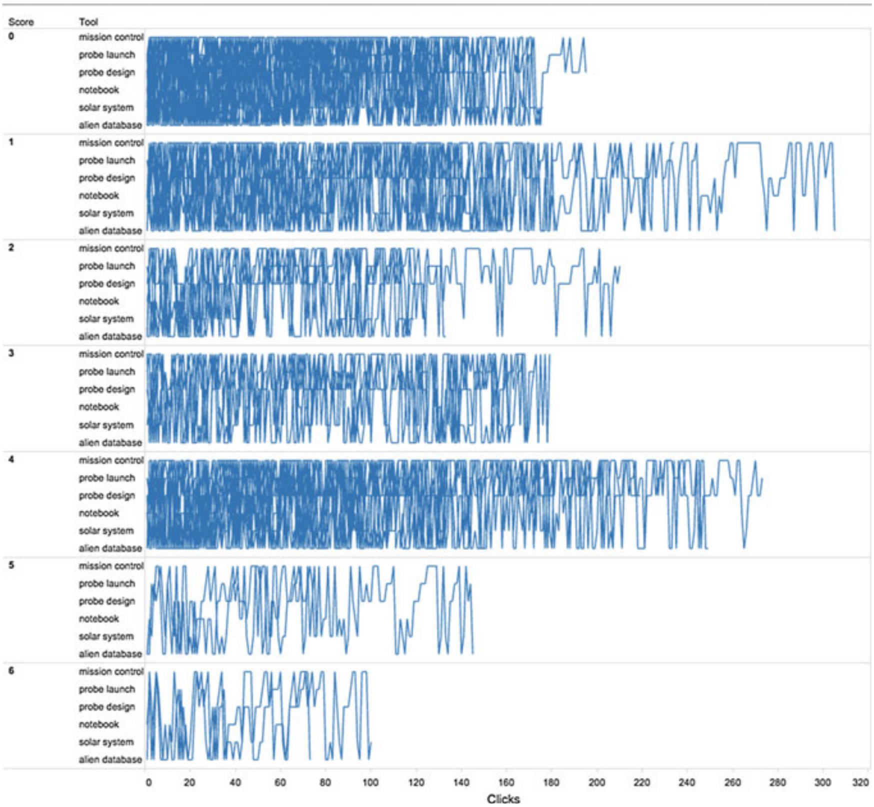

Fig. 10.2 Learning paths for students with different performance scores

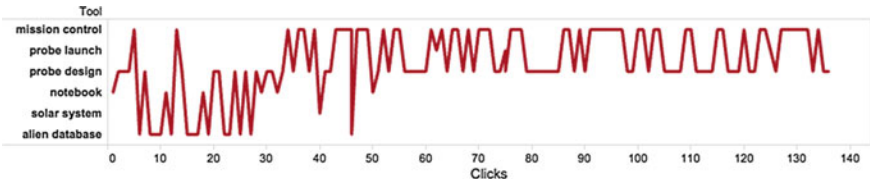

Fig. 10.3 The most frequent learning path for all the students

to understand how students used the tools. As Fig. 10.3 shows, in the first 50 clicks, the students frequently switched between the six tools, and then focused on Probe Design, Probe Launch, and Mission Control tools for the rest of time.

To take a closer look at different students' learning paths during the beginning of the game, two students' learning paths were selected, one with a score of 6 (high) and the other with a score of 0. The student with the higher-score concurrently visited the tools supporting cognitive load during the first 30 clicks to understand

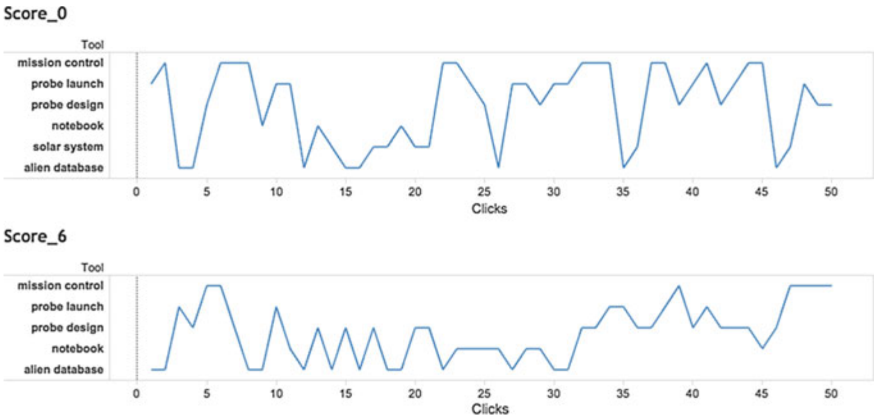

Fig. 10.4 Learning paths for low-scoring and high-scoring students

the problem and gather information (see Fig. 10.4), and then focused on integrating information and testing hypotheses using Probe Design and Mission Control tools. Overall, this student concurrently used Alien DB, Probe Design, and Notebook tools, which showed the approximation to the solution. However, the student with the lower-score seemed to be disoriented, since this student did not try to collect information by visiting the cognitive load tools (Alien DB, Solar System DB) during the early stages of the problem-solving process. In fact, this student rarely used Alien DB, but accessed fun tools (i.e., Probe Design and Probe Launch) more often. It is necessary to point out that when students begin the game, they are expected to explore the game and try out different tools. But, since students are given a certain amount of time to use the program as their curriculum, quickly figuring out what tools are for or when to use them is important for the problem-solving process.

Inspired by the Mathematical Pi(π) visualization (http://mkweb.bcgsc.ca/pi/), we then further developed the patterns of all of the performing groups' learning paths using *D*3. We selected *D*3 for further exploration since it affords flexibility of data representation, while *Tableau* has limited types of data representation. In Fig. 10.5, all the possible solution scores from 0 to 6 are listed inside of the circle. Within each score, a set of colored bars in an outward direction represents the 50 most frequent clicks for that score group. Each bar represents each tool, and each tool has its own unique color. We discussed above the most frequent learning path from the first click to the fiftieth click of each student. In this analysis, in order to identify the 50 most frequent clicks (i.e., different number of decisions) for each solution score group, we developed a partition algorithm in Python. This partition algorithm first sorted the 61 students into groups based upon their solution scores (represented by the center circle). Then, the total number of decisions (i.e., clicks) of each student within their score group was divided into 25 partitions. This number of 25 partitions was decided based on the minimum number of decisions among all the students. For example, Score 0 group has Student A with 100 decisions, and Student B with 175 decisions.

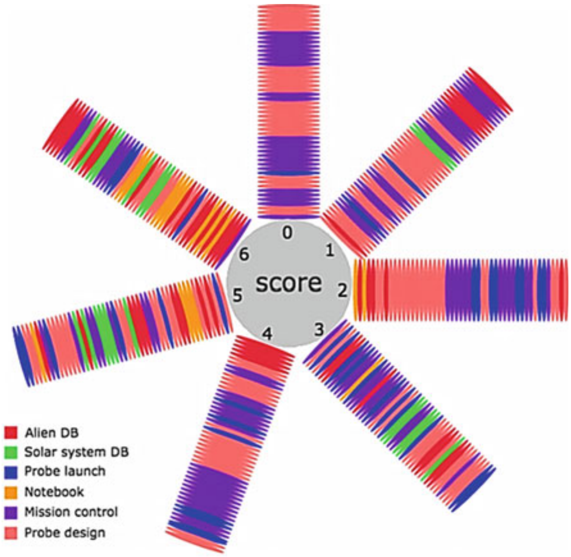

Fig. 10.5 The most frequent learning path for each performance score group (http://alienrescue.edb.utexas.edu/pic/LKAOE_fig5.png)

Student A would have four decisions in each partition (100/25), and Student B would have seven decisions in each partition (175/25). We then selected the two most popular used tools in each partition for all the students within that solution score and these two most popular used tools in the total of 25 partitions would add up to 50 decisions. The visualization as shown in Fig. 10.5 showed the low-scoring groups focused on only certain tools during the 50 decisions; for example, scores 0, 1, and 2 groups used mainly two tools: Probe Design and Mission Control. On the other hand, the high-scoring groups (scores 5 & 6) first focused on cognitive load and processing tools and then concurrently switched tools.

10.5 Discussion and Conclusion

To understand students' behaviors in a game, it is important to find the potential meanings of each parameter of game log data as a behavioral indicator (Linek et al. 2010). The findings of this study showed that three variables of game tracking data were significantly related to students' performance: the count of words in the solution, which can be viewed as a positive behavior indicator of student academic performance; the frequency of use of Alien DB; and the time spent on Alien DB, which showed a tendency to correlate positively with the performance. Their weak effect size ($r < 0.3$) can possibly be explained by the small sample size ($n = 61$). Such findings support our previous research which indicated that the Alien DB is a critical tool for gathering information early in the problem-solving process (Liu et al. 2009). In addition, 3D alien visuals in Alien DB seem to help engage students to gather information as students accessed the Alien DB more frequently and spent more time with the tool (Liu et al. 2015).

Our previous research indicated that high-performing and low-performing students showed different tool use patterns (Liu and Bera 2005; Liu et al. 2015). This study showed that the high-performing students tended to use all six tools concurrently, while the low-scoring students limited themselves to primarily using the Probe Design and Mission Control tools (see Fig. 10.1). This is consistent with the previous research that found students with lower performance scores seemed to use more fun tools such as Probe Design and Mission Control (Liu et al. 2013). Literature has indicated understanding students' learning processes in a PBL environment and how students engage in solving a complicated problem is important (Schmidt et al. 2011). This study revealed that high-scoring and low-scoring students differed in their learning paths, where students' approximation to the solution or disorientation can be inferred (Glaser 1991). In Fig. 10.2, the high-scoring students' shorter learning paths seem to suggest that these students approximated a solution faster than other students. Students need to use the appropriate tools during each stage of the problem-solving process to solve the central problem within the given time limit (Liu et al. 2013). In this study, the high-performing students frequently switched between tools during the early stages to better understand the central problem and then transitioned to the Probe Design and Mission Control tools to test their hypotheses for the rest of stages, which confirmed more appropriate use of the built-in cognitive tools.

Analysis through data visualization can deliver a more holistic view of students' different learning processes (Cybulski et al. 2015). Wallner and Kriglstein (2013, 2014) specifically illustrated the significance of using multiple data visualizations of gameplay to reveal latent patterns, trends, or outliers. In our study, we first explored the students' learning paths through line charts over time using *Tableau* (see Figs. 10.1, 10.3 and 10.4). Beyond traditional statistical analysis summaries, data visualization has enabled us to examine the tool use patterns over the entire process among different performance groups in a single view. It can also reveal detailed and nuanced patterns, which otherwise are not easily found. For example, Fig. 10.4 provided a glimpse of different patterns by different performance scores, which is more revealing than just an overview of one large group's patterns (Drachen and Canossa 2009). The visualization using *D*3 provides a single view of different students' learning behaviors by different performance groups. Such findings supported the potential of utilizing multiple data exploration and visualization views to reveal learning behavior patterns in SG; which can be an area for future research to provide insights about students' behavior, improve their learning experience, and inform SG design.

10.6 Limitations and Future Directions

This study is limited to the log data of students who submitted at least one solution, which eventually reduced the sample size. While the students' log data is accurate and important, the research would have been more robust with expanded data including students' self-reports. As for the log data, preprocessing was required to identify missing values (e.g., no submission record) or out-of-range values (e.g., timestamp occurred during weekends). However, since there was no automated data preprocessing system for this SG, the researchers had to manually label the log data after comparing the logged timestamps with the school calendar to figure out the exact number of days the SG was used. In addition, generalizability is limited as the context of this study is confined to one SG environment.

Our intention is to continue the exploration of meaningful ways of analyzing and visualizing a large multidimensional dataset to discover useful patterns with various data mining techniques (e.g., decision tree and neural network analysis). Discovering potential meanings of each parameter of a log can help define the students' success or failure within SGs such as Alien Rescue. Specifically, it is essential to identify successful features of problem-solving behavior from log data (e.g., number of repeated trials, number of hypothesis testing) to help understand different problem-solving processes by high and low performance students so as to provide necessary support to students who need help. Understanding how students' learning behaviors may impact academic performance can help ensure that all students are guided to succeed. Our ultimate goal is to understand learner behavior and gain insights on how SG environments can be designed to facilitate learning.

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References

Agudo-Peregrina, Á. F., Iglesias-Pradas, S., Conde-González, M. Á., & Hernández-García, Á. (2014). Can we predict success from log data in VLEs? Classification of interactions for learning analytics and their relation with performance in VLE-supported F2F and online learning. *Computers in Human Behavior, 31*, 542–550. doi:10.1016/j.chb.2013.05.031.

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., et al. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences, 2*(2), 141–178. doi:10.1207/s15327809jls0202_2.

Cobb, P., Confrey, J., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational researcher, 32*(1), 9–13. doi:10.3102/0013189X032001009.

Cybulski, J. L., Keller, S., Nguyen, L., & Saundage, D. (2015). Creative problem solving in digital space using visual analytics. *Computers in Human Behavior, 42*, 20–35.

Djaouti, D., Alvarez, J., Jessel, J. P., & Rampnoux, O. (2011). Origins of serious games. In *Serious games and edutainment applications* (pp. 25–43). London: Springer.

Drachen, A., & Canossa, A. (2009). Towards gameplay analysis via gameplay metrics. In Proceedings *of from The 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era* (pp. 202–209). Association for Computing Machinery.

Glaser, R. (1991). The maturing of the relationship between the science of learning and cognition and educational practice. *Learning and Instruction, 1*(2), 129–144. doi:10.1016/0959-4752(91)90023-2.

Johnson, L., Adams, S., & Cummins, M. (2012). *The NMC Horizon Report: 2012 Higher* (Education ed.). Austin, Texas: The New Media Consortium.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). *The NMC Horizon Report: 2014 Higher Education Edition*. Austin, Texas: The New Media Consortium.

Lajoie, S. P. (1993). Computer environments as cognitive tools for enhancing learning. In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools* (pp. 261–288). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Linek, S. B., Marte, B., & Albert, D. (2008). The differential use and effective combination of questionnaires and logfiles. In *Computer-based Knowledge & Skill Assessment and Feedback in Learning settings (CAF), Proceedings of the International Conference on Interactive Computer Aided Learning (ICL), 24th to 26th September*.

Linek, S. B., Öttl, G., & Albert, D. (2010). Non-invasive data tracking in educational games: combination of logfiles and natural language processing. In Chova, L.G. and Belenguer, D.M. (eds.), Proceedings from *INTED 2010: International Technology, Education and Development Conference, Spain, Valenica 8–10 March, 2010*.

Liu, M., & Bera, S. (2005). An analysis of cognitive tool use patterns in a hypermedia learning environment. *Educational Technology Research and Development, 53*(1), 5–21. doi:10.1007/BF02504854.

Liu, M., Bera, S., Corliss, S., Svinicki, M., & Beth, A. (2004). Understanding the connection between cognitive tool use and cognitive processes as used by sixth graders in a problem-based hypermedia learning environment. *Journal of Educational Computing Research, 31*(3), 309–334.

Liu, M., Horton, L. R., Corliss, S. B., Svinicki, M. D., Bogard, T., Kim, J., & Chang, M. (2009). Students' problem solving as mediated by their cognitive tool use: A study of tool use patterns. *Journal of Educational Computing Research, 40*(1), 111–139.

Liu, M., Yuen, T. T., Horton, L., Lee, J., Toprac, P., & Bogard, T. (2013). Designing technology-enriched cognitive tools to support young learners' problem solving. *The International Journal of Cognitive Technology., 18*(1), 14–21.

Liu, M., Kang, J., Lee, J, Winzeler, E., & Liu, S. (2015). Examining through visualization what tools learners access as they play a serious game for middle school science. In C. S. Loh, Y. Sheng, & D. Ifenthaler (Eds.) *Serious Games Analytics: Methodologies for Performance Measurement, Assessment, and Improvement*. Switzerland: Springer. doi:10.1007/978-3-319-05834-4.

Loh, C. S., & Sheng, Y. (2013). Measuring the (dis-)similarity between expert and novice behaviors as serious games analytics. *Education and Information Technologies, 20*(1), 1360–2357.

Loh, C. S., & Sheng, Y. (2014). Maximum Similarity Index (MSI): A metric to differentiate the performance of novices vs. multiple-experts in serious games. *Computers in Human Behavior, 39*, 322–330.

Reese, D. D., Tabachnick, B. G., & Kosko, R. E. (2013). Video game learning dynamics: Actionable measures of multidimensional learning trajectories. *British Journal of Educational Technology, 46*(1), 98–122. http://doi.org/10.1111/bjet.12128.

Rieber, L. (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.

Scarlatos, L. L. & Scarlatos, T. (2010). *Visualizations for the Assessment of Learning in Computer Games,* Paper presented at the 7th International Conference & Expo on Emerging Technologies for a Smarter World (CEWIT 2010), Sept. 27–29, 2010, Incheon, Korea.

Schmidt, H. G., Rotgans, J. I., & Yew, E. H. (2011). The process of problem-based learning: what works and why. *Medical Education, 45*(8), 792–806.

Wallner, G., & Kriglstein, S. (2013). Visualization-based analysis of gameplay data–A review of literature. *Entertainment Computing, 4*(3), 143–155.

Wallner, G., & Kriglstein, S. (2014). PLATO: A visual analytics system for gameplay data. *Computers & Graphics, 38*, 341–356. doi:10.1016/j.cag.2013.11.010.

Chapter 11
Eight Trends Affecting the Field of Instructional Design and Technology: Opportunities and Challenges

Robert A. Reiser

Abstract In recent years, the field of instructional design and technology (IDT) has been greatly impacted by a wide variety of trends in the field of education, both in terms of technological tools that are available for educational and instructional purposes, as well as innovative approaches to instruction and learning. The primary purposes of this chapter are (a) to identify some of the major trends that have affected the field over the past decade, as evidenced by data indicating the extent to which those innovations have been employed in a wide variety of settings, including K–12 schools, higher education institutions, and business organizations; and (b) to discuss some of the opportunities and/or challenges each of these trends presents for IDT professionals.

Keywords Instructional design · Instructional design and technology · Trends · Performance improvement · Performance support · Online learning · Social media · Educational games · Mobile learning · MOOCs · Learning analytics

11.1 Introduction: A Clarification of Terms

In recent years a variety of trends in the field of education, with regard to both instructional tools that have become available and the instructional practices that have become popular, have had an impact on the field of instructional design and technology (IDT). One of the primary purposes of this paper will be to identify some of the major trends that have affected the field over the past 10 years, as evidenced by data indicating the extent to which those innovations have been employed. The other primary purpose will be to identify a few of the opportunities and/or challenges these trends present for instructional designers.

For the purposes of this paper a trend will be defined, in most cases, as a new idea, device or method that has had, or is likely to have, a major impact on the IDT

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field. But what do we mean by the term *new?* Whereas most of the trends that will be described in this paper have gained prominence during the past decade, give or take a few years, two of the trends, namely (a) the performance improvement movement, and (b) performance support tools, first started having a major impact on the IDT field as far back as the early- to mid-1990s. While these trends can no longer be viewed as new, they continue to have a major impact on the IDT field and thus will be discussed in this paper.

Before turning our attention to the trends that have recently affected the IDT filed, it is important to define what the term *instructional design and technology* means, and explain why it, rather than the term *educational technology,* is being used in this paper. From my perspective (Reiser 2012), the problem with using the term *educational technology* as the label for our field is that this term is usually equated with use of media for instructional purposes (e.g., using the Internet as a means of delivering instruction), and our field encompasses much more than that. An equally important (indeed, most likely more important) aspect of our field involves the systematic design of solutions to learning and workplace performance problems; situations in which many members of a target audience are not adequately learning and/or are not performing their jobs satisfactorily. Instructional design models, such as that described by Dick et al. (2014), are often used to guide IDT professionals as they engage in this systematic process.

Given that systematically designing instruction is an important aspect of the work done in our field, I believe that the term that is used as the name for the field should make reference to instructional design, not just to media, as is the case when the term *educational technology* is employed. Thus, I believe a better name for our field is *instructional design and technology*. This term makes reference to the two aspects of the field I have described above; it makes specific mention of *instructional design* and it also incorporates the term *technology,* a term that in the education world is usually associated with instructional media.

11.2 Trend #1: Performance Improvement

Now that I have clarified the meaning of some of the key terms used in the title of this paper, we can turn our attention to the first of the eight trends that I will be discussing: the increasing interest, over the past two decades, in *performance improvement*. What does this term mean? In large part, it refers to attempts to help individuals, whatever their profession, whatever their job title or rank, to perform their jobs better (e.g., to make less errors, to work more quickly, to produce higher quality work).

In the IDT field, the growing importance placed on performance improvement came about as a result of several factors. One such factor is that over the past two decades in the United States a growing number of graduates of academic programs in instructional design and technology have been employed in what might be called *workplace settings,* such as businesses, the military, and government agencies.

As more individuals have been hired in these types of settings, many leaders in the field have come to the realization that the goal of instructional designers working in these settings needs to be more than to simply enhance the learning of people working in these settings; instructional designers must also be able to design interventions that will improve the workplace performance of these individuals. In other words, the interventions instructional designers create should not be designed solely to help people *recall* some factual information or *describe* the process they might use to solve a problem; the interventions should be designed to enable those individuals to actually improve their ability to *perform* the skills they will need to employ in their work.

The increasing emphasis in the IDT world on improving the performance of individuals in the workplace presents a challenge for instructional designers. Namely, how can we design interventions in the workplace that help individuals improve their on-the-job performance? In those cases where instruction or training is used as one of the interventions to help solve a performance problem, one suggestion for instructional designers is that the tasks individuals are asked to engage in during the learning process should be made so as to closely resemble the tasks the individuals will be expected to perform in the workplace setting. Such an approach is likely to facilitate the transfer of skills from the learning setting to the workplace. In other words, such an approach is likely to lead to improved workplace performance.

11.3 Trend #2: Performance Support

Performance support, like performance improvement, is a trend that had its start more than two decades ago, primarily as a result of the work done by Gery (1991), but it is still having an impact on the IDT field today. Performance support can be defined as a system that provides people who have to perform a particular task with access to tools and information that support performance at the moment of need (Nyugen 2012). Two excellent commonplace examples of performance support tools are (a) GPS systems, which provide individuals with directions as to how to get somewhere at the moment they need that information, and (b) income tax preparation software, which provides individuals with the support they need to complete their income tax returns.

Data recently collected by the eLearning Guild (Foreman 2015) reveals that among representatives from more than 430 organizations in the business world, 63 % strongly agreed or agreed with the statement that performance support is strongly sponsored within their organization. However, 55 % of those individuals also indicated that their organization does not effectively manage performance support. These two sets of data present a challenge for instructional designers: how can we improve the design and integration of performance support tools so as to provide more effective and efficient support to learners/workers at their moment of need?

11.4 Trend #3: Online Learning

When it comes to trends in the IDT field, online learning might justifiably be referred to as the elephant in the room. That is because of the growing use of online learning in several sectors in the education and training world. Let us start with online learning in businesses. The 2012 survey by the American Society for Training and Development (ASTD) revealed that among approximately 30 of the leading training organizations in the United States (referred to by ASTD as “BEST Award Winners”), the percentage of training that was delivered online increased from 26 % in 2005 to 38 % in 2011, almost a 50 % increase in a period of just 6 years (Miller 2012).

In higher education the growth in online learning has also been dramatic. The Babson Group (Allen and Seaman 2014) reports that among approximately 2800 colleges and universities, the percentage of students taking online courses has greatly increased. Whereas less than 10 % of the students were taking at least one online course in the fall of 2002, 10 years later, in the fall of 2012, more than 30 % were doing so. Moreover, another report by the Babson Group (Allen and Seaman 2015) reveals that among approximately 7000 academic leaders, in 2002 slightly less than 50 % indicated that online education was critical to the long-term strategy of their institution, whereas by 2014, 70 % felt that way. In contrast to the positive data described above, data from the same survey (Allen and Seaman 2015) indicates that in 2014 almost 45 % of the survey respondents reported that they felt it is harder to retain students in online classes than in face-to-face classes.

In my opinion, all of this data regarding online learning represents an opportunity for instructional designers. Why? Because as the desire to create online courses increases, and as concerns about retaining students in such courses remain prominent, there will be, indeed already is, a need for instructional designers who can work with subject matter experts to improve the instructional quality of such courses.

11.5 Trend #4: Social Media

In the past years there has been a substantial increase in the percentage of the general public who are making use of social media tools such as blogs, wikis and podcasts, social networking sites such as Facebook, and media sharing sites such as YouTube. These various forms of social media have drastically changed the nature of information-sharing and learning in our society. In the past, educational activities such as the creation and presentation of content, sharing knowledge via various media, and the establishment and management of collaborative learning groups were primarily conducted by teachers/instructors, instructional designers, and other “credentialed” educational personnel. Now, with the aid of the innumerable social media tools that are available, anyone can engage in these activities.

Along with the rise in the use of social media by society in general, has come an increase in the use of such media in various educational settings. For example, in higher education, a Babson Group survey (Seaman and Tinte-Kane 2013) of approximately 8000 faculty members revealed that in 2013, about 41 % of them were using social media for instructional purposes; this was an increase of about 8 % from the previous year. What were the most frequently used social media tools? Among those faculties using such tools for instructional purposes, more than 80 % indicated that they were having their students create blogs and/or wikis for individual and group assignments, and almost 60 % were requiring students to view podcasts for individual assignments.

In the business world, there is also much use of social media to improve learning and performance among workers. For example, a recent survey by the eLearning Guild (Foreman 2015) revealed that among representatives from more than 425 organizations in the business world, approximately 33 % strongly agreed or agreed with the statement that social networking and collaboration is strongly sponsored within their organization. However, almost 75 % also indicated that their organization does not effectively manage these activities. These findings and those described in the previous paragraph present instructional designers with a challenge: with the increasing interest in the use of social media for educational purposes, what can we do to better identify suitable social media resources and incorporate and manage them among the many other learning opportunities provided to learners/workers?

11.6 Trend #5: Educational Games

In this paper, educational games are defined as games that are explicitly designed for educational purposes. That is, they are designed to facilitate learner attainment of specific learning outcomes (i.e., specific skills, knowledge, and/or attitudes). Some of the key characteristics of educational games are that they (a) present learners with problem-solving challenges, (b) provide clear goals and rules, (c) allow a high degree of learner control, and (d) provide learners with ongoing feedback (Shute et al. 2012).

As indicated by a survey conducted by the Joan Ganz Cooney Center (Takeuchi and Vaala 2014), educational games are being used fairly frequently in K–12 classrooms. Among the approximately 700 teachers who responded to the survey, 28 % indicated that they use digital games for instructional purposes at least twice per week, with 9 % indicating that they use such games daily. Moreover, another 16 % indicated that they use instructional games once per week, bringing to 44 % the total percentage of teachers in the survey who indicated that they used digital games in the classroom at a minimum of once per week.

In the business arena, a recent survey (American Society for Training and Development 2014a, b) revealed that 20 % of more than 550 companies use educational games to facilitate learning, and that another 37 % were planning to do so within 1 year. However, 38 % of the respondents also indicated that they felt that effectiveness of such games had only a moderate effect on learning and performance within their organization, with another 11 % indicating that such games had little or no effect. These findings present yet another challenge for instructional designers: how can we design educational games so as to facilitate the transfer of skills from the game environment to "real world" business-related tasks? One obvious solution, which oftentimes is not easy to implement, involves making sure that the skills necessary to succeed in a particular educational game are closely related to the job skills individuals are expected to learn from playing the game.

11.7 Trend #6: Mobile Learning

Mobile learning can be defined as learning that is supported by mobile devices, items such as smartphones, tablets, and e-readers. Such devices are frequently being used to support learning within businesses, higher education, and K–12 education. In the business world, a report by the eLearning Guild (Quinn 2012) indicates that in 2012, of approximately 800 organizations responding to a survey regarding the use of mobile devices to present content to their workers, approximately 39 % of those organizations indicated that they had either implemented the use of such devices ($\sim$16 %), were in the process of doing so ($\sim$12 %), or were building a business case for such an effort ($\sim$11 %), whereas in the previous year only 28 % of the organizations were at any of those three stages.

In higher education, the EDUCAUSE Center for Analysis and Research recently conducted a study involving administrators at approximately 300 colleges and universities (Grajek 2014), and the results revealed that these leaders anticipate fast growth in the use of mobile devices for the delivery of online courses. Whereas in 2013, only 19 % of the online courses offered by these institutions were accessible by mobile devices, the administrators indicated that by the 2016–2017 academic year they anticipated that 51 % of the courses would be accessible via such devices.

Perhaps the most surprising finding regarding the use of mobile devices to support learning came from a survey of almost 42,000 K–12 teachers (Project Tomorrow 2015); approximately 47 % of those teachers indicated that their students have regular access to mobile devices in their classrooms. Moreover, 77 % of the respondents indicated that one of the greatest benefits of using mobile devices in the classroom is that it increases student engagement in learning. However, 76 % of the teachers also indicated that one of the biggest challenges faced by those who use mobile devices as tools for learning is the potential that mobile devices have for distracting students away from focusing on learning tasks. This situation presents a challenge for instructional designers: when learners or workers use mobile devices that are intended to support learning and/or performance, what can we do to reduce the distracting influences presented by those devices?

11.8 Trend #7: Massive Open Online Courses

Massive Open Online Courses (usually referred to as MOOCs) are free online courses or programs, usually offered by institutions of higher education, that are designed for the participation of large numbers of geographically dispersed students, oftentimes from all over the world (TechTarget 2015). There are several major providers of MOOCs, and currently two of the largest are Coursera and edX. As of June 2015, Coursera, which originated at Stanford University, had more than 115 university partners offering more than 1000 courses; and edX, which originated at Harvard University and the Massachusetts Institute of Technology (MIT), had more than 50 university partners and greater than 500 courses.

While most businesses have not developed their own MOOCs, a substantial percentage of them do encourage their employees to enroll in MOOCs in order to gain some skills and knowledge the organizations feel will enhance the learning and performance of those individuals. For example, a recent survey of approximately 525 business organizations (Association for Talent Development 2014) revealed that 22 % of them use MOOCs as part of their learning and development program.

In higher education, the data regarding the use of MOOCs is somewhat surprising, given the large number of major institutions that have teamed up to help create MOOCs and the excitement that surrounded MOOCs when they first became popular in 2012. In particular, a recent study by the Babson Group (Allen and Seaman 2015) revealed that in 2014 only 8 % of the approximately 2800 responding institutions indicated that they were currently offering one or more MOOCs. Moreover, approximately 45 % of those institutions indicated that they had no plans to offer MOOCs in the future. Given the tepid growth of MOOCs in higher education, instructional designers interested in helping to plan MOOCs face a number of challenges. Among these are what sorts of instructional activities and learner support tools can be built into MOOCs so as to reduce the high dropout rates, recently estimated to be about 85 % (Jordan 2015), that are common in these types of courses?

11.9 Trend #8: Learning Analytics

Learning analytics, sometimes dubbed "big data," can be defined as the collection and analysis of data about learners for the purpose of understanding and optimizing learning (Society for Learning Analytics Research 2011). This approach to enhancing instruction and learning is gaining a strong foothold in higher education. A 2012 EDUCAUSE survey of more than 330 colleges and universities revealed that 28 % of them had identified the use of learning analytics as a major institutional priority and that another 41 % indicated that some of their departments, but not their entire institution, considered this approach as major priority (Bichsel 2012).

Within the business world, a recent survey of more than 400 businesses (American Society for Training and Development 2014a, b) revealed that 22 % of the more than 400 participating organizations were leveraging learning-related big data, and that another 20 % were planning to do so within 1 year. However, 38 % of the respondents indicated that their organizations were not very effective at analyzing big data. This finding presents yet one more challenge for instructional designers: how can we better identify the data that should be collected, and how can we make better use of that data in order to improve learning and performance within an organization?

11.10 Conclusion: The Expanding Toolbox

Back in the mid-1970s, when I obtained my doctoral degree in what was then called the field of "educational technology," my set of instruction design skills was rather small, consisting primarily of my ability to employ a systematic instructional design process in order to help solve learning problems. However, in the subsequent four decades a variety of trends have had a significant influence on the instructional design field. In this paper I focused on eight of those trends, all but two of which (performance improvement and performance support) have become prominent during the current century.

The advent of the trends described in this paper, as well as many others (e.g., informal learning, the flipped classroom, the learning sciences, and open educational resources, as well as many more), presents current-day and future instructional designers with many opportunities and challenges, some of which have been mentioned in this paper. One not previously mentioned is that it cannot be expected that current-day and future instructional designers will be proficient in employing all of the aforementioned trends. However, I believe that most of the instructional designers being trained today should acquire an adequate set of skills related to several of the trends discussed in this paper; in other words, these designers are likely to have a much larger set of tools at their disposal than I did when I obtained my degree in this field.

With their larger set of tools, future instructional designers should have a greater likelihood of finding the appropriate tools to solve a wide variety of learning and performance problems. And, having identified and properly employed the appropriate tools, designers will have a greater likelihood of facilitating the learning and performance of the members of their target audiences. In turn, this outcome should lead to greater professional success for designers. I sincerely hope that this will be the case for you!

Acknowledgments I would like to sincerely thank Fabrizio Fornara and Weinan Zhao, doctoral students in the Instructional Systems program at Florida State University, for their assistance in gathering most of the survey reports identified in this paper, and for identifying most of the key pieces of data described herein. Without their able assistance, this manuscript would not have been possible.

References

Allen, I.E., & Seaman, J. (2015) *Grade level: Tracking online education in the United States.* Retrieved from http://www.onlinelearningsurvey.com/reports/gradelevel.pdf

Allen, I.E., & Seaman, J. (2014) *Grade change: Tracking online education in the United States.* Retrieved from http://www.onlinelearningsurvey.com/reports/gradechange.pdf

American Society for Training and Development. (2014a). *Playing to win: Gamification and serious games in organizational learning*. Alexandria, VA: Author.

American Society for Training and Development. (2014b). *Big Data, Better Learning?: How Big Data Is Affecting Organizational Learning*. Alexandria, VA: Author.

Association for Talent Development. (2014). *MOOCS: Expanding the scope of organizational learning*. Alexandria, VA: Author.

Bichsel, J. (2012). *Analytics in higher education: Benefits, barriers, progress and recommendations.* Retrieved from http://net.educause.edu/ir/library/pdf/ers1207/ers1207.pdf

Dick, W., Carey, L., & Carey, J. O. (2014). *Systematic design of instruction* (8th ed.). Boston, MA: Pearson.

Foreman, S. (2015). *Learning and performance ecosystems: Current state and challenges.* Santa Rosa, CA: eLearning Guild.

Gery, G. (1991). *Electronic performance support systems*. Tolland, MA: Gery Associates.

Grajek, S. (2014). *Higher education's top-ten strategic technologies for 2014.* Retrieved from http://net.educause.edu/ir/library/pdf/ers1403.pdf

Jordan, K. (2015). *MOOC completion rates: The data.* Retrieved from: http://www.katyjordan.com/MOOCproject.html

Miller, L. (2012). *State of the industry report, 2012*. Alexandria, VA: ASTD.

Nyugen, F. (2012). Performance support. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.). Boston, MA: Pearson.

Project Tomorrow. (2015). *Project Tomorrow/Speak Up infographic: Mobile learning in the United States, 2014.* Retrieved from: http://www.tomorrow.org/docs/SU14MobileLearning_Infographic.pdf

Quinn, C.N. (2012). *Mobile learning: The time is now.* Santa Rosa, CA: eLearning Guild.

Reiser, R. A. (2012). *What field did you say you were in? Defining and naming our field.* In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.). Boston, MA: Pearson.

Seaman, J., & Tinte-Kane, H. (2013). *Social media for teaching and learning*. Retrieved from http://www.meducationalliance.org/sites/default/files/social_media_for_teaching_and_learning.pdf

Shute, V. J., Rieber, L. P., & Van Eck, R. (2012). Games…and…learning. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.). Boston, MA: Pearson.

Society for Learning Analytics Research. (2011). *Open learning analytics: An integrated and modularized platform.* Retrieved from http://www.solaresearch.org/OpenLearningAnalytics.pdf

Takeuchi, L. M., & Vaala, S. (2014). *Level up learning: A national survey on teaching with digital games*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

TechTarget. (2015). *Definition: Massive open online course (MOOC).* Retrieved from http://whatis.techtarget.com/definition/massively-open-online-course-MOOC

Chapter 12
Social Media: An Integration Guideline for Teaching and Learning in Higher Education

Wei Zakharov, Akesha Horton, Pat Reid, James Willis and Donalee Attardo

Abstract Today's students bring to class more than just a notebook and pencil. Using social media is now easier than ever before with a multitude of mobile apps and high speed internet, and most importantly, it is almost always free. In this study, researchers surveyed how instructors at Purdue University have used social media tools for personal, professional, and academic purposes. Specifically, we examined how instructors have used social media tools in support of teaching and learning. Issues instructors need to be aware of during implementation of social media for teaching and learning and practical guidelines for social media integration are discussed. Educational technologists as change agents have worked on the underlying issues to alleviate various barriers related to using social media tools in teaching and learning. Trust, privacy, and safety are critical to learning in an open education.

Keywords Social media · Guidelines · Issues · Barriers · Change agents

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The authors all worked together at Purdue Universitywhen this research was conducted

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12.1 Introduction

Social media, one of the hallmarks of early twenty-first century technological innovation, creates a number of open questions about the way people communicate, the speed at which ideas travel, and the future of internet-connected networks. Social media websites are redefining the limits of where one's virtual "presence" coincides or sometimes conflicts with one's "real" life. One of the more interesting divides in social media is that of users' attitude. There are some, like novelist Jonathan Franzen, who question the merits of social media in general. In a recent interview, he delivered a nuanced, yet rather scathing critique:

> It takes a while for artistic media to mature—I take that point—but I don't know anyone who thinks that social media is an artistic medium. It's more like another phone, home movies, email, whatever. It's like a better version of the way people socially interacted in the past, a more technologically advanced version. But if you use your Facebook page to publish chapters of a novel, what you get is a novel, not Facebook. It's a struggle to imagine what value is added by the technology itself (Lerner 2015, para. 41).

Yet, within education, some find value. Prominent researcher Reynol Junco demonstrates through controlled studies "evidence to suggest that students and faculty were both highly engaged in the learning process through communication and connections on Twitter" (Junco et al. 2011). Similar results are found with Facebook's use, but like Twitter, the platform must be used "…in ways that are advantageous to students" (Junco 2012).

Beyond reshaping society's norms and values, social media has tangible effects seen in everyday life, including the lives of today's college students. Today's students bring to class more than just a notebook and pencil. Many wield an assortment of digital tools, such as smart phones, tablets, netbooks, and notebooks that connect them to resources around the globe. These tools also enable students to engage in powerful social media networks, such as Facebook, YouTube, Instagram, Pinterest, Twitter, and LinkedIn.

Purdue University, a leading research institution, examined how faculty members use social media for academic, professional, and personal purposes. Purdue's division of Information Technology sought to understand faculty members' comfort in and rationale for using the tools in their teaching practice. This study also included social media tools that were developed internally for teaching and learning. For example, Mixable and Hotseat are tools designed at Purdue to enhance student engagement by facilitating social learning with course instructors and fellow students in various academic contexts.

Using social media is now easier than ever before with a multitude of mobile apps, high-speed internet availability, and most importantly, almost always free access. Measuring the impact of social media, especially across a large university where professors and students may reflect a wide range of attitudes toward academic, personal, and career use, is a difficult task. Several questions guided the development of a survey, including: How do instructors seize the opportunity to reach students through social media? What are the academic and administrative opportunities and challenges to integrating social media into teaching and learning? How can educational technologists address instructors' concerns and diffuse social media effectively for teaching and learning?

12.2 Method

12.2.1 Overview of Research Design

We used a mixed method's design to examine what social media tools instructors at Purdue University have used and how they have used them for personal, professional and instructional purposes. Specifically, the authors examined how instructors have used social media tools in support of teaching and learning and limitations and diffusion strategies related to using social media tools in their teaching practices. To address our research questions, survey data were collected in April and May, 2014. Data provided descriptive results. Open-ended question responses triangulated survey findings. Built upon that, the authors discuss the diffusion strategies the Educational Technologists in this institution have been using to facilitate faculty integration of social media for teaching and learning.

12.2.2 Participants

Data were collected in April and May in 2014 via an online survey. The authors used Purdue Today news (a daily e-newsletter to all faculty and staff) twice, Faculty Focus listserv (a monthly IT e-newsletter for faculty), and Wireless Wednesday users group listserv (an opt-in user group about pedagogy and technology) to call for participants among faculty on the Purdue University West Lafayette campus. A total of 126 faculty members visited the online survey web site and began the survey. Seventy-eight completed the survey and provided a sufficient number of responses to be included in the study.

12.2.3 Data Collection and Analysis

Faculty completed an online survey to identify information in demographics ($n = 4$ items), faculty personal use of social media ($n = 8$), faculty professional use of social media ($n = 8$), faculty teaching use of social media ($n = 31$), and mobile devices and platforms ($n = 3$). As for faculty teaching use of social media, there were 30 checklist question items on social media usage, divided among ten social media categories—number these—this will clarify that photos, video & multimedia are 1 category, not three blogs, wikis, maps (Geography), maps (Schematic), online forums, podcasts, SMS webcast/microblog, photos, videos and multimedia sharing, social networking sites, and virtual worlds. Open-ended questions were used to allow reflection of concerns and limitations related to using social media tools in their teaching practices. Data were used to provide descriptive results and open-ended answers were analyzed using a simple pattern-seeking method to identify commonalities among faculty responses, specifically related to faculty barriers and enablers to diffusion of social media into teaching and learning.

12.3 Results

12.3.1 Demographic Characteristics of Participants

Seventy-eight faculty members completed the survey. Below are demographics in Table 12.1, and Figs. 12.1 and 12.2.

Faculty personal use of social media is defined as usage without relationship to professional and/or teaching responsibilities. Results show that almost half of the respondents use Facebook daily. One quarter of the respondents use Twitter and YouTube daily. Facebook and YouTube are the most used social media tools in a faculty member's personal life. In this study, we find that female faculty use social media more than male faculty, as shown in Fig. 12.3.

Table 12.1 Demographic characteristics of faculty participants

N	Gender			Age				
	Female	Male	Prefer not to tell	Under 34	35–44	45–54	55+	Prefer not to tell
78	37	40	1	9	20	18	27	4

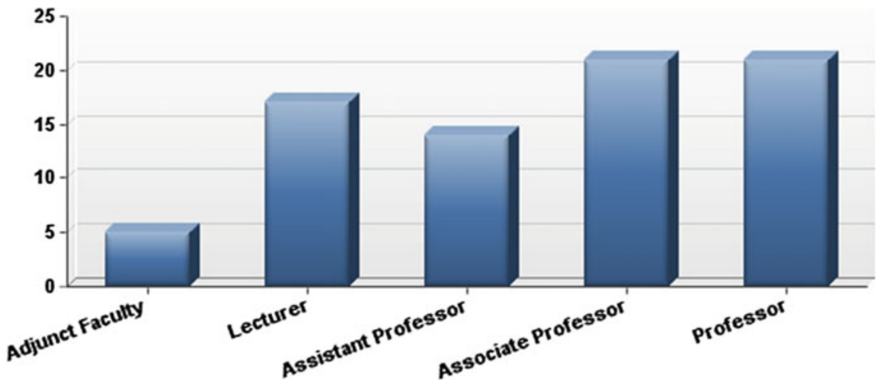


Fig. 12.1 Rank of faculty participants

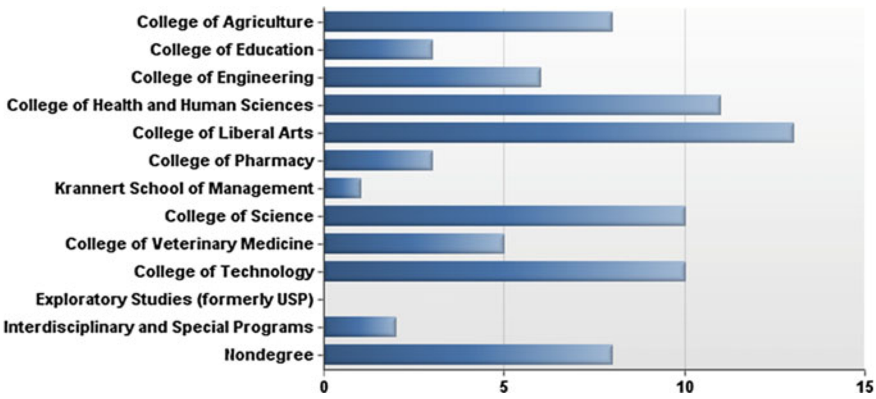
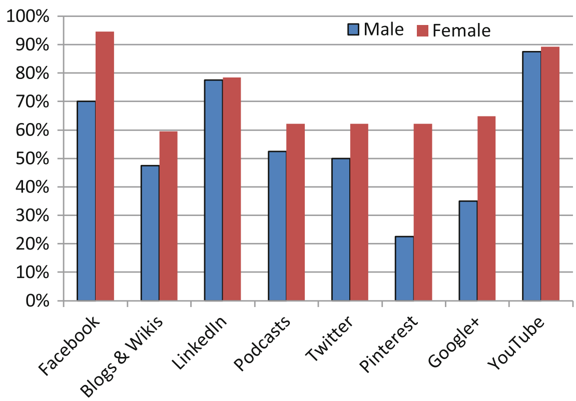


Fig. 12.2 College or school of faculty participants

Fig. 12.3 Use of social media by gender



Faculty professional use of social media is defined as nonteaching use, such as professional networking, administrative/departmental use, and usage NOT related to teaching or course activities. Our survey suggests that 72 % of faculty use YouTube on a weekly or monthly basis in their professional life. The majority of faculty reported that they make "at least monthly" use of social media such as LinkedIn, Facebook, podcasts, and blogs & wikis for professional purposes. Similar to faculty personal use of social media, female faculty use social media more than male faculty in their professional life in this study (shown in the below infographic). Among different age groups of faculty, faculty under 34 used LinkedIn and Facebook for professional purposes more than other ages as shown in Fig. 12.4.

Faculty instructional use of social media is defined as the use of social media for the purpose of teaching and learning. Using Godwin's (2008) Matrix of Web 2.0 technologies, we combined these ideas with functions commonly used in the process of teaching and learning, and organized the social media tools into ten categories—number these—this will clarify that photos, video & multimedia are 1

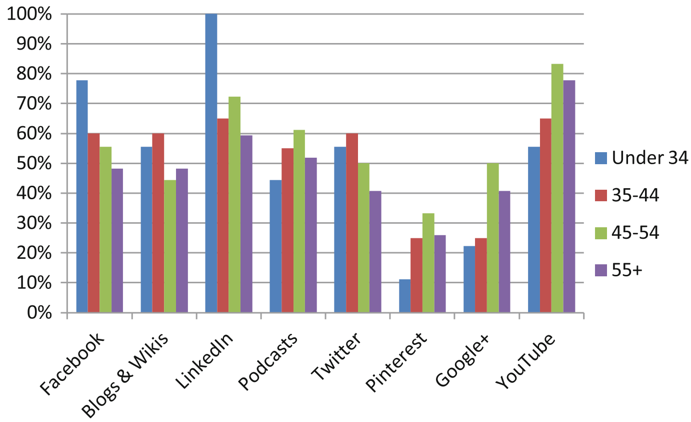


Fig. 12.4 Use of social media by age

category, not three blogs, wikis, maps (Geography), maps (Schematic), online forums, podcasts, SMS webcast/microblog, photos, videos and multimedia sharing, social networking sites, and virtual worlds. The three most used social media categories are photos, videos & multimedia sharing, social networking sites, and online forums. The least used are virtual worlds and maps (schematic).

The authors listed all the institution IT-supported tools and other popular tools under each category. For example, in the photos videos & multimedia sharing category, the institution supports Kaltura and Mixable. More than 80 % of respondents have been using some other tools like YouTube, Pinterest, Flicker, or Vimeo. In the social networking sites category, the institution supports an academic Facebook-like tool called Mixable. Currently 90 % of respondents use other tools like Facebook, Research Gate, or Spinchat. As for "Online forums", the institution supports BB Learn, Mixable, and Hotseat. Around 30 % of participants report using other tools like Piazza or CrowdAsk. Figure 12.5 presents the major findings.

12.3.2 External and Internal Barriers

When it comes to limitations related to using social media tools in faculty teaching practices, our survey results revealed both external and internal barriers for instructors to integrate social media for teaching and learning. External barriers related to the environment, technology, process, and administration place limitations on faculty ability to rely on social media. These are described in terms of the types of resources (e.g., equipment, time, training, support) that are either missing or inadequately provided in faculty implementation environments (Ertmer et al. 1999; Means and Olson 1997; Reid 2014). Research shows that time is the barrier most frequently cited by faculty. In this survey, the instructors ranked "takes too

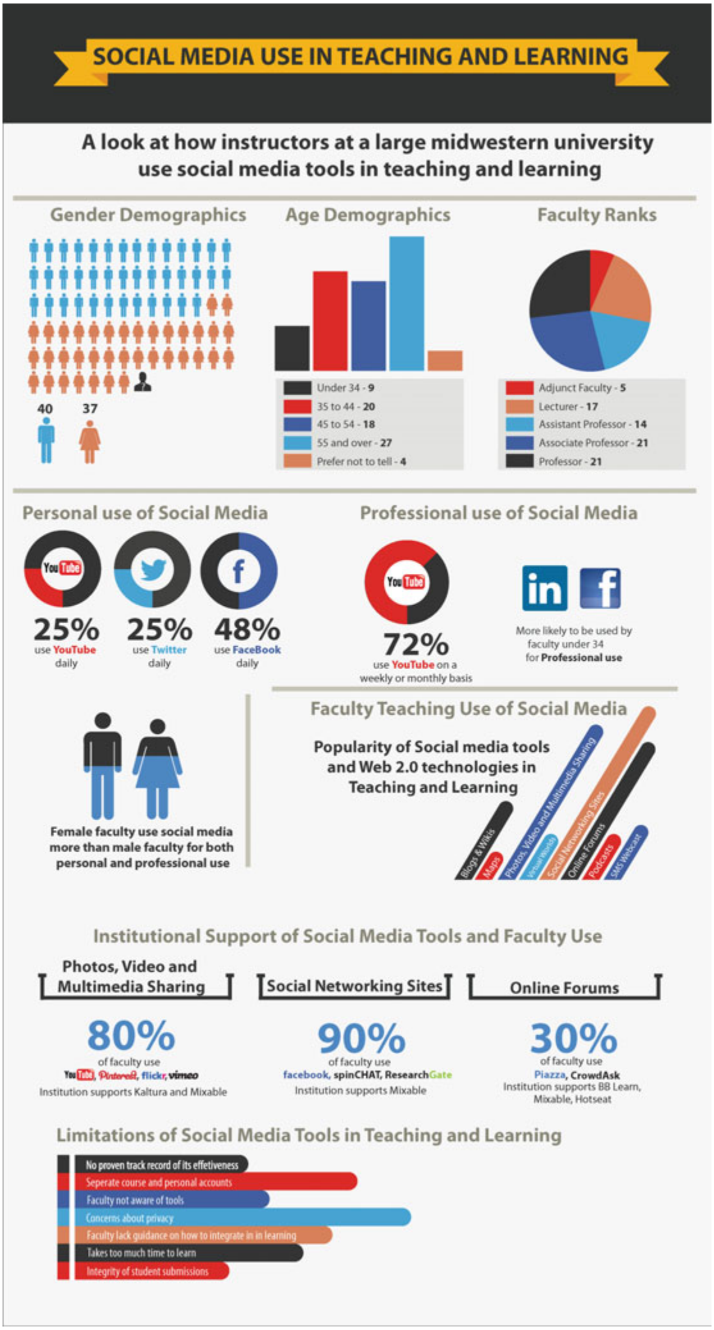


Fig. 12.5 Infographic displaying research findings

much time to learn or use" as their top limitation. Time is a particularly difficult barrier to overcome as it may mean time to learn, use, troubleshoot, or teach students; it may even mean lack of compensation for the time required (Reid 2014).

The faculty participants' written responses show that faculty lack awareness of many social media tools. Comments such as "I don't know what most of them are…" may indicate issues such as lack of support, lack of internal marketing of new technologies, resistance to change, and nonparticipation in professional development. Faculty may also lack guidance in how to integrate social media tools into teaching and learning in a sound pedagogical way. Faculty internal barriers are rooted in instructors' underlying beliefs about teaching and learning (Ertmer 2005; Kerr 1996; Reid 2014). The faculty ranked "concerns about privacy" and "integrity of student submissions" as their top limitations. This could indicate a potential legal barrier (such as security of FERPA data) or a lack of awareness of social media security measures.

In their written responses, extra concerns are identified. The instructors have doubts about the effectiveness of social media for teaching and learning.

> "I am unconvinced that any of these are sufficiently helpful to warrant the effort."
> "…not pedagogically sound or required for my field"
> "The value of using social media for my class is not clear to me. Much of social media seems to be entertainment, not education."
> "I don't want technology for the sake of technology…"
> "Can't see the practicality of using it".

Such attitudes are often a result of a lack of sound research, faculty disbelief in research results, and a lack of faculty awareness of research results (Reid 2014).

This complex interweaving of barriers increases the difficulty in faculty adoption of social media. As faculty can only be held responsible for a few of these barriers, the onus is on the university to remove as many barriers as possible. This falls within the areas of the academic technology support, information technology security, and administration.

12.3.3 Guidelines for Social Media Integration

In this section, we describe issues that faculty need to be aware of during implementation of social media for teaching and learning. Issues to be examined are related to HIPAA, FERPA, antiharassment, intellectual property, copyright, academic integrity, and inappropriate content. Practical guidelines for helping instructors to confront the various barriers are discussed in terms of defining objectives, identifying tools, obtaining training, monitoring content, assessing student learning, reflecting, and improving. In addition, recommendations are provided for institutions wishing to support faculty adoption of social media for teaching and learning.

Constructivism is a popular theoretical underpinning for many online and blended courses. Digital and social media tools provide access to a diverse array of information in a multitude of formats for the purposes of constructing knowledge. Swan et al. (2009) observe that "higher education has traditionally emphasized constructivist approaches to learning in the sense of individual students taking responsibility for making sense of their educational experiences" (p. 3). Constructivists believe that humans create meaning as opposed to acquiring it and that learning is a student-centered process. Angela (2011) explains that "the learning process is based on cooperation, collaboration; students learn through interaction with others, as a result of the discussions with others, the discussions having the role to conduct them to a better understanding and learning; the role of the teacher is to guide students to become actively involved in their learning" (p. 186). Constructivist strategies can be used to teach the "why" or "…higher level thinking that promotes personal meaning and situated and contextual learning" (Ally 2004, para. 14).

Shand (2011) discusses six categories of technologies to help promote teaching and learning. These categories can be applied to the use of social media tools in educational settings:

- Communication—used for both managerial and instructional purposes
- Presentation—allows students and teachers to create and show presentations offline
- Collection—allows both teachers and students to house a collection of links to important websites, primary sources, and music and art collections in one place
- Organization—used to provide scaffolding, guided practice, graphic organizers, timelines
- Collaboration—provides ability for student group work
- Interaction—allows students to grapple with content through tools that require critical thinking or application of knowledge.

Additionally, as students are encouraged to critically explore topics, social media tools can facilitate new methods of research. Emerging technologies encourage students to participate in deeper exploration of academic subject areas through social learning processes connected to collecting resources, gathering evidence, and assembling images, music, or videos. Using Godwin's (2008) Matrix of Web 2.0 technologies, we have combined these ideas with functions commonly used in the process of teaching and learning and added ideas that have appeared since Web 2.0 inception (Fig. 12.6).

Faculty need to be aware of appropriate use of social media. Some of the uses and important considerations are discussed below.

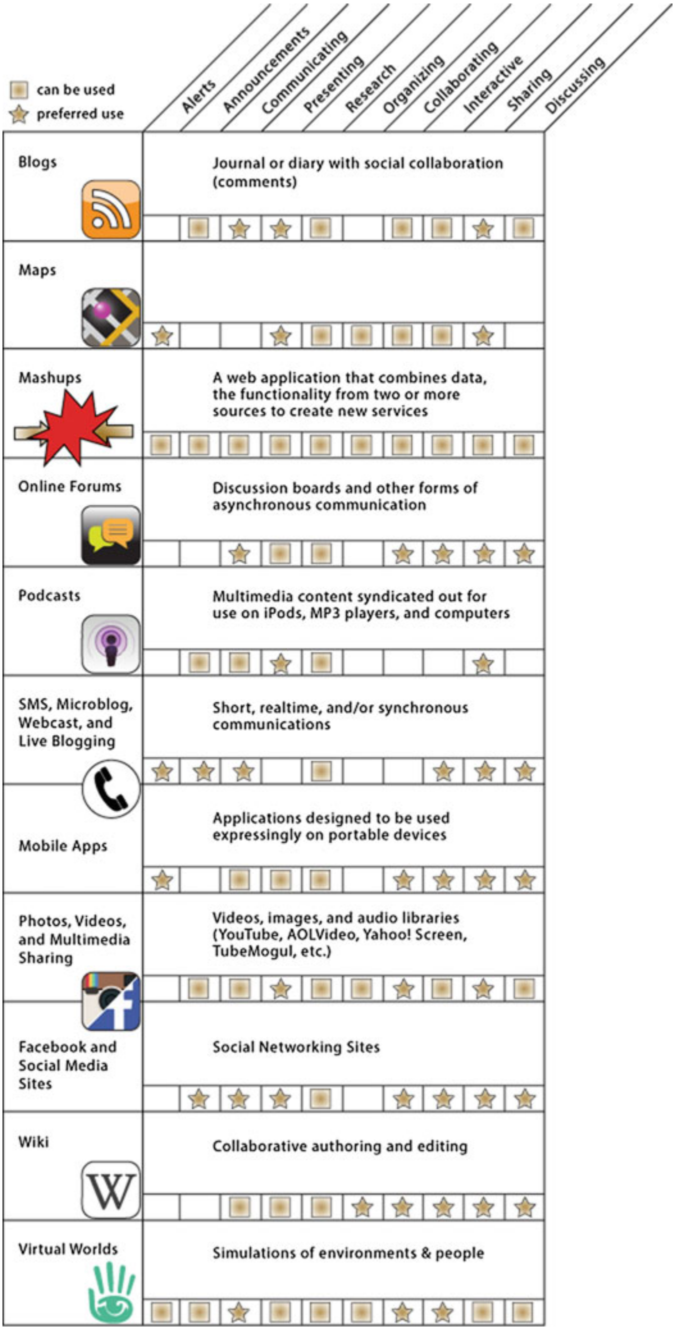


Fig. 12.6 Web 2.0 technologies matched to common teaching and learning processes

12.3.4 Curating Content

A frequent issue faculty face in using social media is uncertainty in how to manage student contributions. These contributions can provide a number of challenges. Procedures should be in place to monitor the class-related social media site(s) for questionable or inappropriate activity. The account administrator (frequently this is the faculty member. However, with courses that have large enrollments this may be a course manager or a grad student) would typically be responsible for such monitoring, but students may share in this task. Faculty set the roles of each person, communicating what settings/functions are appropriate to use based on the given assignment.

A beginning checklist for curating content includes the following:

Intended audience

- Who can originate conversations? Who is the audience for each content producer or communicator?
- How does this frame the structure of the communications or interactions?
- Who has access?
- Is it restricted to the course participants?
- Is there a plan for including outside participants? For example, will the faculty survey the social media landscape for the "thought leaders" in the field to determine what people are already saying?
- List the topics, people and sites that are leading the conversations that are relevant to you. Is it appropriate to include them in the conversation in the class?

Methods to monitor, moderate, comment

- How do you conduct yourself?
- How do you interact with your students?
  - How do you write or submit information in this format?
- How do your students interact with you?
  - What policies, protocols, or norms have you established for them?
  - How do you define appropriate and inappropriate content?
- How do your students interact with each other?
- In what ways (if any) does your class interact with an audience outside of your class?

Content management

- How do you capture data generated via social media tools?
- What type of data can you ask students to share via social media tools?
- Content and the source

  - Is it primarily news updates, research developments, or networking information? Photographs? Video?
- Who is generating content? Where is the content hosted? How will people access content shared via these sources. How long will they have access to content?

Answering these questions will support the faculty member in identifying the appropriate technology and supporting appropriate use.

An additional consideration in curating content is ensuring that the content follows legal guidelines. Students may assume that a social media tool is less formal and therefore may not consider issues such as copyright, intellectual property, academic integrity, student privacy, and harassment. Faculty using social media need to be aware of and able to manage these issues without decreasing the effectiveness of the media.

12.3.5 Copyright

A faculty member must know the copyright status of the material being used for teaching and learning in their course. Put simply, students and faculty should not post materials for which they do not own the copyright. Social media postings, including those required for class purposes are covered by the same copyright considerations as any other form of publication. Posting links to those copyrighted online resources is usually acceptable, as is providing the same contribution information as students would use in a written paper. Faculty may wish to inform students that copyright restrictions apply to postings to social media sites. This could be accomplished with a syllabus statement or an identified link to the appropriate campus policy on the use of copyrighted materials. An example can be viewed at https://www.copyright.com/Services/copyrightoncampus/compliance/policy_sample.html.

An alternative to using copyrighted work would be using Open Educational Resources as well as Creative Commons work. The Educause Learning Initiative (ELI) defines Creative Commons as an alternative to traditional copyright, developed by a nonprofit organization of the same name. Creative Commons allows copyright owners to release some of those rights while retaining others, with the goal of increasing access to and sharing of intellectual property. Creative Commons can be described as a legal development that is meant to be a social movement, as it offers an alternative to traditional copyright laws. ELI explains that supporters of Creative Commons believe that social media technologies have superseded current copyright law, and that creative commons offers more flexibility to content producers working with these tools. Specifically, according to the Creative Common's website (http://creativecommons.org/licenses):

> Creative Commons licenses give you the ability to give express permission for others to use your copyrighted works—such as the right of others to copy your work, make derivative works or adaptations of your work, to distribute your work and/or make money from your work. They do not give you the ability to restrict anything that is otherwise permitted by exceptions or limitations to copyright—including, importantly, fair use or fair dealing—nor do they give you the ability to control anything that is not protected by copyright law, such as facts and ideas (Creative Commons licenses).

While Creative Commons can be applied to the same types of work traditional copyrights can be applied to, such as books, scripts, websites, lesson plans, blogs, and any other forms of writings; photographs and other visual images; some compilations of data; films, video games and other visual materials; musical compositions, sound recordings and other audio works, it is recommended that users not apply a Creative Commons license to software, since Creative Commons does not explore the legalities associated with source or object code, and Creative Common licenses are not compatible with the General Public License (GPL), the most frequently used free software license.

At the heart of Creative Commons is the idea of Share Alike—which, as Creative Commons states, “If you alter, transform, or build upon this work, you may distribute the resulting work only under the same or similar license to this one” (Creative Commons licenses—Share Alike). It also enforces attribution rights. This means that if any percentage of a work under a Creative Commons license is used, one must provide attribution to the original creator of the work through Copyright management information, which identifies the work to the author, as well as the terms and conditions for use.

12.3.6 Intellectual Property

Postings to social media sites for class purposes are governed by the same intellectual property considerations as any other form of publication. It is important that faculty members understand and are aware of the intellectual property definitions and terms of use at their institution.

12.3.7 Violations of Academic Integrity

Students’ postings on social media sites as part of a class assignment are bound by the same rules of integrity as students’ submitted work in any other medium. It is suggested that information about academic integrity be placed in the syllabus along with a clear statement that both the spirit and the letter of these guidelines apply to social media postings made to class sites.

12.3.8 Protecting Student Privacy

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) rules create a framework to protect the privacy and security of patients' and health plan members' health information. Any faculty member or student with legal access to protected health information should receive training on handling HIPPA sensitive data. If they use social media in your class, and if they have reason to believe that they might have individuals in their class that could have access to protected medical information, it is important to be aware of as well as inform students about protocols related to HIPPA.

The Family Educational Rights and Privacy Act FERPA (20 U.S.C. § 1232g; 34 CFR Part 99) is a Federal law that protects the privacy of student education records. Orlando (2011), offers the following suggestions related to FERPA and the use of social media:

- When students are assigned to post information to public social media platforms outside of the university LMS, they should be informed that their material may be viewed by others.
- Students should not be required to release personal information on a public site.
- Instructor comments or grades on student material should not be made public. (Interestingly, grades given by other students on "peer-graded" work can be made public under FERPA) (ACE 2008).
- While not clearly required by law, students under the age of 18 should get their parent's consent to post public work.

FERPA does not forbid instructors from using social media in the classroom, but common sense guidelines should be used to ensure the protection of students.

12.3.9 Antiharassment

According to Purdue's official policy on Antiharassment found at http://www.purdue.edu/policies/ethics/iiic1.html, harassment is:

"Conduct towards another person or identifiable group of persons that has the purpose or effect of:

1. Creating an intimidating or hostile educational environment, work environment or environment for participation in a University activity;
2. Unreasonably interfering with a person's educational environment, work environment or environment for participation in a University activity; or
3. Unreasonably affecting a person's educational or work opportunities or participation in a University activity.

Use of the term Harassment includes all forms of harassment, including Racial Harassment and Sexual Harassment."

Instructors using social media in their class should post a definition of harassment in the syllabus and include language that this definition covers social media activity as well. Higher education institutions interested in supporting faculty in the use of social media can provide faculty with a variety of supports, most obviously, by providing information about the above topics of antiharassment, student privacy requirements, copyright, etc. This information should include not just the legal requirements, but training and/or support in managing issues that arise.

In addition, institutions can review how to best make social media available for instructional use. Administrative, technology, process, and environmental barriers need to be reviewed to provide a positive environment for faculty using social media. For example:

1. Is the technology readily available to the students and faculty in the location(s) needed?
2. Is the social media technology and the underlying infrastructure reliable? Can the faculty member feel confident that the tool(s) will be available when and where needed?
3. Is appropriate training and support available that addresses both the technical and pedagogical use of the tool(s)? And, is this available when and where the faculty need it?
4. Are rewards and/or compensation available for faculty adopting these technologies?

Emerging research indicates that faculty adoption of social media can improve student learning. However, it is not an easy process for faculty. Faculty members venturing into this unknown territory require additional skills and knowledge. Higher educational institutions moving toward social learning will want to address many of the barriers to adoption to support faculty.

12.4 Discussions

Although faculty identified barriers specifically as time, lack of access, and lack of awareness, usually these have underlying issues which must be resolved (Reid 2014). Categories of barriers (Reid) outside faculty control which influence faculty adoption include

- Technology barriers such as access, reliability, and complexity,
- Process barriers such as support and professional development,
- Administrative barriers such as compensation and time requirements, and
- Environmental barriers such as legal issues and technology effectiveness.

At Purdue University we have worked on the underlying issues to ensure that faculty adoption (or lack of adoption) is within their control. Although we have not completely eliminated all the barriers, we have made a good start.

12.4.1 Technology Barriers

12.4.1.1 Wireless Access and Reliability

Although our purpose was not specifically to improve social media access, our wireless network has been strengthened to improve student and faculty use of social media in all classrooms. Areas of difficulty have historically been the very large classrooms and some underground rooms. However, in summer 2014, Hotseat was used to gather incoming freshman responses to questions. With thousands of students all using Hotseat almost simultaneously, students had no problems sending responses via smart phones, tablets, and laptops.

12.4.1.2 Tool Access, Reliability and Complexity

Purdue-developed social media tools such as Hotseat and Mixable are designed to reflect common features of external social media tools. This has decreased the faculty and student learning curve. They are also designed for all major platforms. Students are auto-enrolled in the space and only connect with classmates in the same class. This blends students' social and academic lives into a more engaged learning environment.

12.4.2 Process Barriers

12.4.2.1 Support

In addition to Purdue-built tools, Information Technology at Purdue (ITaP) identifies tools to support teaching and learning. For each of these, knowledge base articles related to social media for academic use are written for common issues (for example, https://www.itap.purdue.edu/learning/innovate/hdiseries/socmedia.html), and a series of web pages provide a description of the tool, access information, applications for teaching and learning, and ease-of-use information.

In addition, our Help Desk provides first level support to all faculty, students, and staff. Calls specific to academic technologies which they cannot answer are referred to our second tier support within our academic technologies area (the Instructional Design Center or IDC). The IDC also has a team of educational technologists who work one-on-one with faculty on resolving technology issues, frequently going to the instructor‘s office or classroom.

12.4.2.2 Professional Development

Although many colleges and universities offer professional development (PD) to faculty on technology use, "PD is often considered ineffective; faculty are not learning the technologies and then adopting them" (Reid 2014). At Purdue, we have attempted to overcome this by offering a variety of PD approaches and types:

1. We hold workshops which focus on how to use a specific technology. However, instead of leading the workshop, we provide participants with step-by-step instructions for common tasks and walk around the room to support people with questions. These instructions are also available online.
2. We find that instructors prefer to hear about tool-use from another faculty member. To this end, in the faculty/staff newsletter we publish articles which focus on a specific instructor and how s/he is using a tool.
3. Shortly after these faculty-focus articles appear, we hold a lunch or breakfast-time session (food provided) where the faculty member (and perhaps others) demonstrate the tool. If appropriate, we also have demonstrations of other tools available and instructors can walk around to explore the different tools, talking with other faculty and with support staff about them.
4. We provide users' groups for many of our tools to gather interested faculty and faculty users together to share ideas about the technology, demonstrate new features, and often view demonstrations of how our faculty use the tools for teaching and learning.
5. We provide web pages with an overview of each tool, access information, training information, any faculty articles about the tool (see 2 above), basic information about pedagogical uses, etc.
6. The Purdue IMPACT (http://www.purdue.edu/impact/) program provides an intensive semester-long series of workshops and learning communities focusing on instructional design for active learning. Faculty members receive a stipend for attending and redesigning a course. Support staff work with faculty to identify and incorporate technology to support active learning.
7. The IDC provides student trainers who offer training on tools an instructor has assigned. These student trainers also provide in-class training at an instructor's request.

12.4.3 Administrative Barriers

12.4.3.1 Compensation and Time Requirements

Probably the most frequently mentioned issue by faculty when adopting technology is time. In this study, as in many others (Reid 2014), the instructors ranked "takes too much time to learn or use" as their top limitation. However, in this comment, "time" could refer to time required to:

- identify a pedagogical issue and the appropriate technology to resolve it,
- learn the technology
- obtain the technology
- set up the technology before and during class
- teach and support the students in use, etc.

Faculty members are typically not compensated for using technology in the classroom. Faculty interested in adopting social media must, therefore, eliminate something else from their schedule to have the time to learn, practice, and adopt. At Purdue, we have tried to minimize the time issue by providing support on a variety of days and using a variety of methods (detailed more in Professional Development above).

12.4.4 Environmental Barriers

12.4.4.1 Legal Issues

The most common legal issue in use of social media relates to FERPA requirements. At Purdue, we have built access to many social media tools via Blackboard. This requires secured authentication minimizing the possibility of disclosure of student information. Purdue app developers also consider legal issues during development. For instance, Hotseat allows students to post anonymously; although faculty members can determine who posted, other students cannot. Hotseat also provides a communication method for those students who need time before responding. Figure 12.7 shows a Mixable FERPA statement and waiver agreement.

12.4.4.2 Technology Effectiveness

A lack of research on the effectiveness of technology also impacts faculty adoption (Reid 2014). At Purdue, as mentioned above, we publish articles in the faculty/staff newsletter. These articles focus on a specific instructor and how s/he is using a tool. We also encourage research into technology and pedagogy (SoTL-Scholarship of Teaching and Learning). This support is available through our Center for Instructional Excellence (CIE) and our research areas. CIE staff often meet with instructors to discuss how to determine effectiveness of new approaches. In addition, as part of the IMPACT program, instructors work with support staff over time to answer a specific research question. IDC members have worked with instructors on research and publication on how a specific technology has impacted student learning.

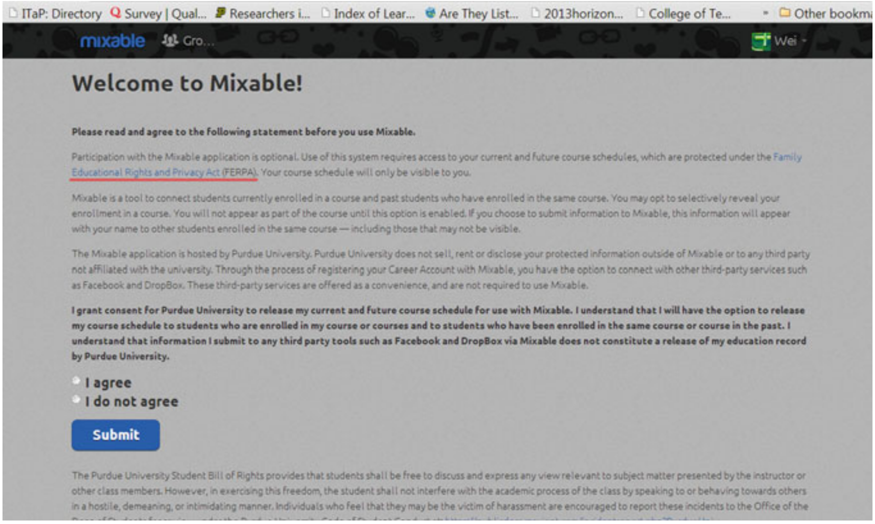


Fig. 12.7 Mixable user agreement. From https://www.purdue.edu/mixable/Home/SiteWaiver. Accessed 3/30/15

12.5 Conclusion

Social media has redefined education for faculty in higher educational settings in various ways. It has rapidly opened up new avenues for collaboration and communication between faculty and students. Further, educators in blended and online environments can leverage the affordances of social media to strengthen online communities as well as foster student-centered active learning spaces. While social media has transformed the possibilities for learning in higher education, Selwyn (2011) notes, "…many higher education institutions (and educators) now find themselves expected to catch up with this world of social media applications and social media users" (p. 1). As a result, faculty interested in integrating social media into their teaching practice must think through how social media can be used for the purposes of teaching and learning in a safe and efficient manner. Additionally, institutions of higher learning must support faculty in overcoming barriers to adoption and ensure student data and privacy are secure as faculty and students connect through social networks and cloud-based services.

In conclusion, we examined how instructors have used social media tools in support of teaching and learning, described issues instructors need to be aware of during implementation of social media for teaching and learning, provided guidelines for social media integration, and identified how educational technologists as change agents have been working to address various barriers to ensure faculty integrate social media into teaching and learning effectively. Lessons taken from our study will also help other practitioners who may want to follow or build upon what has already been done here.

References

Ally, M. (2004). *Foundations of educational theory for online learning. Theory and practice of online learning*. Athabasca: Athabasca University.

Angela, T. (2011). A constructivist approach to new media: An opportunity to improve social studies didactics. *Procedia Social and Behavioral Sciences, 11*, 185–189.

Creative Commons licenses. (n.d.). Retrieved March 26, 2015, from http://creativecommons.org/licenses/.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25–39.

Ertmer, P., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education, 32*(1), 54–72.

Ethics: Anti-Harassment (III.C.1). (5/16/2014). In *Purdue University Policies.* Retrieved from http://www.purdue.edu/policies/ethics/iiic1.html.

Godwin, B. (2008). Matrix of web 2.0 technology and government. Retrieved from http://www.howto.gov/sites/default/files/documents/Web_Technology_Matrix.pdf.

Junco, R. (2012). The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. *Computers & Education, 58*(1), 162–171.

Junco, R., Heiberger, G., & Loken, E. (2011). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted learning, 27*(2), 119–132.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons, 53*(1), 59–68.

Kerr, S. T. (1996). Visions of sugarplums: The future of technology, education, and the schools. In S. T. Kerr (Ed.), *Technology and the future of schooling: Ninety-fifth yearbook of the National Society for the Study of Education, (part 2)* (pp. 1–27). Chicago: University of Chicago Press.

Kukulska-Hulme, A. (2012). How should the higher education workforce adapt to advancements in technology for teaching and learning? *Internet and Higher Education, 15*(4), 247–254.

Lerner, S. (2015). A conversation with Jonathan Franzen. *Booth: A Journal*. Online blog. Retrieved from http://booth.butler.edu/2015/02/13/a-conversation-with-jonathan-franzen/.

Means, B., & Olson, K. (1997). *Technology and education reform: Studies of education reform*. Washington, DC: U.S. Government Printing Office.

Mixable Site Waiver. (2015). In Mixable. Retrieved from https://www.purdue.edu/mixable/Home/SiteWaiver.

Orlanda, J. (2011, February 7). FERPA and social media. Retrieved April 1, 2015, from http://www.facultyfocus.com/articles/teaching-with-technology-articles/ferpa-and-social-media/.

Reid, P. (2014). Categories for barriers to adoption of instructional technologies. *Education and Information Technologies,* 19-2 (June). Retrieved from http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10639-012-9222-z.

Scott, P. R., & Jacka, J. M. (2011). *Auditing social media: A governance and risk guide*. John Wiley & Sons.

Selwyn, N. (2011). Social media in higher education. In A. Gladman (Ed.), *The Europa World of Learning* (pp. 1–9). London, UK: Routledge.

Shand, K. (2011, November 8). Planning with technology in mind. Retrieved April 1, 2015, from http://engage.intel.com/thread/9167

Smith, C. M., & Sodano, T. M. (2011). Integrating lecture capture as a teaching strategy to improve student presentation skills through self-assessment. *Active Learning in Higher Education, 12*(3), 151–162.

Swan, K., Garrison, D. R., & Richardson, J. C. (2009). A constructivist approach to online learning: the Community of Inquiry framework. In C. R. Payne (Ed.), *Information technology and constructivism in higher education: Progressive learning frameworks* (pp. 43–57). IGI Global: Hershey, PA.

Yen, C., & Abdous, M. (2011). A study of the predictive relationships between faculty engagement, learner satisfaction and outcomes in multiple learning delivery modes. *International Journal of Distance Education Technologies, 9*(4), 57–70.

Chapter 13
An Instructional Design Model for Information Science

Robert Maribe Branch

Abstract Effective instructional design models facilitate active, multi-functional, inspirational, situated approaches to intentional learning. Instructional design is an iterative process of planning performance goals, selecting strategies, choosing media, and conducting evaluation. Proper instructional design is fundamentally student centered, responsive, generative, complex, innovative, authentic, a collaborative process, practical, and inspirational. Good instructional design promotes activities that are creative, systematic, systemic, and cybernetic. Models help us conceptualize representations of reality. A model is a simple representation of more complex forms, processes, and functions of physical phenomena or ideas. Models of necessity simplify reality because often it is too complex to portray and because much of that complexity is unique to specific situations. Although instructional design is a social construction, complexity as a fundamental principle tends to be

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underestimated, over-simplified, and otherwise insufficiently addressed in many instructional design models. Information is part of the data-information-knowledge continuum with the aim of creating, replacing, improving, or understanding information systems. Information science professionals study and apply the effective use of knowledge within organizations as well as the interaction between people, organizations, and information systems. Information science provides ways to analyze, collect, organize, store, and retrieve data. Therefore, an appropriate instructional design model can facilitate the transition of data to information, and, subsequently, the construction of knowledge. A basic instructional design model for information science is introduced in this paper.

Keywords Design · Teaching · Learning · Instruction · Information · Complexity · Student centered · Instructional design · Model

13.1 Introduction

This paper examines the relationship between information science and instructional design. Instructional design "is the science and art of creating detailed specifications for the development, evaluation, and maintenance of situations which facilitate learning and performance" (Richey et al. 2011, p. 3). Instructional design models facilitate active, multi-functional, inspirational, situated approaches to intentional learning. While information is "the communication or reception of knowledge" (Taylor 2004, p. 3), information science is an interdisciplinary approach to the analysis, collection, classification, manipulation, storage, retrieval, and dissemination of information (Stock and Stock 2013). Therefore, instructional design models should foster the dissemination of information and the exchange of knowledge. This topic is important for school educators at all levels, learning service professionals in business and industry, and government personnel responsible for the construction of knowledge and skills.

13.2 Instructional Design

Instructional design is an iterative process of planning performance objectives, selecting instructional strategies, choosing media, selecting or creating materials, and evaluation. Instructional design centers on individual learning, has immediate and long-range phases, is systematic, and uses a systems approach about knowledge and human learning. Instructional designers should work backwards from desired outcomes. Several educational technology researchers have offered commentaries about instructional design. Merrill et al. (1996) stated that instructional design is a set of scientific principles and technology for implementing these principles boldly reclaimed the technology of instructional design that is built upon the rock of instructional science. Rowe (1987) contended that in almost all cases the step beyond description into a normative realm in which process became pursued as an end in itself resulted in abject failure. Attempts to devise *the* process became exercises in inanity when compared to the great subtlety and profundity of observed problem-solving behavior. Goel and Pirolli (1992) considered design as a space, rather than a process, which exhibits a number of invariant features that distinguish it from other forms of problem solving.

The above commentaries notwithstanding, instructional design is founded upon the concept of product development. Instructional design applies the product development concept for constructing performance-based intentional learning environments. Instructional design is fundamentally student centered, responsive, generative, complex, innovative, authentic, a collaborative process, practical, and inspirational.

Instructional design is about designing for students first. The teaching and learning concept of instructional design moves away from designs that encumber didactic, limiting, passive, singular modes of teaching, and instead move toward designs which facilitate active, multifunctional, inspirational, situated approaches to intentional learning. The instructional design process responds to situations that can be attributed to a lack of knowledge and skills. The instructional design process accepts whatever goals are identified as the first step in the process. Therefore, educators and other instructional designers need to, first, identify the curriculum or course goals before initiating any kind of instructional design as a response to the lack of knowledge and skills. Good instructional design promotes activities that are creative, systematic, systemic, and cybernetic. Each of these four entities contributes to the production and reproduction capacity of the instructional design process, and is thus generative. Although instructional design is a social construction, complexity as a fundamental principle tends to be underestimated, over-simplified, or otherwise insufficiently addressed in many instructional design models. Complexity theory is described as having five attributes: (1) independent complicated entities, (2) multiple entities contained within, (3) the entities within perform interrelated functions, (4) seeks a common goal, and (5) uncertainty (Ni and Branch 2008). Indeed, instructional design possesses all five attributes. The process of instructional design is a collaboration among a design team, clients, sponsors, primary stakeholders, and secondary stakeholders. Collaboration can be understood on a multitude of levels for instructional design processes and practices. There are considerations to be made for collaboration in terms of the roles, the content, and the philosophical perspectives in instructional design. Effective instructional design focuses on performing authentic tasks, complex knowledge, and genuine problems. Thus, effective instructional design promotes high fidelity between learning environments and actual work settings. High fidelity between learning and work environments is accomplished by instructional design through emphasis on measurable outcomes. The models produced from various applications of instructional design serve as conceptual, management, and communication tools

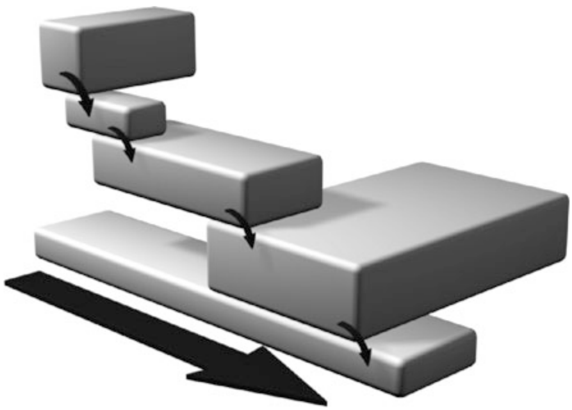

Fig. 13.1 Visualization of the instructional design process

for analyzing, designing, creating, and evaluating guided learning ranging from broad educational environments to narrow training applications. Figure 13.1 conceptualizes the majority of instructional design processes.

13.3 Instructional Design Models

While models provide the conceptual reference, they also provide the framework for selecting or constructing the operational tools needed to apply the model. Operational tools such as PERT charts, nominal group techniques, task analysis diagrams, lesson plan templates, worksheets for generating objectives, and production schedule templates contextualize the instructional design process, which makes instructional design a practical approach to addressing educational problems that are due to a lack of knowledge and skill.

Models help us conceptualize representations of reality. A model is a simple representation of more complex forms, processes, and functions of physical phenomena or ideas. Models of necessity simplify reality because often it is too complex to portray and because much of that complexity is unique to specific situations. Thus, models typically seek to identify what is generic and applicable across multiple contexts. Seel (1997) identifies three different types of ID models (theoretical/conceptual, organization, and planning-and-prognosis) and would label those we review here as organization models that can be used as general prescriptions for instructional planning.

Models provide conceptual and communication tools that can be used to visualize, direct, and manage processes for creating high quality instruction. Models also assist us in selecting or developing appropriate operational tools and techniques as we apply the models.

13.4 Information Science

Information, in the context of this paper, is part of the data-information-knowledge continuum with the aim of creating, replacing, improving, or understanding information systems. Science, in the context of this paper, is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment. Both the concept of information and the concept of science can be joined in order to identify a field of study relevant to educational technology and essential to instructional design. Figure 13.2 is intended to visualize data streaming through the information continuum on the path to knowledge.

Information science is also known as **information studies**. Information Science is an interdisciplinary field of study concerned with the analysis, collection, classification, manipulation, storage, retrieval, and dissemination of information. Information science professionals study and apply the effective use of knowledge within organizations as well as the interaction between people, organizations, and information systems.

It is important for instructional designers to examine the relationship of information and technology from the perspectives of intellectual freedom, intellectual property, ethical behavior, authenticity, plagiarism, confidentiality, accessibility, and cyber-bullying. Educational technologists should be able to construct authentic artifacts that demonstrate the influence of information in teaching, research, or service.

Fig. 13.2 Visualization of data streaming

Several of the primary areas of information science include: information resources, information retrieval, information management, digital information architecture, data visualization, information law, and open educational resource development systems. Information resources provide an understanding of the principles and practice of the organization of information and knowledge. Specific topics include metadata, cataloging, resource description, classification, indexing, and abstracting. Information retrieval features documentary information retrieval and the evaluation of information retrieval systems. Specific topics include information retrieval models, search strategies, bibliographic retrieval, image retrieval, and sound retrieval. Information management explains the principles of the management of information resources within a variety of environments. Digital information architecture describes the technical background required to store, structure, manage, and effectively exchange information. Common digital information architecture contexts are currently found in computing technology, the Internet search systems, Web 2.0 technologies, and popular social media applications. Data visualization utilizes information science applications to design, create, and use relevant data sets for teaching, learning, research, service, recreation, and personal goals. Effective data visualization uses good information design and applies appropriate guidelines for visualizing complex processes. Information law establishes boundaries and legal principles regarding data protection, freedom of information, breach of confidence, computer misuse, and privacy rights. Open educational resource development systems focus on designs and technologies devoted to generating online teaching, learning, and research resources for people to share, use, and reuse.

13.5 An Instructional Design Model for Information Science

Because instructional design is practiced in a variety of settings, there are many different models devoted to the instructional design process. The designer creates procedural models to match unique organizations of information; for example, instructional designers should consider specific contextual issues that may require a rapid prototyping or concurrent engineering approach, depending on the type of information, the quantity of information, and the intended use of information.

Rapid prototyping as an approach to instructional design increases opportunities to clarify needs, enhance creativity, reduce errors in final product, increase usability, and increase customer acceptance where applicable. Concurrent engineering promotes an approach whereby most of the instructional design procedures occur during the same time. Probably the factor most constant in instructional design is that it is a process devoted almost exclusively to seeking ways to close a performance gap that is caused by a lack of knowledge and skills. Therefore, all of the instructional design components identified in Fig. 13.3 require specific types, quantities, and various intents of information.

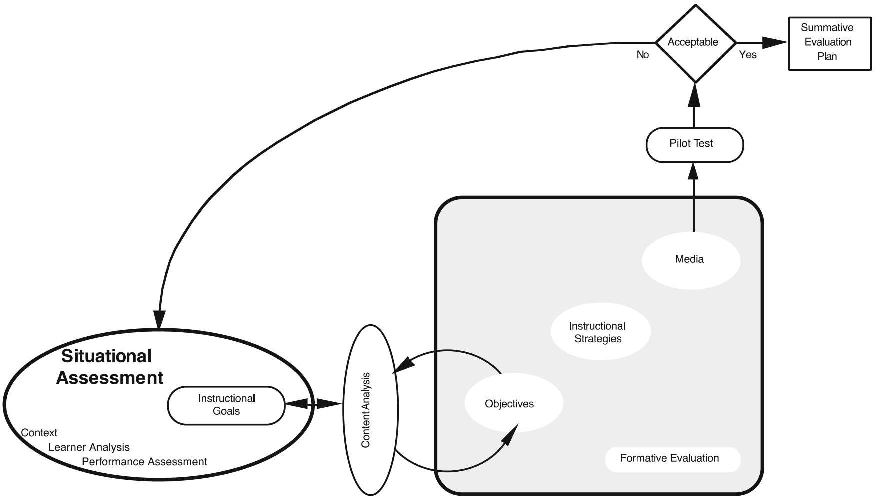

Fig. 13.3 An instructional design model relevant for information science

The rendition of an instructional design model, which is presented in Fig. 13.3, includes components that address the type, quantity, and intent within the realm of information science. The shape of the model may vary, but the following components are relatively constant: a situational assessment, which leads to instructional goals; a content analysis that forms an iterative relationship with learning objectives; formative evaluation, which culminates in a pilot test; and a summative evaluation plan, which provides the information required for implementation.

13.6 Conclusion

Instructional design models facilitate active, multifunctional, inspirational, situated approaches to intentional learning. Information science provides ways to analyze, collect, organize, store, and retrieve data. Therefore, an appropriate instructional design model can facilitate the transition of data to information, and subsequently, the construction of knowledge.

References

Branch, R. (2009). *Instructional design: The ADDIE approach*. New York, NY: Springer.

Goel, V., & Pirolli, P. (1992). The structure of design problem spaces. *Cognitive Science, 16*(3), 395–429.

Merrill, M. D., Drake, L., Lacy, M. J., Pratt, J. & The IID2 Research Group. (1996). Reclaiming instructional design. *Educational Technology, 36*(5), 5–7.

Ni, X., & Branch, R. (2008). Complexity: Concept, theory and practice within educational communications and technology. In M. J. Spector & M. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed.). Upper Saddle River, New Jersey: Merrill-Prentice Hall.

Richey, R. C., Klein, J. D., & Tracey, M. W. (2011). *The instructional design knowledge base: Theory, research, and practice*. New York, NY: Routledge.

Rowe, P. (1987). *Design thinking*. Cambridge, MA: The MIT Press.

Seel, N. (1997). Models of instructional design: Introduction and overview. In R. Tennyson, F. Schott, N. Seel, & S. Dijkstra (Eds.), *Instructional design: International perspectives (Vol. 1)*. Mahwah, NJ: Lawrence Erlbaum Associates.

Stock, W. G., & Stock, M. (2013). *Handbook of information science*. Berlin, Boston, MA: De Gruyter Saur.

Stolterman, E. (2008). The nature of design practice and implications for interaction design research. *International Journal of Design, 2*(1), 55–65.

Taylor, A. G. (2004). *The organization of information* (2nd ed.) (Library and information science text series). Westport, Connecticut: Libraries Unlimited.

Chapter 14
If Content Is King then e³ Instruction Is Queen

M. David Merrill

Abstract The Internet is a wonderful vehicle for presenting information, lots and lots of information. But *information alone is not instruction*. When content information is accompanied by appropriate learning activities then more effective, efficient, and engaging learning is promoted. Too much so-called instruction consists of mostly content information. This instruction can be significantly improved by the addition of appropriate demonstration that shows learners how to use the information. Instruction can be further improved by adding appropriate application which requires learners to identify new instances of a given object or event or to actually execute a series of steps to complete some complex task or solve a problem. While the addition of appropriate demonstration and application learning activities will significantly improve the instruction, an even more dramatic improvement results from instruction that is organized in the context of a progression of increasingly complex instances of a problem to be solved or a task to be completed.

Keywords Learning events · Instructional strategies · Demonstration learning events · Application learning events · Problem-centered instructional strategy · First principles of instruction

For over 50 years my career has been focused on one very important question: "What makes instruction effective, effective, and engaging?" I decided that e-learning should refer to the quality of the instruction not merely to how it is delivered, so I labeled effective, efficient, and engaging instruction as e^3 instruction. In this brief presentation I will try to share with you a little of what I've learned. Perhaps the underlying message of my studies and this presentation is this simple statement: "**Information alone is not instruction!**" Indeed, content may be king, but e^3 instruction is queen.

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In 1964 in our research lab at the University of Illinois we were sending messages from one computer to another via ARPANET. Little did we realize the fantastic potential of this experimental communication from computer to computer. Unfortunately for our subsequent fortunes, none of us in that lab envisioned the Internet and the World Wide Web and the impact that this invention would have on communication, the availability of information, social interaction, commerce, education, and almost every other aspect of our lives.

In 1963 I was doing my student teaching in a junior high school; my subject was American History. Unfortunately for this experience, my major was psychology with a minor in mathematics. I never had an American History class in my entire college career. The students' textbook was woefully inadequate so I spent my evenings poring through the American Encyclopedia, which fortunately was resident in my home. This paucity of information left me very underprepared for teaching these students, but thanks to the ongoing presidential election (Nixon vs. Kennedy) there was a debate on television that I could use as a springboard that allowed me to teach a little about the electoral process, the Electoral College, and something about our two-party system of government.

But today, thanks to the Internet, you can find information about almost anything in the world whether current events or historical events. Teaching American History to junior high students today would be so much easier because of the almost unlimited amount of information in all different media that is available including audio, video, animation, as well as text. But is access to this wealth of information instruction? What I have learned from my study of this question is that the answer is an emphatic NO! I repeat, **Information alone is not instruction**.

14.1 Motivation

All of us have heard the saying that "students didn't learn because they just weren't motivated." Or that "motivation is the most important part of learning." Or "we really need to find a way to motivate out students." What is it that causes motivation? People have often asked me, "Is motivation one of your principles?" The answer is no; motivation is not something we can do, motivation is an outcome. So if it is an outcome, what causes motivation? Motivation comes from learning; the greatest motivation comes when people learn. We are wired to learn; all of us love to learn; every student loves to learn. And, generally, we are motivated by those things that we find we are good at. For example I am not much of an athlete. I look back on my past and ask "why am I not an athlete?" I remember that I was very small as a child. In my elementary school we used to divide up into teams during recess to play softball. I always ended up as last shag on the girls' team. That was very embarrassing for me, and consequently I lost interest in sports; I did not want to be a sportsperson. Consequently, I never pursed sports. On the other hand, somewhere in my youth I was given a scale model train. I was very interested in trains as all little boys are, but in this case one of my father's friends showed me how to build scenery and how to make a model railroad that looked like the real world. I became very interested in building a model railroad. Consequently throughout my life, I have pursed the hobby of model railroading. Why was I motivated to do this? Because I was good at it, because I learned things about how to build a realistic model. The more I learned, the more interested I became. We need to find ways to motivate our students, and that comes from promoting learning. And learning comes when we apply the effective and engaging principles of instruction.

14.2 Typical Instructional Sequence

In my experience I have had the opportunity to review many courses. Figure 14.1 illustrates a common instructional sequence that I have observed. You may have also observed this common instructional sequence and may have used a variation of this sequence in your own courses.

The course or module consists of a list of topics representing the content of the course. Information about the topic is presented, represented by the arrows. Occasionally a quiz or exercise is inserted to help illustrate the topic, represented by the boxes. The sequence is to teach one topic at a time. At the end of the course or module there is a culminating final test, or in some cases a final project, that asks the students to apply the topic to complete some t*ask* or solve some problem.

Sometimes this sequence is very effective in enabling students to gain skills or to learn to solve problems. Too often, however, this sequence is ineffective and not engaging for students. The effectiveness of this sequence and the degree of engagement it promotes for learners depends on the type of learning events that are represented by the arrows and the boxes in this diagram.

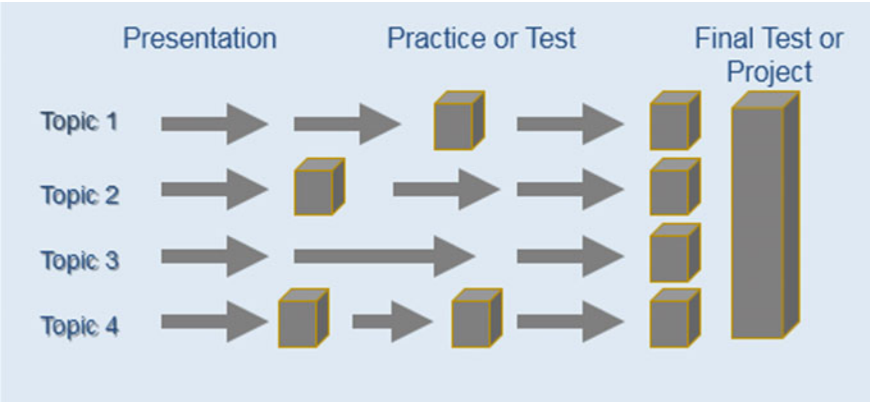

Fig. 14.1 Typical instructional sequence

14.3 Instructional Events

There are many different types of instructional events or learning events. Perhaps the most frequently used learning event is to present information or *Tell*. This *Tell* can take many forms including lectures, videos, text books, and PowerPoint presentations.

The next most frequent instructional or learning event is to have learners remember what they were told, what they read, or what they saw. This remember instructional event we will label as *Ask*. Even though *Tell* and *Ask* are the most frequently used instructional events if they are the only instructional events used then the *Tell-Ask* instructional sequence is the least effective instructional strategy.

If the arrows in Fig. 14.1 represent *Tell* learning events and the boxes represent *Ask* learning events then this module is not going to be very effective and most likely will not prepare learners to adequately complete a project using the information taught. If the culminating learning activity is an *Ask* final exam, learners may be able to score well on this exam but a good score on an *Ask* exam does little to prepare them to apply the ideas taught to the solution of a complex problem or completion of a complex t*ask*.

14.4 *TELL-ASK* Example

I am currently working with a faculty composed of international professors from a number of different countries. Their instructional methods vary but by far the most common instructional strategy is the one we have illustrated with *Tell* and *Ask* instructional events. This example is typical of many of the approaches originally used by this faculty.

With the permission of the faculty member I am sharing a slide (Fig. 14.2) from the PowerPoint presentation originally used in a course in business ethics along with the corresponding examination question from the final exam. This is obviously only a small part of this course on Business ethics but it is a critical learning event because if the learner does not learn to distinguish an ethical issue from an ethical dilemma then it is unlikely that they will be able to learn to help businesses solve

Differences between ethical issues and dilemma

- Ethical issues are specific with sometimes legal implications.
- Dilemma is more general
- Ethical issues are a questions of right and wrong.
- Dilemma has several alternative courses, sometimes all right but basically different in terms of significance of impact.

Most significant differences though is: dilemma, there is a desire to do the right thing but it is not clear what it is.

Fig. 14.2 Slide from Business Ethics Course End term examination question: ethical dilemmas are more complex in nature than ethical issues, comment ethical problems. The professor of this course did have an assignment for each small group of students to review the business practices of an assigned business to see if they could identify ethical dilemmas or ethical issues. They reported their finding to the class. Such a "find examples" assignment is better than no examples but naïve learners are not likely to identify the best examples or even to be able to observe examples when they do occur.

A little history is in order. In 1999 Charles Reigeluth published a collection of papers on Instructional Design Theories and Models. In the preface to this book, he indicates that there are many different kinds of instructional theories and that instructional designers need to be familiar with these different approaches and select the best approach or combination of approaches that they felt were appropriate for their particular instructional situation. I challenged Dr. Reigeluth, suggesting that while these different theories stressed different aspects of instruction and used different vocabulary to describe their model and methods, that fundamentally, at a deep level, they were all based on a common set of principles. Dr. Reigeluth kindly suggested that he did not think that my assumption was correct but if I felt strongly about it that perhaps I should try to find evidence for my assumption.

I took the challenge and spend the next year or two studying these various instructional theories. The result was the publication in 2002 of my often referenced paper on First principles of Instruction (Merrill 2002). I have spent the time since in refining my proposition in a series of papers and chapters on First Principles. In 2013 I finally published my book *First Principles of Instruction* (Merrill 2013) that elaborated these principles, provided a set of suggestions for how these principles might be implemented in various models of instruction, and provided a wide variety of instructional samples that illustrate the implementation of First Principles in a wide range of content areas and in different educational contexts including training, public schools, and higher education.

14.5 First Principles of Instruction

Principles are statements of relationships that are true under appropriate conditions. In instruction these relationships are between different kinds of learning events and the effect that participating in these learning events has on the acquisition of problem-solving skills. I identified five general principles that comprise First Principles of Instruction. As I reviewed the literature on instructional design theories and models, I tried to be as parsimonious as possible by selecting only a few general principles that would account for the most fundamental learning activities that are necessary for effective, efficient, and engaging instruction.

Activation: Learning is promoted when learners activate a mental model of their prior knowledge as a foundation for new skills. A frequently cited axiom of education is to start where the learner is. Activation is the principle that attempts to activate a relevant mental model already acquired by the learner to assist him or her to adapt this mental model to the new skills to be acquired.

Demonstration: Learning is promoted when learners observe a demonstration of the skills to be learned. I carefully avoided the word presentation for this principle. Much instruction consists largely or entirely of presentation. What is often missing is demonstration, show me. Hence, the demonstration principle is best implemented by *Tell-Show* learning events where appropriate information is accompanied by appropriate examples.

Application: Learning is promoted when learners engage in application of their newly acquired knowledge or skill that is consistent with the type of content being taught. Way too much instruction uses remembering information as a primary assessment tool. But remembering information is insufficient for being able to identify newly encountered instances of some object or event. Remembering is also insufficient to be able to execute a set of steps in a procedure or to grasp the events of a process. Learners need to apply their newly acquired skills to actually doing a t*ask* or actually solving a problem.

Integration: Learning is promoted when learners share, reflect on, and defend their work by peer collaboration and peer critique. Deep learning requires learners to integrate their newly acquired skills into those mental models they have already acquired. One way to insure this deep processing is for learners to collaborate with other learners in solving problems or doing complex tasks. Another learning event that facilitates deep processing is when learners go public with their knowledge in an effort to critique other learners or to defend their work when it is critiqued by other learners.

Problem-centered: Learning is promoted when learners are engaged in a problem-centered strategy involving a progression of whole real-world t*ask*s. The eventual purpose of all instruction is to learn to solve complex problems or complete complex tasks, either by themselves or in collaboration with other learners. This is accomplished best when the problem to be solved or the t*ask* to be completed is identified and demonstrated to learners early in the instructional sequence. Subsequent component skills required for problem solving or for completing a complex task are best acquired in the context of trying to solve a real instance of the problem or complete a real instance of the task.

14.6 Support for First Principles of Instruction

Do First Principles of Instruction actually promote more effective, efficient, and engaging instruction?

A study conducted by NETg (Thompson Learning 2002), a company that sells instruction to teach computer applications, compared their off-the-shelf version of their Excel instruction, which is topic centered, with a problem-centered version of this course that was developed following First Principles. Participants in the experiment came from a number of different companies that were clients of NETg. The assessment for both groups consisted of developing a spreadsheet for three real-world Excel problems. The problem-centered group scored significantly higher, required significantly less time to complete the problems, and expressed a higher level of satisfaction than the topic-centered group. All differences were statistically significant beyond the 0.001 level.

A doctoral student at Florida State University completed a dissertation study comparing a topic-centered course teaching Flash programing with a problem-centered course (Rosenberg-Kima 2012). This study was carefully controlled so that the variable was merely the arrangement of the skill instruction in the context of problems or taught skill by skill. The learning events for both groups were identical except for the order and context in which they were taught. On a transfer Flash problem that required students to apply their Flash programing skills to a new problem, the problem-centered group scored significantly higher than the topic-centered group and felt the instruction was more relevant and resulted in more confidence in their performance. There was no time difference between the two groups for completing the final project.

A professor at Indiana University designed a student evaluation questionnaire that had students indicate whether the course being evaluated included First Principles of Instruction (Frick et al. 2010). The correlations all showed that the extent to which First Principles are included in a course correlates with student rating of instructor quality and their rating of satisfaction with the course. Students also spent more time on task and were judged by their instructors to have made more learning progress when the courses involved First Principles of Instruction. This data was collected in three different studies.

The conclusion that can be drawn from these three different and independent studies of First Principles clearly show that courses based on First Principles do facilitate effectiveness, efficiency, and learner satisfaction.

14.7 Demonstration Principle

When I am asked to review course material, my approach is to immediately turn to Module 3 of the material. By then the course is usually into the heart of the content and the introductory material is finished. What do I look for first? Examples. Does the content include examples, demonstrations, or simulations of the ideas being taught? Adding demonstration to course will result in a significant increment in the effectiveness of the course.

Do most courses include such demonstration? MOOCs are a recent very popular way to deliver instruction. How well do these *Massive Open Online Courses* implement First Principles of Instruction? Anoush Margaryan and her colleagues (Margaryan et al. 2015) published an important paper titled Instructional Quality of Massive Online Courses (MOOCs) that addresses this question. They carefully analyzed 76 MOOCs representing a wide variety of content sponsored by a number of different institutions to determine the extent that these courses implemented First Principles of Instruction. Their overall conclusion was that most of these courses failed to implement these principles.

The demonstration principle, providing examples of the content being taught, is fundamental for effective instruction and engaging instruction. How many of these MOOCs implemented this principle? Only 3 out of the 76 MOOCs analyzed included appropriate demonstration. The effectiveness and engagement in these MOOCs could be significantly increased by adding relevant and appropriate demonstration.

14.8 Application Principle

When I am asked to review a course the second type of learning event I look for is application that is consistent with and appropriate for the type of learning involved. Remembering a definition or series of steps is not application. There are two types of application that are most important but too often not included. *DOid* or *DOidentify* requires learners to recognize new divergent examples of an object or event when they encounter it. *DOidentify* is also the initial application required when learning the steps of a procedure or process. The learner must first recognize a correctly executed step when they see it, and they must also recognize the consequence that resulted from the execution of the step. Once they can recognize appropriate steps and appropriate consequences for these steps, then *DOexecute* is the next level of application. *DOexecute* requires learners to actually perform or execute the steps of a procedure. When appropriate application is missing, the effectiveness of a course is significantly increased when appropriate application learning events are added.

MOOCs are often about teaching learners new skills. Did the MOOCs in the study cited above include appropriate application for these skills? They fared better than they did for demonstration. At least 46 of the 76 MOOCs did include some form of application. This still leaves 30 MOOCs in this study without application of any kind. However, on careful analysis of the sufficiency and appropriateness of the application included, it was found that only 13 of the MOOCs in this study had appropriate and sufficient application.

14.9 Learning Events

While *Tell* and *Ask* are the most frequently used learning events, as we have seen a strategy that uses only these two learning events is not an effective or engaging strategy. Learning to solve problems and to do complex tasks is facilitated when a *Tell* instructional strategy is enhanced by adding demonstration or *Show* learning events. A *Tell-Show* sequence is more effective than a *Tell* only sequence.

Learning to solve problems and to do complex tasks is facilitated even more when a *Tell-Show* strategy is further enhanced by adding *Do* instructional events. These *Do* learning events are most appropriate when they require learners to identify unencountered instances of some object or event (*DOidentify* learning events) and when they require learners to execute the steps in a procedure or observe the steps in a process (*DOexecute* learning events). A *Tell-Show-Do* sequence is even more effective than a *Tell-Show* instructional sequence.

Much existing instruction can be considerably enhanced by the addition of appropriate *Show* and *Do* learning events. If the arrows in Fig. 14.1 consist of *Tell* and *Show* learning events and the boxes consist of *Do* learning events and if the final project is not merely a remember or *Ask* assessment but the opportunity for learners to apply the skills they have acquired from the *Tell-Show-Do* instruction to a more complete problem or task, then the resulting learning will be more effective, efficient, and engaging for learners. Much existing instruction can be significantly enhanced by converting from *Tell-Ask* learning events in this typical instructional sequence to *Tell-Show-Do* learning events.

14.10 Example *Tell-Show-Do* Instruction

To revise the business ethical dilemma module which was originally a *Tell-Ask* instructional sequence we started with one of the slides from the original PowerPoint presentation that defines an ethical dilemma contrasted with an ethical issue. To enhance this module we searched the Internet for examples of ethical dilemmas and ethical issues. We were surprised with the number and variety of examples that are available both in text formats and video formats. We added short videos that illustrated both ethical issues and those that illustrated ethical dilemmas. The instructor would elaborate each of these examples pointing out the nature of the dilemma involved or why the case was an ethical issue rather than an ethical dilemma. The revised module included several examples of both ethical dilemmas and ethical issues in a variety of different settings, each accompanied by elaboration of the nature of the dilemma or the issue involved. Finally, the revised model included additional examples that the learners were required to identify either as an ethical issue or an ethical dilemma. They were also required to explain the nature of the dilemma or issue involved in each of these examples.

14.11 How to Revise Existing Instruction

Much existing instruction is primarily *Tell-Ask* instruction. This instruction can be significantly enhanced by the demonstration of appropriate examples (*Show* learning events) and even further enhanced by the addition of appropriate application activities (*Do* learning events).

The fundamental instructional design procedure to enhance existing instruction is fairly straightforward. Start by identifying the topics that are taught in a given module. Create a matrix and list these topics in the left column of a matrix. Across the top of the matrix list the four primary learning event types: *Tell, Ask, Show, and Do.*

Second, identify the *Tell* information for each topic and reference it in the *Tell* column. Review this information to insure that each topic is accurate and sufficient for the goals of the instruction.

Third, identify existing *Show* learning events for each topic. If the existing instruction does not include appropriate or sufficient examples of each of the concepts, principles, procedures, or processes listed then identify or create appropriate examples for inclusion in the module. You may want to use this matrix as a cross-reference for the new content examples you identify or create.

Fourth, identify existing *Do* learning events for each topic. If the existing instruction does not include appropriate or sufficient *Do* learning events then identify or create appropriate *Doidentify* or *Doexecute* learning events for inclusion in the module.

Finally, assemble the new demonstrations and applications into your module for more effective, efficient, and engaging instruction.

14.12 The Context Problem

Even after appropriate demonstration and application learning events are added to this traditional instructional sequence there is still a potential problem that keeps this instructional sequence from being as effective, efficient, and engaging as possible. In this sequence topics are taught one on one. The demonstration and application learning events added to a *Tell* sequence are usually examples that apply to only a single component skill and are merely a small part of solving a whole problem. Too often learners fail to see the relevance of some of these individual skills learned out of context. We have all experienced the often used explanation: "You won't understand this now, but later it will be very important to you." If "later" in this situation is several days or weeks, there is a good possibility that the learners will have forgotten the component skill before they get to actually use this skill in solving a whole problem or doing a whole task. Or, if learners do not see the relevance of a particular skill they may fail to actually learn the skill or they are unable to identify a mental model into which they can incorporate this skill. Then, when it is time to use this skill in the solution of a whole problem, learners are unable to retrieve the skill because it was merely memorized rather than understood. Furthermore, if solving a whole problem or doing a whole task is the final project for a module or course, there may be no opportunity to get feedback and revise the project.

Is there a better sequence that is more effective, efficient, and engaging than this typical sequence?

14.13 Problem-Centered

To maximize engagement in learning a new problem-solving skill, learners need to acquire these skills in the context of the problem they are learning to solve or the task they are learning to complete. If learners first activate a relevant mental model (activation principle) and then are shown an example of the problem they will learn to solve and how to solve this problem, then they are more likely to see the relevance of each individual component skill when it is taught and they will have a framework into which they can incorporate this new skill, greatly increasing the probability of efficient retrieval and application when they are confronted with a new instance of the problem.

Does existing instruction use a problem-centered sequence in instruction? Even though many MOOCs are designed to facilitate problem solving, Margaryan and her colleagues found that only 8 of the 76 MOOCs they analyzed were problem-centered. Several previous surveys of existing instruction in a variety of contexts found that most courses do not use a problem-centered instructional sequence or even involve students in the solution of real-world problems as a final project.

A typical instructional sequence is topic centered, that is, each topic is taught one by one and then at the end of the module or course learners are expected to apply each of these topics in the solution of a final problem or the completion of a final task. Figure 14.3 illustrates a problem-centered sequence that turns this sequence around. Rather than telling an objective for the module, which is a form of information, the (1) first learning activity is to show a whole instance of the problem that learners are being taught to solve. This demonstration also provides an overview of the solution to the problem or the execution of the task. (2) Students are then told information about the component skills necessary to the solution of this instance of

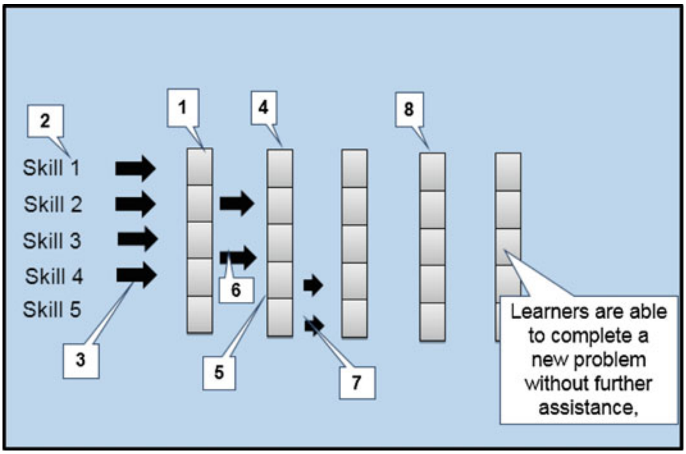

Fig. 14.3 Problem-centered instructional sequence

the problem and (3) shown how each of these component skills contributes to the solution of the problem. (4) After this *Tell-Show* demonstration for the first instance of the problem is complete, a second problem instance is identified and shown to learners. (5) The learner is then required to apply the previously acquired component skills to this second problem (*Do*). (6) Some of the component skills may require some additional information or a different way of using the skill to solve this second instance of the problem. Learners are then told this new information and (7) shown its application to another instance of the problem. Note that the *Tell-Show-Do* for each component skill or topic is now distributed across different instances of the problem. The first instance of the problem was primarily *Tell-Show*. The second instance of the problem is a combination of *Tell-Show* for new parts of each component skill and *Do* for those component skills already acquired. (8) Additional instances of the problem are identified. Learners apply those skills already acquired (*Tell-Show*) and apply those skills already acquired (*Do*) for each new instance of the problem. The sequence is complete when learners are required solve a new instance of the problem without additional guidance.

This problem-centered instructional sequence makes it more likely that learners will see the relevance of each new component skill, and will provide multiple opportunities for learners to apply these newly acquired component skills in the context of real instances of the problem. This problem-centered sequence enables learners to see the relationship among the individual component skills in the context of each new instance of the problem. This problem-centered sequence provides gradually diminishing guidance to learners until they are able to solve a new instance of the problem with this guidance.

Instruction that is revised to include a *Tell-Show-Do* sequence of learning events all in the context of solving a progression of instances of a whole problem or a whole task has the potential of being maximally engaging for students while providing efficient and effective learning activities.

14.14 Problem-Centered Example

An entrepreneur course, designed and developed at BYU Hawaii, illustrates a problem-centered instructional sequence. This course was designed to introduce students from developing countries to entrepreneurship. The slogan of the business department for these students from third world countries is “Don’t go home and be an employee, but go home and be an employer.” Six major component skills were identified as being necessary to the establishment and running of a small business. Each of these skills also has nested within a number of subskills for each of these main skills.

This course is taught with a sequence of five examples of small businesses that were developed for developing countries. A Product business was a pig farm in Cambodia; a service business was a carpet cleaning business in Mongolia; a Retail business was a cell phone franchise in Laie Hawaii; a Restaurant business was a

Mexican restaurant in Russia. After studying each of these four businesses students were required to develop a business plan for their own small business designed for their own country. The course involves a progression of examples of developing whole small businesses. Each of these businesses involved the same set of skills. Each business is more complex than the preceding business and while using the same skills requires more detail for each of these skills. This whole course is available on the Internet. Contact me at professordavemerrill@gmail.com, and I will send you the link to this course.

14.15 Recommendation

In summary: You may want to analyze your courses. Perhaps their effectiveness, efficiency, and especially their engagement may be enhanced by adding appropriate demonstration, application and using a problem-centered instructional sequence. Do they include appropriate and adequate demonstration? Do they include appropriate and adequate application? Are the skills taught in the context of an increasingly complex progression of instances of the problem?

14.16 Conclusion

Motivation is an outcome, not a cause. What promotes engagement and hence motivation? Effective, efficient, and engaging instruction. What promotes effective, efficient, and engaging instruction? First Principles of Instruction: Activation, Demonstration, Application, Integration, and Problem-centered. In this paper, we have emphasized the demonstration and application principle and a problem-centered instructional sequence.

My book, *First Principles of Instruction* is available in English in both print and electronic formats. It is also available in Korean, and a Chinese translation is in press and will be released in the near future.

Please do not hesitate to contact me at professordavemerrill@gmail.com

References

Frick, T., Chadha, R., Watson, C., & Zlatkovska, E. (2010). Improving course evaluations to improve instruction and complex learning in higher education. *Educational Technology Research and Development, 58*, 115–136.

Margaryan, A., Bianco, M., & Littlejohn, A. (2015). Instructional quality of massive online courses (MOOCs). *Computers & Education, 80*, 77–83.

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43–59.

Merrill, M. D. (2013). *First principles of instruction: Identifying and designing effective, efficient and engaging instruction*. San Frisco: Pfeiffer.

Rosenberg-Kima, R. (2012). *Effects of task-centered vs topic-centered instructional strategy approaches on problem solving* (Doctoral dissertation). Retrieved from Florida State University. Electronic Theses, Treatises and Dissertations. Paper 5148.

Thompson Learning. (2002). Thompson job impact study: The next generation of learning. Retrieved from http://www.delmarlearning.com/resources/Job_Impact_Study_whitepaper.pdf.

Chapter 15
Academic Writing, Publishing, and Presentations in Educational Technology

Tristan E. Johnson, J. Michael Spector and Minhong (Maggie) Wang

Abstract There are many misconceptions about academic writing and publishing that sometimes inhibit or intimidate educational researchers. One misconception is that academic writing should reflect the complexity of challenging scholarly research. As it happens, a complex writing style can detract from the comprehensibility of a manuscript. It is possible to tell a very complex story using simple, descriptive language. Short sentences are often more easily understood than long sentences containing multiple dependent clauses. Academic writing should not result in discovery reading; the reader needs to know the purpose, scope, and major point prior to embarking on the adventure of reading the rest of the manuscript. This document includes some tips on writing clearly for an academic audience along with an editor's perspective on publishing research.

Keywords Academic writing · Publishing · Research framework · Research agenda

One of the key societal benefits of conducting research is the knowledge created that provides information and direction for understanding and application in various settings. The value of the research knowledge is derived from many criteria. One of the main criteria is the research framework and logic that is used to generate the knowledge. Other value components include the ability to clearly articulate the process for creating the knowledge and also specifying the value based on prior

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research and critical reasoning. This paper presents several ideas that are considered important and valuable in the process of creating knowledge as it relates to Educational Technology research.

Educational research often involves an intervention aimed at solving a problem or improving a situation pertaining to learning, performance, and/or instruction. The specific problem addressed in a research study is likely to be representative of (or a part of) a larger problem of significance to society or others outside the scope of the specific study; this is especially the case with funded research, and which is why the ability to generalize is important. While one study may not establish a sufficient basis to generalize findings to other situations, it is generally desirable to at least lay a foundation for generalization (e.g., through the validation of instruments and an investigative methodology or through a study that can be replicated in other contexts).

15.1 Assumptions and Implications

One of the key factors in laying a foundation for generalization is the need for a logic framework for one's research and critical reasoning. Consider the following assumptions and implications.

Assumption #1: The general goal of an education system is to develop responsible, thoughtful, and productive citizens who will be lifelong learners.

Assumption #2: Developing effective communication skills (writing, speaking, listening, and reading) is a key factor in achieving that goal—early initial development of these skills is critical.

Assumption #3: The standards and expectations for academics and scholars are especially challenging and demanding in the area of communications skills.

Implication #1: Effective communication skills enable the development of higher order, critical reasoning skills.

Implication #2: Those who develop effective communication skills will be more successful in their adult lives than those who do not.

These general assumptions and implications along with our experiences with graduate students and with our own writing and presenting have led us to develop a few basic guideposts that may benefit others.

15.2 Organization

One way to organize an academic paper or presentation is around a valid deductive argument form or a strong inductive argument form (see http://www.iep.utm.edu/ded-ind/ for an overview). A common valid deductive argument form is one called *modus ponens*, which has this general form:

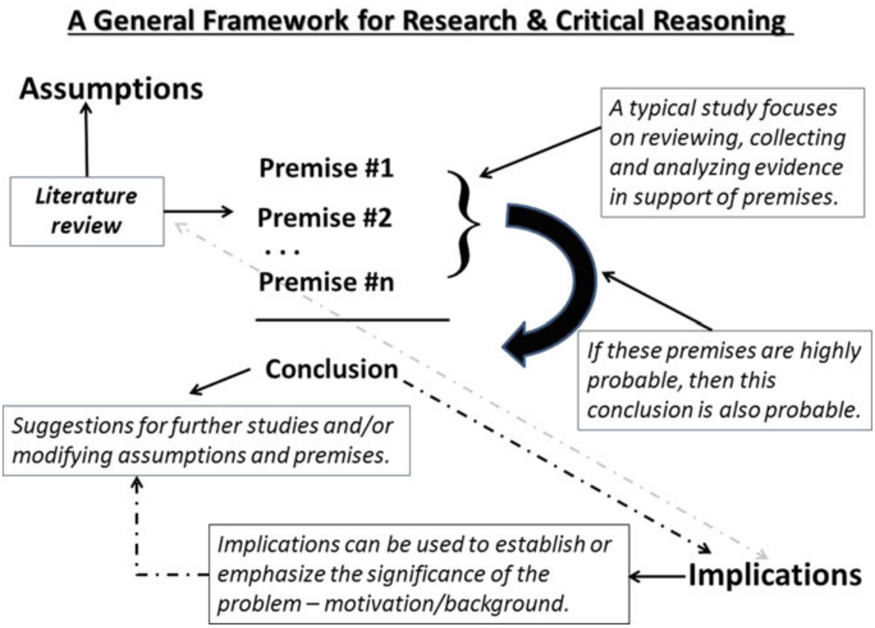

Fig. 15.1 A general framework for research and critical reasoning

P
If P then Q
So, Q
(P and Q represent statements or propositions)

An elaborated version of this argument that is more likely to pertain to academic writing is this

If (W and X and Y), then Z; W and X and Y; therefore Z.

We might now modify this argument form as follows to reflect the inductive nature of most academic research:

If it is probable that (W and X and Y), then Z is probable; W and X and Y are collectively probable; therefore, Z is probable.

Inductive research is challenging as degrees of probability based on statistical reasoning are required as part of the analysis. The point here, however, is to focus on the general form of the reasoning and how that might be used to structure and organize writing and presenting one's research (see Fig. 15.1).

15.3 Educational Research

Broadly speaking, research can be categorized as (a) exploratory—aimed primarily at describing what is happening with regard to a relatively unexplored situation, (b) explanatory—aimed primarily at the reasons that things seem to be happening as they do, and (c) predictive—aimed primarily at indicating what is likely to happen if certain things are changed. The kind of question one has (What is going on here? Why is that happening? What will happen if this is changed?) to a great extent determines the methodology to be involved. The question that is driving one's research is often shaped by a general problem of interest to a stakeholder group. When writing about one's research, the purpose (general problem and specific objectives) provide the motivation for the study. The motivating problem should be made clear in the abstract and again in the introduction, along with the purpose, scope, and general findings.

When elaborating the problem and purpose, one is then led to examine what is already well established by prior research and widely accepted theories. The introduction to a study determines the scope of the review of relevant research and theory. That literature review can then provide the basis for the research design. Based on what has been established or suggested by prior research and theory, one can be led to propose (a) a deeper look at the situation (descriptive research), (b) examining the variables likely to explain why things happen the way they do, or (c) creating an intervention that one has reason to believe (based on the review of the relevant research and theory) will bring about desired outcomes.

The general logic of such research can be characterized as follows: Based on what has been previously established it is likely that W, X, and Y will, to a significant extent, determine Z (see Fig. 15.1). In writing and presenting this research, one should make one's assumptions explicit and provide a concise and compelling summary of relevant research and theory. In the case of predictive research or a study that involves an intervention of some kind, one should be able to specify the problematic situation and explain why it is likely that the intervention or changes are likely to bring about the desired outcome. That explanation is sometimes called a theory of change, and it should be provided early in a presentation or article, and when possible supported with a visual representations, which is sometimes called a logic model.

The major part of a research study typically involves an investigation of the premises (these could be independent variables and/or the circumstances surrounding an intervention) and how they influence the outcomes (dependent variables) or possibly how they interact to influence outcomes. The analysis of findings might support the hypothesized outcome or it might not. In any case, in writing about the findings one is usually led to (a) admit the limitations of the study, (b) to speculate about the reasonableness of the assumptions and premises, and (c) to describe what further studies will provide additional insight and understanding of the phenomenon or situation being investigated.

One can conceptualize a report or presentation of research as a kind of story. People readily understand stories. Stories have (a) a beginning (a statement of the problem—why go there), (b) a journey of some sort (an analysis of who has explored this territory previously and what they found, and then the design and implementation of a study to further explore the territory), and (c) the arrival at the destination (the findings, limitations, and suggestions for further study). Sometimes one arrives at an unanticipated destination (e.g., no significant results), but this can make the research story even more interesting.

15.4 Presentation Guidelines

When presenting research to an audience at a conference, workshop or seminar, one will typically have supporting slides. What one puts on the slides in large part depends on the audience involved. When the audience is comprised of many whose first language is not English, for example, one might consider having slides with a lot of words and information so that those who may not understand everything you say can still keep up by reading the slides. However, an audience fluent in English will be more appreciative and responsive to slides with just a few key words and images that convey or complement what you will be saying. When presenting, one should not read or even look at the slides for prolonged periods of time; of course one might glance at a slide briefly before talking about what that slide depicts, but eye contact with the audience helps to keep them engaged. Slides should be reviewed by a colleague to ensure they convey desired information. Most presentations have time limits and these should always be carefully observed. Going overtime will generate ill will and prevent time for questions and discussion. Good questions and suggestions for further work are an excellent outcome of a presentation. A good strategy to consider is to make a presentation prior to submitting an article so that feedback on how the presentation is received and what things might require specific emphasis or consideration are taken into account.

15.5 Writing Guidelines

Even with the most developed research framework and methods, communicating the knowledge developed needs to follow general guidelines for writing. These guidelines include the following:

- Use simple descriptive sentences whenever possible; a complex story can be told using very simple sentences.
- Try to express just one idea in each sentence; writing is quite different than speaking; write for maximum comprehension by a wide audience; minimize cognitive load placed on readers who are often very busy people.
- Avoid doubly modified nouns and exaggeration; understatement is often more effective than grandiose claims, especially with academic readers.
- Avoid sentences with multiple independent and dependent clauses; complex sentences are difficult to follow; show consideration for readers.

- Avoid the use of relative pronouns as they tend to create ambiguity and place a cognitive load on the reader; better to use a noun or noun phrase even when repetitive (except within a single sentence).
- Avoid sweeping generalizations and words such as 'all,' 'none,' 'always,' 'never,' 'proves,' and so on as these will create a natural response in the reader to find a counterexample, and they are rarely needed to make the intended point or argument.
- Be familiar with the guidelines and requirements of the publication venue and follow those very carefully.
- There are many good resources available at no cost online to support academic writing; one example is the Purdue Online Writing Lab—http://owl.english.purdue.edu/owl/.

15.6 Developing a Research Agenda

There are many steps that can be taken to develop a research agenda. Some of the key steps include identifying key problems, considering the impact of potential answers, matching your strengths to current issues, and work on developing a research agenda logic framework. The subsequent steps would be to establish the research questions and the associated methods.

Consider the steps to develop a research agenda.

- Identify deep and persistent problem areas of concern to yourself, your colleagues, and your professional community—identify what is known and what is not known—map out a research agenda, perhaps with a grid indicating key research questions with un[der]-researched questions highlighted and an accompanying hierarchy showing the research questions you intend to address and in what order along with the significance of the research to the academic community and to society.
  - Sources—your dissertation and previous research, studies by other researchers, professional associations, think tanks, the government, etc. In our field we often refer doctoral students to look at the *Handbook of Research on Educational and Communications Technology* (3rd ed., Spector, Merrill, van Merriënboer, & Driscoll 2008; Spector, Merrill, Elen, & Bishop 2014, 4th ed.).
  - Funding agencies—consider multiple funding agencies, including the university, state agencies, national agencies, professional groups, foundations, international organizations (NATO, World Bank, UN, EC, etc.).
    http://www.nsf.gov
    http://www.ed.gov
    http://www.tea.state.tx.us/
    http://www.mellon.org

http://www.aaas.org/index.shtml
http://www.nfie.org/
http://www.fundsnetservices.com/
http://fdncenter.org/marketplace/catalog/product_directory.jhtml?id=prod10019
http://www.ed.gov/about/offices/list/os/technology/index.html

- Assess impact of potential answers and value to those concerned
  - The greater the potential impact and value, and the more challenging the research tasks, the more likely the funding support and the more likely the motivation and will to succeed.
- Match your strengths and interests to the main issues
  - Where can you make a real contribution to the knowledge base and profession?
- Develop a background statement with related research literature—a white paper.
  - Useful in grant proposals, especially in discussion with program officers
- Identify the best people engaged in related research.
  - UUPS[1] Corollary #3—others generally have better ideas—collaboration is not just one approach to learning—it is a great research strategy—an interdisciplinary and cross-institutional research is highly valued by national funding agencies.
- Develop a hierarchy of interim questions and hypotheses to explore in order to contribute to the major problem identified.
  - Determine and use methods that fit the questions raised; for exploratory research, qualitative methods are often appropriate; for causal studies, quantitative methods are often appropriate; mixed methods are desirable in many cases as they may add depth and increase confidence in findings, but they are challenging often require additional time and analysis.
  - Conduct a first study and get it published; present and publish findings along with the long range plan—make the research agenda known to your colleagues and professional community.
- Build on prior work and address increasingly difficult and challenging issues.
  - Your commitment and passion to finding answers will be contagious.

[1]UUPS = Spector's Universal Underlying Principle of All Stuff, which is: Something has already gone wrong. Corollary #1: Mistakes rarely happen in isolation; one typically leads to another; best to minimize errors early. Corollary #2: Resources are generally inadequate to accomplish what one believes should be done; this requires prioritization and compromises to be made. Corollary #3: Others usually have better ideas; this requires collaboration and an openness to alternative approaches.

15.7 Types of Research Questions and Associated Methods

Once your research agenda is developed, the next key task is to craft your research questions and align the appropriate methods to answer your questions. Consider the following three types of questions and the associated methods.

- What is happening? (e.g., an unexpected phenomenon requires exploration)
  - Descriptive methods—could be quantitative (e.g., surveys) or qualitative (e.g., interviews) or mixed—the purpose is to describe the unusual situation (explore the landscape to determine likely causes); the findings or outcomes are not causal—co-relational or suggestive of areas to investigate further.
- Why does this happen? (e.g., a likely causal explanation for the unusual situation or unexpected phenomenon)
  - Experimental methods—very likely quantitative (e.g., controlled studies with large samples and random assignment to explore causal relationships between independent and dependent variables).
- What would happen if? (e.g., if a process is changed, what is the likely outcome)
  - Prescriptive methods—design and developmental research (see Spector, Merrill, van Merriënboer, & Driscoll 2008—*Handbook of Research for Educational Communications and Technology*); design-based research and formative evaluation also fall into this category and have connections to the other categories.

Here are some examples of research programs that have been developed based on solid research agendas.

- How best to use emerging technologies to improve learning and instruction?
  - Department of Education, NSF, AERA, AECT, etc.
  - Student performance in US schools is poor yet technology access is high.
  - TIMSS—4th grade math students in the USA were 11th in Mathematics and 8th in Science in the 2007 study American students were near the top in terms of student access to computers and the Internet.
- How to effectively and efficiently determine progress of learning in domains that are complex and involve problems that do not single or simple solutions
  - DEEP Problem Conceptualization Software—**contact** jmspector007@gmail.-com **for details**
  - HIMATT Assessment Software—http://link.springer.com/content/pdf/10.1007%2Fs11423-009-9119-8.pdf
  - AKOVIA Automated Knowledge Visualization and Assessment—http://www.ifenthaler.info/?page_id=310

- Improving student abilities has many long-term benefits
  - Economic and social benefits
  - Personal benefits
- History of failed promises to deliver from educational technology in some areas
  - Technology solutions to simpler problems succeed, YET
  - How to promote learning in and about complex areas that often have ill-defined aspects, many interrelated components, delayed effects, nonlinear relationships among components, etc.?

15.8 Presenting—Where to Present and Why

A key activity of developing one's research program is to share your work with others. This is easier done in a face-to-face venue where you can share your work and get immediate feedback from others. Also in presenting your work you can share your work in progress that helps to refine how you are thinking about your overall research logic.

There are different venues where you can present your work.

- Local and regional groups
  - University
  - Local and regional professional associations
  - State meetings
- National and international groups
  - Professional associations

    Discipline specific—especially with educationally oriented groups
    Educational research/instructional technology—AACE (SITE, ED-MEDIA, etc.), AECT, AERA, EduCause, ICALT, SALT, ISTE, ISPI.

15.9 Publishing

One of the most impactful activities of research is to have one's work published. This provides both a searchable document for others to consider and if soundly designed and conducted, a well written manuscript can provide a mechanism to significantly contribute to the community of research knowledge.

Where to publish

- Refereed journals—peer reviewed; blind or double blind process—these are often categorized in two or three tiers with the top tier being those with a high impact factor (see Web of Science) and a strong reputation within the relevant academic community; this varies somewhat and in many cases in somewhat subjective
- Online journals—some are serious, peer reviewed, and high quality, such as *Educational Technology and Society*—http://www.ifets.info/
- Trade journals—often not peer reviewed but can have significant impact

Refereed Educational Technology Journals

- *Computers in Human Behavior*
- *Distance Education*
- *Educational Computing Research*
- *Educational Researcher*
- *Educational Technology Review*
- *Educational Technology Research and Development*—high quality, considered the premier journal in educational technology research, good fit for many ITS projects
- *Educational Technology and Society*—high quality, refereed, online, fits most of the ITS projects—case studies, empirical findings, conceptual frameworks, qualitative studies, design and development research, etc.
- *Evaluation and Program Planning*
- *Journal of Computing in Higher Education*
- *Journal of Higher Education*
- *Knowledge Management and E-Learning: An International Journal*
- *Innovative Higher Education*—a generally good fit for ITS projects—evaluation reports and case studies
- *Journal of the Learning Sciences*—high quality journal focusing on multidisciplinary approaches to improving learning through cognitive and collaborative approaches
- *Journal of Research on Technology in Education*—good fit for many ITS projects
- *Instructional Science*—outstanding for research (quantitative or qualitative) pertaining learning and instruction broadly conceived
- *Interpersonal Computing and Technology Journal*
- *International Journal of Teaching and Learning in Higher Education*
- *Performance Improvement Quarterly*
- *Quarterly Review of Distance Education*
- *Review of Research in Education*
- *Simulation and Gaming*
- *Technology, Instruction, Cognition, and Learning*

Non-refereed Educational Technology Journals

- *Educational Technology*—very influential within the educational technology community
- *Tech Trends*—very influential within the educational technology community
- *THE Journal—Technological Horizons in Education*

See also combined listings such as: http://lrs.ed.uiuc.edu/tse-portal/publication/dans-journals.html.

Enduring the manuscript review process—What reviewers look for and what to expect—submit, revise, and resubmit

- Take feedback seriously and do your best to revise and resubmit
- Be familiar with what has been published.
- Be sure your contribution fits the journal focus and represents something new or innovative that adds to the knowledge base.
- Expect a critical review and be open to suggested revisions.
- Everyone gets rejected—learn from it and rewrite or rework the piece and submit elsewhere.
- Write clearly and use simple language throughout—be sure the logic flow of the article is clear.
- Follow all submission guidelines.

15.10 Resources

As you continue to practice, we suggest the following list of recourses that you can consider to develop your research skills including presenting and publishing.

AAAS Developing a research agenda for technology education Project 2061: see http://www.project2061.org/events/meetings/technology/Introduction.htm

Cennamo, K.S., Nielsen, M. C., & Box, C. (1992) Survivors guide to graduate research, *TechTrends*, 37(1), Springer, US, p 15–18. http://dx.doi.org/10.1007/BF02800582

Department of Education—Office of Technology—http://www.ed.gov/about/offices/list/os/technology/index.html

LICEF—Télé-université in Montréal: http://www2.licef.ca/Default.aspx?alias=www2.licef.ca/cice

National Research Council (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Spector, J. M., Merrill, M. D., van Merriënboer, J. J. G., & Driscoll, M. P. (Eds.) (2008). *Handbook of research for educational communications and technology* (3rd ed.). Mahwah, NJ: Erlbaum and AECT.

Spector, J. M., Merrill, M. D., Elen, J., & Bishop, M. J. (Eds.) (2014). *Handbook of research on educational communications and technology* (4th ed.). New York: Springer and AECT.

References

Spector, J. M., Merrill, M. D., van Merriënboer, J. J. G., & Driscoll, M. P. (Eds.). (2008). *Handbook of research for educational communications and technology* (3rd ed.). Mahwah, NJ: Erlbaum and AECT.

Spector, J. M., Merrill, M. D., Elen, J., & Bishop, M. J. (Eds.). (2014). *Handbook of research on educational communications and technology* (4th ed.). New York: Springer and AECT.

Chapter 16
Chinese Scholars' Perspectives Regarding Educational Technology

Feng-Qi Lai

Abstract The purpose of this study was to understand the perspectives that Chinese scholars hold regarding educational technology. An illustrative case study with purposive sampling was used to gain this understanding. Fifty-two participants representing faculty in educational technology from 34 different universities in China, a majority ranging in ages from 36 to 50 years old, and most having worked in the educational technology field for more than 10 years, completed and submitted the survey. After analyzing the data, the author found that most participants perceived that the strength of educational technology in China was attributable to the strong funding support from the Chinese government, but the faculty members also felt that this field needed help with research methodology. To help improve educational technology in China, the major efforts the participants believed would be most useful included self-development, enhancing academic exchanges, conducting research, applying theories in practice, and improving training/teaching and learning. The pace of development in educational technology in China is fast; however, there is concern for how Chinese scholars deal with the potential problems arising with this rapidly developing field. The current situation in China provides great opportunities for academic exchanges globally.

Keywords China · Educational technology · Perspectives · Academic exchanges · Global · Trends and issues

16.1 Introduction

Educational technology is a relatively new area in China. After an interview with Professor Sang at Nanjing University in China, Lai (2007) summarized that "educational technology in China has a history of about 80 years. It started in the middle of 1930s, called traditional electronic education or audiovisual instruction."

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(p. 72). When multimedia and network technologies were introduced into China in 1990s, educational technology in China experienced a tremendous change (Lai 2007). In 2004, I started academic exchanges with colleagues in China. I noticed a big portion of the faculty in educational technology of the older generation were professors from various areas like physics, computer science, and education. While they held their own perspectives toward this field based on their field experience and world knowledge, most of them followed the global trends and issues really rapidly and closely. The following were some viewpoints from those older generation prominent scholars in Chinese educational technology.

Nan (2000) summarized that with the development of educational technology in China, instructors who adopted technology in teaching realized that their roles should not be making audio/video, playing back audio/video, and fixing machines for audio/video as they usually did but be education innovators. He summarized many aspects in a successful integration of technology into Chinese education, in which he believed that the learner should be the center and the goal of teaching is to promote learners' learning. He emphasized active learning and advocated always having learners in mind when we design, develop, utilize, and manage educational resources. Li (1996) identified two major problems with teaching and learning in China. One was the emphasis on teaching while learners' active engagement was ignored. The other was Chinese educators overlooked the research on learners' cognitive learning processes because they were heavily influenced by behaviorist learning theories. Zhang and Li (2005) criticized the big problem that occurred in the development of technology—focusing on technology and ignoring people. They called on a shift from "technology manipulating people" to "people manipulating technology." Sang (2005) summarized in his paper that the best teaching and learning were individualized learning, conversational teaching and learning, and self-learning. However, there were other different perspectives. Noticing the problems, a much younger scholar, Jiao (2005) commented that although educational technology had become a relatively independent academic field in China, researchers in educational technology still had unclear concepts or misunderstanding about the field and wondered what research they needed to conduct in this field. A much more recent paper does have a very different viewpoint in terms of trends and issues in educational technology today. He (2013) argued that learner-centered and learner-oriented were radical viewpoints of some western scholars. He criticized the notion of focusing on learning while ignoring teaching. He believed that the learning model will not help teaching but only learning. He also believed that learner-centered and learner-oriented were beliefs in 1990s and in the twenty-first century, the main focus in educational technology is blended learning.

Disturbed by some current arguments in educational technology journals in China such as the criticism of the viewpoints from the young scholars in learning sciences and wondering what the concepts and perspectives of the majority of Chinese scholars in educational technology are today, I decided to conduct a study collecting data from those who have been working in this field so that I will be able to better understand what Chinese scholars are thinking and doing in this field. The research questions were:

What are the backgrounds of Chinese scholars in Educational Technology?
What is Chinese scholars' understanding of the Educational Technology field?
What are the research areas in which Chinese scholars are interested?
What perspectives do Chinese scholars hold regarding trends and issues in Educational Technology?

16.2 Methodology

16.2.1 Design and Sample

This is an illustrative case study using purposive sampling. An e-survey of a total of 20 questions was delivered using Qualtrics. The first part was an informed consent form and the second part was the questionnaire. When they logged in, the participants read the informed consent before proceeding to the questions. They were allowed to quit at any point while responding to the questions. They were also allowed to skip the questions that they were not willing to answer. They were informed that clicking the Submit button meant they agreed for the researcher to use the data for analysis.

The target population of this study was full-time faculty members in educational technology programs including both undergraduate and graduate programs. I obtained an emailing list from a colleague in China. The emailing list included 180 Chinese faculty members as an academic network in educational technology in China. An email about the survey was sent to the 180 Chinese faculty members. Those who were willing to participate could click the embedded link to the e-survey. Forty-two emails were bounced back and did not reach the projected recipients, and another 17 may or may not have received the email but did not respond. One hundred and twenty-one who received the email participated but only 52 completed and submitted the survey. These 52 participants were the unit of analysis, and their submitted data were analyzed. However, not all the questions were answered by all the participants who submitted the survey. Some participants skipped some questions. The exact number of responses to each question is reported in this paper.

The 52 participants were employed at 34 different universities from four municipalities, twelve provinces, and two autonomous administrative divisions in China. Based on the information on the universities' web sites, of the 34 universities, seven had bachelor's, master's and doctoral programs, fifteen had bachelor's and master's programs, one had only a doctoral program, one had only a master's program, and six had only a bachelor's program. No program information was found on three universities' web sites. One response was not clear about in which

Table 16.1 Participants' age distribution (N = 52)

Age	Response	Percentage (%)
25–30	1	2
31–35	3	6
36–40	15	29
41–45	13	25
46–50	14	27
51–55	6	11

Table 16.2 Participants' work experience in educational technology (N = 52)

Year	Response	Percentage (%)
1–2	1	2
3–5	3	6
6–10	9	17
Above 10	39	75

university the participant was employed. The response said: "in a Chinese normal university." According to this information, the participants were from the universities at various levels. The majority of the 52 participants were in the age range of 36 to 50 (see Table 16.1). Most of them have been working in the educational technology field for more than 10 years (see Table 16.2).

The majority of the participants earned degrees in other areas rather than in educational technology. Tables 16.3 and 16.4 present the responses collected. Other areas included education, learning science, psychology, computer, physics, management, geography, communications, information, and engineering. Education included education science, higher education, and agricultural education. Computer included computer science, computer software, computer hardware, computer applications, and computer technology. Management included educational management, environment science and management, and management science.

Twenty-three of the 52 completed the question regarding their degrees, including their bachelor's, master's and doctoral degrees. Twenty-three did not respond to the bachelor's degree question, and 14 did not respond to the master's degree question.

Table 16.3 Major and degree (N = 52)

Bachelor	Resp.	%	Master's	Resp.	%	Doctoral	Resp.	%
BS in Ed Tech	13	25	MS in Ed Tech	14	27	PhD in Ed Tech	2	4
BA in Ed Tech	1	2	MA in Ed Tech	4	7	EdD in Ed Tech	15	29
			MEd in Ed Tech	3	6	SD[a] in Ed Tech	2	4
Other	15	29	Other	17	33	Other	18	34
No response	23	44	No response	14	27	No response	15	29

[a]Doctor of Science

Table 16.4 Major distributions in other areas

Degree	Education	Learning science	Psychology	Computer	Physics	Management	Other
Bachelor	4	0	1	4	3	1	2
Master's	7	0	2	4	0	3	1
Doctoral	6	1	2	3	0	2	4

No follow-up measures were used because the data was collected anonymously. Eleven participants responded to neither bachelor's degree nor master's degree. The only guess for those is they might have thought of providing a final doctoral degree that should be enough to represent their education. It is possible that those who did not respond to the bachelor's degree question might not have a bachelor's degree but a diploma of 3 years' education or a diploma of 4 years' education. The difference between having a bachelor's degree and having a bachelor's diploma concerns whether or not the students passed the college English standardized test required for all the college students in order to receive a bachelor's degree (a policy which did not last long and finally was removed from the graduation requirements). Of the 15 who did not respond to the doctoral degree question, it is likely that those 15 did not have a doctoral degree. Chinese usually are very proud of having a doctoral degree, so it is unlikely for them not to provide information of their doctoral degrees when providing information of the lower level degrees. From this sample, we can assume that 29 % of higher education faculty in educational technology in China do not have a doctoral degree. Table 16.5 shows the age range of those who did not report having a final doctoral degree.

The sample was not randomly selected; however, based on the demographics, it should be fair to say that the information collected from this unit of analysis could represent quite well the population of educational technology higher education faculty in China.

Table 16.5 Distribution of those who do not report having a doctoral degree

Age range	Response	Total response	Percentage of no degree/total (%)
26–30	1	1	100
31–35	0	3	0
36–40	4	15	27
41–45	5	13	38
46–50	2	14	14
51–55	3	6	50
Total	15	52	29

16.2.2 The Survey Instrument

The survey questionnaire was developed by the researcher to investigate the background information and perspectives of the educational technology faculty in China. It was composed of six closed-ended questions and 14 open-ended questions. Three closed-ended and two open-ended questions were about demographics. The other questions were designed to find out participants' understanding of the educational technology field, knowledge acquired, research conducted, papers published, and their perspectives about educational technology in China. The questionnaire was created in English and then translated into Chinese. A pilot study was conducted earlier in the year in the format of personal interviews to three educational technology faculty members who came for the academic conference in a large university in Zhejiang province in China to pretest the questionnaire and examine the clarity of the questions. The three tryout interviewees were interviewed on 3 different days after the conference sessions. They were able to understand all the questions on the questionnaire. Before finalizing the questionnaire, I also discussed the Chinese translation with a Chinese doctoral student, who had been an associate professor in educational technology in Shanghai. Minor revisions were made on the Chinese word choices of the translated book titles to match the existing translation in China.

16.3 Findings and Analysis

16.3.1 Procedure of Data Analysis

The open-ended questions were analyzed one question at a time using the following procedures:

1. Reading each individual response to the question carefully to fully understand the participant's thoughts
2. When having an overall picture of all the responses, reading each individual response for a second time to further familiarize with each participant's response
3. Forming a coding system based on the themes identified from the review of the responses
4. Verifying the coding system and the themes against each response and revising the coding system accordingly
5. Coding the data and summarizing to form a report draft
6. Moving to the next question
7. When all the questions were analyzed, after one and a half months, repeating the same procedure of Steps 1–5 for each question

8. Comparing the analysis results of the two report drafts to identify possible discrepancies
9. Adjusting the report based on the better understanding of the data collected and analyzed

16.3.2 Findings

16.3.2.1 Understanding of the Educational Technology Field

A general question was included to find out how much the participants could talk about the educational technology field. Fifty-two participants all answered this question. The responses were coded into four categories: no thoughts, comments, shallow understanding, and comprehensive understanding. The response in the no thoughts category was simply a sentence of "I don't know." Those responses that were classified in the comments category were personal opinions, such as "Information technology is the most important components of educational technology;" "Theories need improving and educational technology certainly enhances education;" "Educational technology will have a great impact on higher education;" etc. A total of 21 responses were personal opinions. Those responses that were classified in the shallow understanding category were very simple answers, usually one to two sentences. They reflected some correct concepts although information provided was far from sufficient. The examples included "Using technology to help enhance human learning;" "Technology use in school education and in business training;" "Research on application of technology in education;" etc. A total of 10 responses fell into this category. Those responses that were classified in the comprehensive understanding category, although not really inclusive, include key elements in educational technology. Here are a few examples:

> Appropriately use modern technology to solve problems in teaching and learning. Educational technology serves education and applies technology. Use various types of information technologies in various learning and teaching situations and form various research focuses for educational technology. The research and practice in educational technology include instructional games, instructional design, smart teaching and learning, distance education, etc.
>
> Educational technology is a bridge between education and technology. Integrate information technology in instructional design to enhance teaching and learning, improve teaching and learning, and design innovative strategies in teaching and learning.
>
> According to AECT 2005 [2008] definition, Educational Technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources.

A total of 20 responses were identified as comprehensive understanding of the educational technology field. Table 16.6 presents the responses and percentage of the responses in each of the four categories in each age range.

Table 16.6 Levels of understanding in each age range ($N = 52$)

	25–30 ($n = 1$)	31–35 ($n = 3$)	36–40 ($n = 15$)	41–45 ($n = 13$)	46–50 ($n = 14$)	51–55 ($n = 6$)
No Thoughts	0	0	0	1 (8 %)	0	0
Comments	1 (100 %)	0	5 (33 %)	6 (46 %)	6 (43 %)	3 (50 %)
Shallow	0	0	3 (20 %)	2 (15 %)	3 (21 %)	2 (33 %)
Comprehensive	0	3 (100 %)	7 (47 %)	4 (31 %)	5 (36 %)	1 (17 %)

16.3.2.2 Understanding of the Major Areas in the Educational Technology Field

This question was a follow-up question to the previous one to find out more detailed information about participants' understanding of this field. The question was more specific. Forty-six participants answered this question. Six participants skipped this question. Of the six, two did a very detailed answer to the previous question, which provided the reason why they did not answer this question. They had actually included the answer to this question in the previous answer. Examining the other four participants' answers to the previous question, I found they all used one very short sentence to make a comment on the educational technology. They were "improving learning," "will have a great impact on higher education," "takes a very important role in education," and "diffusing to more areas." From their answers to the previous question and the fact that they skipped this question, we may assume they did not have much knowledge in this field.

The participants were asked to provide their rationales for their answers to the question. Twenty participants wrote rationales but 26 did not include a rationale. These 20 rationales can be coded into three categories. They were understandings based on (1) personal opinion, (2) reading and/or practice in the field, and (3) AECT definition. Four responses were based on personal opinions, six based on their reading and/or practice in the field, and the remaining ten based on the AECT definition. Most of those whose responses were based on the AECT definitions focused their answers on the AECT five standards at various detail levels. However, one who said his/her understanding was based on the AECT's 1994 definition did not provide a substantial answer by saying: "I never seriously thought about it; my understanding is AECT's 94 definition." Summarizing the responses collected, I found, in general, except for those who did not have much knowledge or conceptions about this field, the understanding of the majority of those who answered the question was quite consistent with the understanding of scholars in the western countries.

16.3.2.3 Where Most Knowledge in Educational Technology Was Obtained

Fifty-one participants answered the question of where they had obtained most knowledge in educational technology. Except for one participant who said multichannels without specifying them, other responses were categorized into six channels, including Web, readings (books and journals), academic exchanges (conferences and visiting scholarship), practice (projects and teaching), formal education (degree seeking), and "self-learning." Self-learning is directly quoted from the answer but those who said self-learning did not provide a definition. Eighteen participants only mentioned one channel and others mentioned more than one and up to four channels. Table 16.7 provides responding frequencies to each channel. The one whose response was multichannels without specifying what they were is not included in the table.

16.3.2.4 Textbooks Used in the School

Forty-seven participants answered the question of what textbooks they used in the school. Of the 14 texts provided as options, only one text was not used. Table 16.8 lists the texts and the frequencies mentioned from the responses. Fourteen responses also mentioned other texts. Of the other texts mentioned, one was an English text and the rest were Chinese texts. The English book was Reigeluth, C.M.'s *Instructional-design theories and models: A new paradigm of instructional theory*. The Chinese texts were about media environment, educational psychology, computer science, curriculum design, multimedia technology, Web, distance education, research methodology in educational technology, communication, C language, Pacal [Pascal] language, video instruction, black and white TV, color TV, electronics, and analog circuit. Many did not mention whether or not they used the English or the translated version of the texts originally published in English. According to several who included comments, the texts they used were the translated versions in Chinese.

Table 16.7 Where most knowledge was obtained ($N = 50$)

Channel	Frequencies
Readings	33
Web	25
Academic exchanges	15
Formal education	9
Practice	9
Self-learning	3
Total	94

Table 16.8 Texts that are used in China ($N = 47$)

Text	Frequencies
Dick, Carey, & Carey: *The systematic design of instruction*	28
Smith & Ragan: *Instructional design*	17
Reiser & Dempsey: *Trends and issues in instructional design and technology*	17
Smaldino, Lowther, & Russell: *Instructional technology and media for learning*	16
Mayer: *Multimedia learning*	15
Jonassen, Howland, Marra, & Crismond: *Meaningful learning with technology*	12
Rogers: *Diffusion of innovations*	8
Mayer: *Learning and instruction*	7
Gredler: Learning and instruction: Theory into practice	7
Tapscott: *Growing up digital: How the net generation is changing your world*	6
Driscoll: *Psychology of learning for instruction*	5
Alessi & Trollip: *Multimedia for learning: Methods and development*	4
Ertmer & Quinn: *The ID casebook: Case studies in instructional design*	2
Other	14
Total	158

16.3.2.5 Research Interest in Educational Technology

The research areas of interest to the Chinese scholars in educational technology were varied. The majority had more than one research interest. The responses are summarized in Table 16.9. Interest in the research of technologies included areas like computer games, educational video, technology resource development, educational software development, information technology courses, integration of emerging technology in education, online technology, 3D technology, digital

Table 16.9 Research interest in educational technology ($N = 52$)

Category	Frequencies
Various technologies	15
Online education	13
Teacher development/education	10
Instructional design	9
Learning and performance	8
K-12	7
Open education	5
Assessment	3
Hybrid learning	3
Mobile learning	3
Distance education/e-learning	4
Other	27
Total	107

technology, technology application, virtual technology, multimedia technology, etc. Interest in the research of online education included areas like online teaching and learning, online social interaction, online learners' psychological behavior, adaptive online learning systems, etc. Interest in the research of teacher development and education included areas like application of instructional design in teacher training, development of teachers' technology capability, etc. Interest in the research of instructional design included areas like online instructional design, instructional system design, integration of information technology into instructional design, multimedia instruction design, instructional context design, etc. Interest in the research of learning and performance included areas like learning science, performance improvement, reform of teaching and learning with technology, learners' motivation, etc. Interest in the research of K-12 educational technology included areas like digital campus, educational technology application in schools, robots in the classroom, flipped classroom, etc. Interest in the research of open education included areas like open education resources, development and utilization of open education resources, open courses, and MOOCs. Interest in the research of assessment includes areas like performance assessment, online learning assessment, etc. Interest in the research of hybrid learning included areas of hybrid learning environments and hybrid collaborative learning. Those who mentioned that their research interests were mobile learning, distance education, and e-learning did not specify the areas. The other category included individual topics that do not fit well in any of the above-mentioned categories such as educational technology policy, technology and language education, media comparison, etc.

16.3.2.6 Research Areas in Which Studies Were Conducted

In which research areas did Chinese scholars in educational technology conduct studies? Table 16.10 summarizes the responses. The other areas of research studies included Internet education policy analysis, computer games and social network, design and development of digital resources, technology and facilities in higher education, research in educational technology history, educational technology curriculum construction, distance education and online teaching and learning, teacher development, electronic instructional materials, and information systems.

Table 16.10 Areas where research studies were conducted ($N = 50$)

Research area	Frequencies
e-Learning	38
Instructional design	29
Educational technology in K-12	7
Other	11
Total	85

Table 16.11 Types of papers published (N = 50)

Types	Frequencies
Research studies conducted	42
Literature review	23
Opinion papers	22
Other	2
Total	89

16.3.3 Papers Published

What types of papers had the Chinese scholars in educational technology published? Table 16.11 summarizes the types of papers they published. Two participants checked the other category. One specified it as empirical data/demonstration, and the other specified it as research paper and technical report.

16.3.3.1 Perspectives

This section summarizes participants' perspectives on the strengths and weaknesses of educational technology in China, how they could help improve educational technology in China, and trends and issues perceived in educational technology.

Forty-nine participants answered the question of strengths and weaknesses. The strengths included:

- The government's strong support
- The country's tendency of developing information technology
- Overarching plan on enhancing development of educational technology in China
- Sufficient funding for research and development
- Sufficient funding for academic exchanges internationally
- Sufficient funding for teacher training and development
- Sufficient manpower for developing and conducting research
- Numerous highly intelligent scholars in the field
- Various backgrounds of the scholars in the field
- Fast pace of following the development in educational technology in the world
- Quick access to new thoughts and new ideas from over the world
- Many problems that need solving, which provided more practical opportunities for the development of research and practice in educational technology
- Research in various areas
- Strong technology and development of both hardware and software
- Active and energetic field and sensitive to the happenings in the world

The weaknesses included:

- Research methods were not robust, especially design in quantitative studies
- Lack of evidence-based studies
- More focused on research in information technology
- Most journal papers were personal opinion papers
- Lack of language capability, which prevented papers from publishing in the international journals
- Except for several higher level universities, research in other universities was relatively weaker
- The main flow of research follows government's direction, which prevents academic research from developing healthily
- Unfair evaluation of research project proposals, favoring some but unfair to the others, which created unfairness in academic development
- Many researchers not having clear directions in research
- Research needs more focus and in depth instead of big, touching everything, and reaching everywhere
- School teachers need more guidance in action research
- Lack of theoretical framework and instructional design research in educational technology
- Busy following what happened outside of the country but lack of originality
- Problems with implementing what is learned from outside of the country
- Lack of original and operational guidance in practical opportunities
- More focused on what it was instead of what it was for (learners)
- More focused on hardware (technology) but lack of knowledge in learning science
- Lack of profound research base in this field
- Theory needs enhancing, technology needs improving
- No systematic curriculum design, mission of the programs not clear
- Graduated students did not meet the needs of the society
- Lack of directions in business training and research
- Lack of effective ways to solve practical problems in educational technology
- Teaching for testing, which more or less affected research and practice in educational technology
- Lack of new models for application
- The government does not regard educational technology as equally important as other fields in education
- Not quite accepted by other fields
- Strong outside but weak inside, lack of influence in the society
- Large investment but small return

From the summarized lists, we can see the strength mentioned most was the government support with funding, and the weakness most mentioned concerned research methodology. Comments made by the participants were quite consistent except for a few controversial ones on technology (strong vs. weak), development of the field (hopeful vs. problematic), and quality research (theory vs. practice).

Three questions were composed for finding out participants' perceptions about how they would like and be able to help the development of educational technology in China, from more general to more specific. They were: "How do you plan on helping improve educational technology in China?" "What can you do to help improve educational technology in China?" and "What can you do currently to help improve educational technology in China?" The responses to the three questions are summarized in Tables 16.12, 16.13, and 16.14. Most responses focused on one aspect while some mentioned more than one aspect. Some responses that were not relevant to the questions were not included in the tables.

Table 16.12 How do you plan on helping to improve educational technology in China? ($N = 48$)

Category	Frequencies
Self-development	15
Research	11
Academic exchanges	9
Theory into practice	9
Enhancing teaching and training	5
Solving ethical issues	3
Total	52

Table 16.13 What can you do to help improve educational technology in China? ($N = 46$)

Category	Frequencies
Self-development	11
Research	10
Enhancing teaching and training	9
Publishing to influence others	9
Introducing advanced knowledge and technology into China	7
Theory into practice	7
Total	53

Table 16.14 What can you do currently to help improve educational technology in China? ($N = 41$)

Category	Frequencies
Exchange and collaboration	17
Enhancing teaching and training	9
Research	7
Self-development	5
Design	4
Ethical	4
Total	46

Table 16.15 What ideas do you have on the joint programs/projects between China and other countries? ($N = 45$)

Category	Responses	Percentage (%)
Specific ideas	23	51
Opinions	14	31
No idea	8	18
Total	45	100

16.3.3.2 Ideas, Perceptions, and Perspectives

The last three open-ended questions were about respondents' ideas on joint programs/projects with other countries, perceptions of the trends and issues in educational technology in China, and perspectives of global education in future. Table 16.15 summarizes the responses into three categories. The specific ideas included what they could do including joint programs and projects on research, training, resource sharing, and academic exchanges. The opinions included what they thought should be done, such as setting specific joint program/project goals, building networks, improving language, strengthening exchanges, etc.

Forty-eight participants responded to the question of what were perceived about trends and issues in educational technology in China. Fourteen responses answered both parts about trends and issues. Nineteen responses were about the trends perceived only, and eight responses were about the issues perceived only. Six participants did not provide substantial responses and one response was not to the question. The following is a summary of the trends and issues in China perceived by the participants.

Trends

- More emphasis on practical applications, effects, learning, performance, methods, and influence of technology on education
- Hybrid leaning model
- Education resources development and application
- Integration of multiple subject areas into educational technology
- Convenient use of technology in education
- Educational technology heavily influenced by information technology
- Open education, virtual education, and online education
- Focusing on the learner and learning tasks not technology
- A system of sharing good-quality resources
- Enhancing teachers' educational technology capability
- Scientific and systematic building of educational technology theories
- Mobile learning, ubiquitous learning, and microcontent of instruction
- Big data
- Technology supporting learning not teaching
- Research becoming more challenging
- Emerging technology in learning
- Increasing gaps between the advanced area in the east and the remote area in the west in China regarding research resources

Issues

- Challenge of not being accepted internationally
- Challenge of many scholars in educational technology in China being from other subject areas
- Lacking of knowledge and depth in research
- Seeking for new concepts, new technology but overlooking empirical studies on theory into practice
- Needing teacher training
- Needing enhancement of information technology
- Talking more than acting
- Talking about what without knowing why and how
- Lacking of design for the integration of technology into teaching and learning
- Quick following before ready for accepting

Forty-six participants responded to the question of perspectives of the global education. The responses from the participants were quite consistent and the following is a summary of the key perspectives:

- There would be no distinguishing definitions between formal and informal education
- There would be transformation from learning in the classroom to learning in the real world, less emphasis on traditional classrooms
- MOOCs and virtualization would be the trend
- There would be disappearance of boundaries in learning between countries
- There would be advancement of online technology
- Education would become open and free, everyone enjoying learning from the best resources at home
- Resources and achievements would be shared
- There would be more international communications, academic exchanges, and joint research projects
- Learning would be ubiquitous, mobile, collaborative, and active
- Technology would enhance learners' high-level critical thinking
- Learning would be personalized and lifelong
- There would be challenges in instructional design and competition in higher education

16.4 Discussion and Conclusion

The unit of analysis of this study was composed of faculty members in higher education from 34 universities at various levels throughout China. From the demographic data, this sample can be considered as well representing the population. Findings from this sample tell us that a relatively large portion of the current faculty in educational technology in China have other academic backgrounds than educational technology, and about 29 % of the faculty do not have a doctoral degree. Knowledge about educational technology that Chinese faculty obtained was from various channels including Web, readings (books and journals), academic exchanges (conferences and visiting scholarship), practice (projects and teaching), and formal education (degree seeking). Most knowledge that Chinese faculty in educational technology was obtained from readings. Only 9/50 mentioned that most knowledge that they obtained was from formal education. In the Chinese universities, the programs adopted textbooks written by both western and Chinese scholars, but they mostly use the translated versions rather than the original versions of English texts.

As faculty members in higher education, the majority had quite a good sense of what this field is. They follow AECT definitions closely and have quite a few ideas regarding what they can do to contribute to this field in China; however, not all the faculty members in this field fully understand this field. Besides a few who do not understand this field well, there are some others who do not have much idea regarding what to do to contribute to or help with educational technology in China. This group of faculty does not have substantial ideas about what they can do but make comments on what this field should do and be like.

The interest that Chinese scholars in educational technology hold in research varies, focusing on various technologies. The interesting finding is only 5 of the 52 participants responded that they were interested in open education while open education was considered as the most interesting topic in China according to a large university in East China. The responses provide evidence that faculty's research interests are more focused on online education, teacher education and development, instructional design, and learning and performance. Their studies are very much focused on e-learning and instructional design. The findings show that most papers published by the participants are the reports of the studies they conducted. There are also papers on literature review, and a relatively smaller number of the papers are personal opinions. This fact indicates that the publications in educational technology in China now emphasize empirical studies rather than personal opinions.

China is growing at a fast pace, so is the educational technology in China. The Chinese government has been providing tremendous funding for improving higher education in China, including inviting scholars from western countries as well as sending Chinese scholars out for academic exchanges. More and more Chinese scholars realize the importance of self-improvement, having opportunities of going abroad for further development, and establishing relationships with universities internationally for academic exchanges. While research is largely thought of as important for academia, Chinese scholars find that there is a vital need for help with research methodologies. While in China there used to be little emphasis on ethical issues in academia, a few participants in this study claimed that they could help improve Chinese educational technology with ethical issues.

Chinese scholars do see the challenges they face. Their concerns, among other things, include the challenges of not being accepted internationally, many scholars in educational technology in China lack an educational technology background, lack of knowledge and depth in research, lack of design strategies, and talking more than acting. China is following and doing its best to keep up with the trends in the world. The pace is unbelievably fast but challenges are many. Theory into practice and thorough work on the implementation of technology in an appropriate manner may help educational technology in China move on and forward.

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References

He, K. (2013). English translation of the title. (247), 34–45.
Jiao, J. (2005). On research in educational technology. (223), 20–23.
Lai, F.-Q. (2007). Five tens, eighteen circles, & online learning of educational technology in China. *International Journal of Technology in Teaching and Learning, 3*(2), 69–84.
Li, K. (1996). Issues about applied research in multimedia education. *109*, 19–23.
Nan, G. (2000). Development of e-education in China since 1980s. *92*, 3–6.
Sang, X. (2005). Exploring new models for curriculum and instructional design in higher education at the information age. (6), 38–41.
Zhang, X., & Li, J. (2005). The relationship between the subjectivity of human being and educational technology. *11*(2), 18–22.

Chapter 17
Epilogue

Robert A. Reiser

The Merriam-Webster online dictionary indicates that an epilogue is "a concluding section that rounds out the design of a literary work". I am not sure that this epilogue does that, but what I have attempted with this epilogue is to identify what I consider to be some important themes that were addressed, either directly or indirectly, across the various chapters of this volume. In doing so, I have not attempted to summarize the key points in each chapter; instead I have focused on one or two particular points in each chapter, points that are related to one of the several themes I will be discussing. But before I turn to those themes, let me briefly comment upon the wide variety of topics discussed in this volume.

Regardless of the perspective you take, it is apparent that over the more than 100 years in its history, the field of instructional design and technology has been constantly changing and expanding. Whether you examine the field in terms of the media that are considered part of it, the learning theories that underlie it, or the instructional design approaches that have been associated with it, you cannot help but note that the ideas, practices, tools, and products linked to the field are continually growing. Thus it is not surprising that the chapters in this volume, each of which is based upon a paper presented at the 2015 AECT-LKAOE (Learning and Knowledge Analytics in Open Education) Research Symposium, focus on a much broader range of topics than those mentioned in the title of the symposium.

The titles of the chapters in this volume provide you with some indication of the range of topics that are addressed. Among others, these include: digital games, open education resources, online instruction, social media, and MOOCs (Massive Open Online Courses). I have purposely mentioned these topic areas because each one specifically refers to, or connotes, a particular *technology*, a physical means via which instruction is presented to learners. Currently, interest in such technologies is quite high. For example, in Chap. 16, Lai indicates that a survey she conducted

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reveals that the research topics that were of interest to the largest number of Chinese scholars involved technologies such as computer games, educational video, and online instruction. And in Chap. 11, Reiser discusses several of the aforementioned technologies, stating that usage data clearly indicates that they are among the major trends that have affected the field over the past 10 years.

However, in spite of the current interest in a wide array of technologies for presenting instruction, a careful examination of the chapters that mention or refer to these technologies in their titles indicates that the primary focus of those chapters is *not* on the technologies themselves. What do these chapters focus upon? They focus on the learning activities (I will call them *instructional events*) that are presented via technology. This leads me to the first theme I would like to discuss: the importance of instructional events.

17.1 The Importance of Instructional Events

As stated above, while the titles of many of the chapters in this book focus on technology, the primary focus of many of those chapters is on the learning activities, what Gagné (1985) referred to as instructional events, that are presented via those technologies. For example, in Chap. 9, Li, Zhang, Bonk, Zhang, and Gao describe a study involving an online course, but the suggestions the authors provide at the end of the chapter do not focus on the technology of online instruction; instead, they discuss a variety of instructional events that might be presented via online instruction in order to facilitate student learning. In particular, they mention the importance of providing suitable *scaffolding* for learners and designing opportunities for face-to-face and online *interactions*.

The authors of three other chapters follow a pattern much like the one employed by Li, Zhang, Bonk, Zhang, and Gao. They examine how student learning is affected by a particular instructional event that is incorporated within an online course or other form of technology. In particular, Liu and Adams (Chap. 5) discuss how *scaffolding*, an instructional event they employed in an online course, affected student learning. As described in Chap. 6, Jiao, Yang, Zhong, and Ren also conducted research involving an online course, in this case in the form of a MOOC, but their primary focus was on what effect a particular instructional event—*the provision of peer feedback*—would have on student learning. The chapter by Zakharov, Horton, Reid, Willis, and Attardo (Chap. 12) is another example of the point being made here. On the one hand, the authors are focusing on faculty use of social media, a technology or group of technologies via which messages are conveyed. On the other hand, when the authors turn their attention to the types of professional development activities they offer to faculty so as to encourage them to use social media in their classes, most of activities focus on the ways social media can be used in the classroom; in other words they focus on the learning activities/instructional events that can be delivered via social media so as to actively engage students and to promote student learning.

Several other chapters in this volume also discuss the importance of the instructional events that comprise a lesson. David Merrill's chapter (Chap. 14) focuses almost exclusively on this issue. He clearly explains that learning is promoted when instruction incorporates four types of instructional events, namely instructional activities designed to: *activate* students' prior knowledge, *demonstrate* to students the skill to be learned, require students to *apply* the skill, and have students *integrate* the newly acquired skill with those they already possess. Merrill labels these four principles, plus the importance of creating *problem-centered learning,* as the *First Principles of Instruction* (Merrill 2013). In her chapter, Ana Donaldson (Chap. 7) also focuses on the importance of these principles, indicating that instructional designers should incorporate them, plus the principles described in John Keller's ARCS model (Keller 2010), in order to design effective instruction.

In his chapter, Michael Spector (Chap. 2) also expresses concern about designing effective instruction and clearly describes many reasons why various educational technology projects have not had the impact on learning that many have expected. One issue Spector raises relates directly to the instructional principles discussed by Merrill and Donaldson. He points to the fact that MOOCs, one category of online courses, typically do not include some of the instructional events often considered crucial for supporting learning—namely timely and informative feedback to students and en-route measures of students' acquisition of skills and knowledge. Merrill makes a similar point, indicating that a recent study examining 76 MOOCs found that only three of them included appropriate demonstrations of the skills that students were expected to learn.

From my perspective, the most important point raised in the chapters described here is the one I mentioned earlier, that the key to effective instruction is not the technology that is used, rather it is the instructional events that are presented via that technology. That is not to say that technology is unimportant; indeed, as has been discussed elsewhere (Kozma 1994; Reiser 1994) some types of instructional events (e.g., demonstrating a physics concept in slow motion) can only be presented via particular technologies. Nonetheless, when it comes to student learning, what is crucial is the careful design of the instructional events that are presented via technology.

17.2 Aligning Goals, Instruction, and Assessment

One particular instructional event—evaluation, or assessing student learning—is one of the foci of Chap. 1. In that chapter, Harris and Walling discuss, among several issues, the importance of aligning evaluation with instructional goals and instructional activities. As these authors indicate, given that we want our learners to attain the goals we have set for them, it is important that we (a) plan instructional activities that provide learners with the information, examples and practice necessary for them to attain the desired goals, and (b) design assessment methods that assess whether our learners have done so. These seem like common sense principles, but oftentimes there is poor alignment between these three components (goals, instruction, and assessment), with each component addressing the same content, but focusing on a different type of learning outcome. Making sure that all three components are clearly aligned is one of the keys to designing effective instruction.

17.3 The Growing Interest in Learning Analytics

Several of the chapters in this volume focus on learning analytics, the collection, analysis, and reporting of various types of data about learners and learning, for the purpose of improving instruction and learning. This focus is not surprising, inasmuch as learning analytics research was one of the major themes of this conference. In Chap. 3, Johnson offers suggestions as to which types of data, from the vast array that are available, are most important to collect. He states we should begin by identifying the key indicators of expert performance within a particular domain, and then design a system for collecting data that focuses primarily on those indicators. He indicates that doing so will enable us to better assess each learner's progress, adjust our instructional decisions in light of that progress, and provide appropriate feedback in light of the learner's performance.

As is the case with Johnson, Li, Bao, and Xu (Chap. 4) also discuss the challenge that arises when a very large amount of data is available, making it difficult to decide which data needs to be collected and analyzed, and they offer suggestions as to how to address this problem. In the process of doing so, they make a key point, namely that the collection of large amounts of data is only worthwhile to the extent to which that data is used to help further specific learning and/or organizational goals.

Using learning analytics to help foster student attainment of learning goals is exactly the focus of the work described by Kang, Liu, and Liu (Chap. 10). In their chapter they describe how they examined, depicted, and analyzed the activities of students engaged in a serious game environment, and how that effort provided information that can be used to improve the design of learning environments and facilitate student learning.

The use of learning analytics is also one of the many topics that Childress discusses in his chapter (Chap. 8). He indicates that the careful analysis of the data that learning analytics provides should result in improvements in instruction and learning, resulting in greater opportunities for skill mastery. However, he cautions that a new set of skills will be necessary in order to identify the most useful data from the plethora of information now available. This issue is also addressed in Chap. 13, in which Branch discusses the emphasis that information science places on the collection and analysis of data. He goes on to state that effective visualization of that data should lead to insights as to how to improve instruction which, in turn, should result in greater student attainment of learning goals.

Although learning analytics was one of the major foci of most of the aforementioned chapters and the AECT-LKAOE Research Symposium, it is interesting to note that, as the data collected by Lai (Chap. 16) indicates, currently this topic is not one of the major research interests of Chinese scholars in educational technology. However, as we continue to improve the means by which we can identify, collect, analyze, and report key types of learning data, interest in using, and conducting research on, learning analytics will certainly increase. The chapters described above are examples of this increasing interest.

17.4 The Importance of Clear Written Communication

In their chapter on academic writing, publishing, and presentations, Johnson, Spector, and Wang (Chap. 15), offer a wide variety of helpful tips. Given the importance of clear written communication in the academic world, the writing guidelines these authors provide, and the excellent resource they cite (the Purdue Online Writing Lab https://owl.english.purdue.edu), are particularly useful. One of the many writing suggestions that the authors provide that is worth repeating is that writers should try to express just one idea in each sentence. A corollary to this suggestion is that each paragraph in a manuscript should focus on one main idea, and that idea should be expressed in a topic sentence that should appear at or near the beginning of the paragraph, usually in the first or second sentence (you might want to go back and skim through this epilogue to examine whether these principles have been applied here!).

In addition to their suggestions regarding clear written communication, Johnson, Spector, and Wang also provide excellent advice on developing a research agenda, delivering presentations at conferences and getting manuscripts published. In short, this chapter serves as a very useful primer for those pursuing a career in academia.

17.5 Conclusion

As an attendee at the 2015 AECT-LKAOE (Learning and Knowledge Analytics in Open Education) Research Symposium, I was very impressed with the quality of the papers that were presented at the event. Indeed, I found the symposium to be one of the most informative and well-organized professional meetings I have attended. The chapters in this book, each of which serves as the written version of one of the conference presentations, are excellent examples of the high quality work that was shared at the conference.

In this epilogue I have tried to highlight a very small number of the ideas described in the chapters in this book, focusing on themes and topics that are particularly interesting to me. In doing so, I have barely touched upon the many ideas and suggestions discussed in these chapters. In order to fully benefit from those ideas and suggestions, I encourage to go back and reread some, or perhaps all, of the chapters. As for this epilogue, I imagine that you will conclude reading it once was enough!

References

Gagné, R. M. (1985). *The conditions of learning* (4th ed.). New York: Holt Rinehart, and Winston.

Keller, J. M. (2010). *Motivational design for learning and performance: The ARCS model approach*. New York: Springer.

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development, 42*(2), 7–19.

Merrill, M. D. (2013). *First principles of instruction: Assessing and designing effective, efficient, and engaging instruction*. San Francisco, CA: Wiley.

Reiser, R. A. (1994). Clark's invitation to the dance: An instructional designer's response. *Educational Technology Research and Development, 42*(2), 45–48.

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