Chapter 18
Looking Back and Moving Forward with Game-Based Learning Across the Disciplines

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18.1 Introduction

Game-based learning is a dynamic field that has recently garnered much interest from different areas, including digital game design, human–computer interaction, and different branches of education and psychology, such as cognitive, motivational, and social psychology. As emphasized in this edited volume, the various subject domains (e.g., business and economics, social studies, STEM) are also pivotal. Although game-based learning is not limited to digital games, and has in fact a long-standing history in human learning and development far beyond the times of digitalization (Huizinga, 1971; Leontiev, 1978), the growing interest—not to say "game hype"—in educational settings can also be attributed to technological advances as well as to particular preferences in users' digital media behavior. Nowadays, digital games are strongly anchored in the everyday life of especially (but not only) young people. According to a recent study (JIM, 2020), 68% of young people in Germany play on a regular basis, only 8% of the 12- to 19-year-olds do not play. Boys have a higher gaming affinity overall than girls. On average, young people of this age group of both genders played computer, console, tablet, and mobile games for around 121 min per day from Monday to Friday and 145 min at weekends. In comparison to 2019, this represents a plus of 40 min during the week and 28 min at weekends, respectively, a growth that is presumably related to the

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current COVID-19 lockdown situation. These developments are not limited to Germany but are also to be found in a similar way in other (industrialized) countries.[1]

If games exert such a fascination, it is only natural to ask whether and how they can be used to successfully promote learning by merging game activities with learning activities. This purpose, however, is what differentiates games for learning from purely entertaining games, although there is significant overlapping, since motivation and fun are also crucial for game-based learning.

This edited volume presents a wide-ranging collection of work and findings on game-based learning inside and across various disciplines. Overall, it features chapters that are routed in various disciplines, theoretical foundations, and research traditions. It also addresses different educational fields, including kindergarten, secondary, vocational, professional, and higher education and covers multiple game genres, such as board games, adventure games, or simulation games.

In this concluding chapter, we aim to situate the single contributions of the volume within more general reflections on the potential benefits of game-based learning (Sect. 18.2) as well as to provide an analysis and synthesis of major themes that have emerged in the previous chapters (Sect. 18.3). Finally, we intend to sketch ideas for future research on game-based learning from an inter- and transdisciplinary perspective (Sect. 18.4).

18.2 Potential Benefits of Game-Based Learning Across the Disciplines

As Whitton (2012) notes, there are many similarities between the characteristics of games and the characteristics of effective learning experiences in that they should be challenging but attainable, engaging, and interactive. It is no wonder, then, that the potential benefits of digital games become particularly evident from the perspective of contemporary learning theories, notably constructivist, situated, and experiential approaches (e.g., Collins et al., 1989; Greeno, 1998; Lave & Wenger, 1991; Moon, 2004). These theories, in turn, are inspired by tenets from pragmatism (e.g., Dewey, 1963), sociocultural and cultural-historical psychology (e.g., Vygotsky, 1978) as well as fundamental findings in cognitive and motivational psychology (e.g., Malone & Lepper, 1987; Suchman, 1987). In particular, they view learning as an active, contextually bounded, and socially mediated process of making meaning out of individual experiences. This process aims at the formation of a multidimensional and, first and foremost, transferable set of competencies. Teaching, in turn, is conceived as the provision of adequate learning opportunities, i.e., the design of learning arrangements that stimulate students' active participation and guide their

[1] For data on the situation in France, India, Italy, Japan, Singapore, South Korea, United States and United Kingdom as well as a global score see, for example, the latest "State of Online Gaming" research report issued by Limelight Networks https://www.limelight.com/resources/white-paper/state-of-online-gaming-2020/

experiences. Within the frame of contemporary approaches, the following (non-exhaustive) advantages of digital learning games can be emphasized:

- *Digital games may support domain-related knowledge construction and higher order cognitive skills*. In digital games, learning is at its essence a kind of performance, as students learn by doing within the affordances and constraints of information-rich virtual worlds, instantiated through software and social systems. The primacy of game-based learning is on experience, constantly inviting the learner to understand and manipulate complex situations, learn through failure and related feedback, and develop identities as expert problem solvers (Squire, 2008). Thus, game-based learning provides what Barab et al. (2010: 525) call "consequential engagement" and is particularly expected to foster the acquisition of different forms of domain-related higher order knowledge and skills, such as conceptual understanding, strategic decision-making, and/or problem-solving (Eseryel et al., 2011).
- *Digital games can promote enjoyment, intrinsic motivation, and positive attitudes.* Due to their entertaining qualities, digital games are believed to be fun and thus much more attractive for learners, especially the ones from the digital native generation. This may lead to more effective involvement as well as to sustained intrinsic motivation. As Malone (1981) proposed, the primary factors that make an activity intrinsically motivating are challenge, curiosity, control, and fantasy. Digital games incorporate these factors, for example, through the need to attain goals, through sensory and cognitive activation, or with the help of narratives. In addition, their immersive nature may also enable the experience of flow (e.g., Csíkszentmihályi, 2008). In sum, these characteristics may positively influence attitudes toward learning both in general and in specific domains (Eseryel et al., 2014).
- *Digital games may foster generic abilities as well as psychomotoric and interpersonal skills.* As, for example, Granic et al. (2014) assume digital games may also foster more generic, often meta-cognitive abilities such as handling of complexity or information processing under the condition of risk and uncertainty as well as persistence, ambiguity tolerance, and self-efficacy. Depending on the specific game condition, they are moreover expected to (1) support psychomotoric skills (e.g., speed of reaction, eye-hand-coordination) and (2) if addressing facets of role-playing, or if played in teams of learners, to promote social skills.

In addition to these theoretical considerations, there is an ever-growing number of individual research studies on the effectiveness of game-based learning. Moreover, there are a dozen or so literature reviews (e.g., Boyle et al., 2015; Connolly et al., 2012; Donovan, 2012; Granic et al., 2014), both narrative and systematic, and a handful of meta-analyses (e.g., Clark et al., 2015; Sitzmann, 2011; Vogel et al., 2006; Wouters et al., 2013). The findings of this empirical research base show that games as a medium can, indeed, support productive learning under certain circumstances, but drawing general conclusions about their effectiveness is difficult because of the large range of areas and topics they cover, genres they represent, and age groups they target. However, what has become clear from the available

empirical investigations as well as from the contributions in this book is that we need to take an evidence-based approach for the study of learning with games. This includes evidence-based design principles for game-based learning as well as subsequent research efforts to further our understanding of how and under which conditions game-based learning works (Ge & Ifenthaler, 2017). Both of these issues will be addressed in the sections that follow.

18.3 Key Themes Emerging from Current Research

Several key themes on game-based learning inside and across the disciplines have emerged from the chapters in this book. From the perspective of designing effective learning arrangements, we have identified four main aspects that are important for harnessing the potentials of games in the different domains. These aspects will therefore be highlighted and analyzed further here, and include the following: (1) integrative design, (2) activity-oriented design, (3) context-sensitive design, and (4) participatory design.

18.3.1 Integrative Design: Taking Domain Knowledge into Account and Connecting it with Educational Theories

Since the 1980s, research has brought increasing attention to the importance of domain-related knowledge in human performance, learning, and development (e.g., Chi et al., 1988; Glaser, 1984; Glaser et al., 1987). As Patricia Alexander (1998) highlights, it is not a question of whether the "what" of learning (i.e., subject matter or domain knowledge) influences the "how" (i.e., the learning activities and processes). Such an influence is assumed. It is rather the question of how domain knowledge could be effectively considered when designing learning arrangements. Thus, in the wake of this recognition of domain knowledge, numerous instructional design models have been developed that call for appropriate analysis and mapping of the domain as a starting point for the development of any type of learning arrangement (e.g., Clark et al., 2008; Jonassen et al., 1999; Van Merriënboer & Kirschner, 2018).

These considerations have also made their way into game design. While some less elaborate, naive approaches simply add game elements as a "fun factor" to content learning, newer, more theory-driven, and empirically grounded models emphasize the need to purposefully integrate domain-specific learning contents into game design and to merge them with principles derived from educational theories, especially theories of learning, motivation, and engagement (Plass et al., 2020). This concern is also evident in many chapters of this volume. Schultheis and Aprea (Chap. 1) explicitly use insights from behavioral finance, a state-of-the-art approach

to financial theory, to elaborate human heuristics, and biases in financial decision-making. They also demonstrate how these features of the domain could be merged with considerations from educational psychology and ultimately be incorporated into the design and development of a decision-oriented financial literacy serious game. A financial decision-oriented approach to financial literacy is also evident in Chap. 4 by Andrea Pfändler, who additionally applies findings from happiness research to map the domain and to develop a holistic financial literacy board game. Similarly, Weber and colleagues (Chap. 6) start their activities to create a game that intends to assess sustainability competence in retail by analyzing and modeling the domain, providing a detailed picture of situations related to sustainability and their specific requirements.

While the aforementioned authors model the domain in a decision- or situation-oriented manner, Warren, Roy, and Robinson (Chap. 5) choose an alternative modeling approach by referring to key domain concepts. In their specific case, they identify "boundary of the firm," "explore and exploit," and "creative destruction" as core business concepts on which they base their subsequent business simulation game activities.

Ge and colleagues (Chap. 12) focus on another important yet often disregarded domain-related issue, which game designers and researchers should consider, namely, the difficulties that students experience with specific learning content, in this case, algebra. Finally, arguing from a design process perspective, Schuldt and Niegemann (Chap. 13) consider a proper analysis of the respective domain as the departure point of the decision-oriented instructional game design model they propose.

18.3.2 Activity-Oriented Design: Carefully Drafting Game Mechanics and Other Game Design Features

Along with the recognition of domain knowledge, recent learning theoretical accounts also emphasize the central role of learning activities as the primary means by which learners engage with the learning content (e.g. Chi, 2009; Honebein et al., 1993). Learning activities have long been relegated to the role of a vehicle for practicing a skill or process. In contrast, modern approaches inspired by constructivist philosophy, such as problem- and case-based learning or cognitive apprenticeship, have placed the activity that students engage in during learning firmly at the heart of any curriculum (Reeves et al., 2002). Learning activities structure, direct, and control the learning processes. Therefore, learning activities fulfill important cognitive and metacognitive functions when they are carried out appropriately. Given that learning activities are the means to bridge the gulf between (learning) goals and (learning) results or outcomes, they also play an essential role from a motivational point of view.

As pointed out in the introduction of this chapter, the distinctive feature of game-based learning is that it combines game activities with learning activities. This linkage is therefore of utmost importance in any game design process and is addressed (implicitly or explicitly) in all the contributions of this volume. The main game design element through which this linkage could be realized is game mechanics (Plass et al., 2020). According to Salen and Zimmerman (2004) game mechanics can be considered as the experiential building blocks of player interactivity, representing the moment-to-moment activity of players, something that is repeated over and over throughout a game.

For example, Yu and Denham (Chap. 11) specifically describe how the game mechanics of their augmented reality mathematics board game are inspired by the principles from three prominent learning science theories, i.e., cognitive load theory, multimedia theory, and collaborative learning theory. Paeßens and Winther (Chap. 3) also particularly feature the latter aspect, i.e., collaborative gameplay, in the context of basic financial education for adult learners. Similarly, Rosenblum and colleagues (Chap. 7) provide insights into the game mechanics of an experiential strategy designed to challenge college students to cooperatively tackle the complex problem of achieving peace in the Middle East. Moreover, these authors particularly stress the need for culturally sensible and responsive game design.

Lindberg and Naxer (Chap. 8) focus on motivational aspects of game mechanics by outlining how self-determination theory (Deci & Ryan, 2012) can be used to enhance the game design. They illustrate their considerations by providing examples from game-based learning in business and law online higher education at a small scale (i.e. within a learning activity) and a large scale (i.e. within a full course). A similar concern underlies the considerations of Platz, Jüttler, and Schumann (Chap. 2) who ask how an educational game could be used to promote learners' interest in economics. And again, the importance of game mechanics is stressed in Schuldt and Niegemann's decision-oriented instructional game design model mentioned earlier (Chap. 13).

Besides game mechanics, other game design elements shape the way in which learning activities can be performed during gameplay. An important element directly connected to the learning activities is how learning supports are designed and implemented in a game. Kim et al. (Chap. 8) address this aspect. They argue that learning supports should not impair flow experience during gameplay and be specific in the sense that they cater to the cognitive and affective states of the learners. In their contribution, the authors provide examples for learning supports from two case studies on authentic and complex problem-solving in secondary school and special needs STEM education.

In addition, narratives are an essential game feature. As especially Schrader and colleagues (Chap. 16) underline, all video games are implicitly or explicitly oriented in the narrative. Their contribution sheds light on this prominent design element by focusing on the epistemological relationship between the field of literacy and game-based learning. Furthermore, they examine the characteristics and properties of three prominent video games to demonstrate transversal elements of

literacy and describe reciprocal ways in which literacy supports an understanding of games, and games model, in the application, the elements of literacy events.

18.3.3 Context-Sensitive Design: Bearing in Mind the Needs and Constraints of the Implementation Setting

Games for learning purposes do not only provide contexts through their narratives, but they also need to work in specific contexts, settings, or environments. As especially approaches close to ecological systems theory (Bronfenbrenner, 1989) as well as such from ecological psychology (Gibson, 1966; Noë, 2009) and activity theory (Leontiev, 1978; Vygotsky, 1978) highlight, these contexts shape the way in which human thought and performance are carried out through their respective affordances and constraints. This powerful impact of the context is particularly important when it comes to the implementation of innovations in social settings such as schools or companies, mainly because these innovations usually require multilevel change or transformation processes to be successful. This is no exception for social and/or technological innovations, such as those involved with the implementation of digital learning arrangements (Aprea & Cattaneo, 2019; Ifenthaler et al., 2021), including serious games and game-based learning.

Acceptance from key actors in the context in which the innovation is ought to function is crucial. This aspect is the focus of the contribution by Nieland et al. (Chap. 15), who investigate teachers' acceptance as a critical factor for the successful implementation of game-based learning in vocational school settings. Similarly, Li and colleagues (Chap. 10) explore what STEM teachers consider important for successfully integrating digital games into classrooms. Both chapters confirm the critical role of teachers as "gatekeepers." In addition, the alignment of game-based learning with educational goals and openness for new pedagogical approaches seem to be crucial for the effective use of game-based learning in applied settings. Both chapters also provide stimulations insights for teacher education and development.

However, the success of game-based learning is not only dependent on the setting in which it should be implemented, but games may also change the respective contexts. Thus, the relationship needs to be conceived as reciprocal, as Bryan Sanders elaborates in Chap. 17. Based on the observation that traditional educational practices are very perseverant, this author uses a kind of thought experiment by asking "Could Minecraft be a school." He also describes how the surge of interest in complex game-based learning platforms could contribute to a disruption of many reliable but outdated fixtures in school settings, and eventually to a complete revision of educational efforts, also giving more space to true inter- and transdisciplinarity.

18.3.4 Participatory Design: Incorporating the Expertise from Different Fields and Perspectives

The foregoing should have made clear that game-based learning is a complex design endeavor and, as such, typically requires cooperation. Cooperative—or synonymously also named participatory design—is a general approach to the design of all kinds of material or immaterial products (so-called design artifacts) attempting to actively incorporate expertise from different fields and to involve perspectives from various stakeholders into the design process. This should help to ensure that the results meet the intended needs and are usable. Participatory design is focused on processes and procedures of design, and is not a design style. The term is used in a variety of fields, such as software design, urban design, architecture, landscape architecture, product design, sustainability, graphic design, planning, and even medicine as a way of creating environments that are more responsive and appropriate to their inhabitants' and users' cultural, emotional, spiritual, and practical needs. Recent research suggests that designers create more innovative concepts and ideas when working within a co-design environment with others than they do when creating ideas on their own (e.g., Mitchell et al., 2015; Trischler et al., 2018).

Participatory design is also eminent in recent studies of game-based learning (e.g., Pereira et al., 2019) as well as in many chapters of this volume. For example, Schultheis and Aprea (Chap. 1), Paeßens and Winther (Chap. 3), and Lindberg and Naxer (Chap. 14) all describe game-based learning design projects that involve many parties, such as game and media designers, content experts from diverse fields, parents, teachers, and learners. Moreover, participatory design is at the center of the contribution by Heinz and Born-Rauchenecker (Chap. 9), who report the cooperative development of a game-based learning app intended to raise prospective kindergarten educators' awareness of STEM learning opportunities. To identify their expectations about the app, these researchers conducted workshops and developed questionnaires aimed at users of the app, teachers employing the app in their lessons, experts in early STEM education, and experts in the area of digital media.

18.4 Future Directions of Research on Game-Based Learning Across the Disciplines

The contributions in this edited volume provide rich and valuable insights into the fascinating and growing field of game-based learning. In particular, they have demonstrated how games could be productively used to support learning in a wide range of domains, including business studies, economics, and finance as well as science, technology, engineering, and mathematics at different levels of the educational system in several countries. As specifically highlighted in the previous section of this concluding chapter, the contributions also shed light on the question of how

game-based learning should be designed to promote intended learning purposes in different fields. In this way, they contribute to a still-pending but practically and scientifically highly relevant question in this field of research. For example, Young et al. (2012) reviewed trends in serious gaming for education and stated a lack of studies that explore the complex interplay of purposefully designed games with different kinds of learners, learning contexts, contents, and outcomes. Similarly, Clark et al. (Clark et al., 2015: 116) conclude in their meta-analysis that "games as a medium provide new and powerful affordances, but it is the design within the medium to leverage those affordances that will determine the efficacy of a learning environment." They further recommend that we should "shift our attention to studies exploring how theoretically driven design decisions influence situated learning outcomes for the broad diversity of learners within and beyond our classrooms." The contributions of this volume demonstrate how this gap could be filled by drawing on the body of knowledge from the learning sciences and expanding it with theoretical and empirical research from other domains to inform the design of effective game-based learning environments across the disciplines. In addition, the contributions pinpoint several ideas and requirements for future research studies, including the following:

- Most of the research included in this edited volume are case studies. A few are usability studies or design-based research studies. According to Plass et al. (2020), there are various other types of studies, including: (1) value-added studies that focus on the effectiveness of specific design features; (2) impact studies that focus on the cognitive, motivational, affective, and sociocultural consequences of game-based learning on learning processes and outcomes; and (3) relational effectiveness studies that compare game-based learning with other media. As the authors further explain, these types of studies can be seen as a progression in the sense that they recommend first conduct user and design-based research before conducting value-added studies or studies on impact and relative effectiveness. Altogether, these considerations could point to an interesting pathway for continuing the research efforts presented in this book.
- An issue that deserves further attention, and is closely related to what has been said previously, concerns the lack of a common or standard framework for evaluating game-based learning. As All et al. (2014) point out, this lack of an overarching methodology has led to the use of different outcome measures for assessing effectiveness, varying methods of data collection, and inconclusive or difficult to interpret results. Given the complexity of game-based learning, Tobias et al. (2014) claim that an evaluation framework necessarily needs to be multidimensional to make it possible to understand the various relationships between games, contents, contexts, players, their social interactions with one another, their game-play, their cognitive, meta-cognitive, affective and motivational reactions as well as their learning processes and outcomes. Despite some promising advances, the current methodological and empirical research regarding this aspect is not yet consolidated. However, a shared evaluation methodology is an important prerequisite for coming to valid conclusions with regard to the

effectiveness of game-based learning. These include the possibilities (1) to replicate studies, (2) to conclusively compare results across studies, (3) to make claims regarding the effectiveness of game-based learning on a more general level, and (4) to set a baseline for quality, which could serve as an evaluation tool for published studies. The development of such a framework should thus be brought forward with high priority.

- Also closely connected to what has been mentioned above are questions regarding assessment in game-based learning (Ifenthaler et al., 2012; Ifenthaler & Kim, 2019) and related analytics functions (Alonso-Fernández et al., 2019). The implementation of assessment features into game-based learning environments is still emerging. While assessment after learning in a game-based environment often focuses on the outcome, it may neglect important changes during the learning process. In contrast, assessment while learning in a game-based environment mostly focuses on the process. The benefits of this assessment method are manifold. First, assessing learners while playing a game will provide detailed insights into underlying learning processes. Second, tracking motivational, emotional, and metacognitive characteristics while playing a game will help us to better understand specific behavior and the final outcomes. Third, immediate feedback based on the embedded or stealth assessment can point to specific areas of difficulties learners are having while playing the game. Further research is required to identify assessment features, which support the game flow and game mechanics and also inform about changes in learning processes and how to support possible barriers in the learning process (Kim & Ifenthaler, 2019). Closely related to issues of assessment in the game are games analytics which focuses on (a) improving gameplay and make the games more enjoyable to the players, and (b) improve game design and create content that players like in order to increase post-sale revenues (Loh et al., 2015). In contrast, serious games analytics focuses on actionable metrics developed through problem definition in learning scenarios and the application of statistical models, metrics, and analysis for skills and human performance improvement and assessment, using game-based learning as the primary tools for learning (Loh et al., 2015). Clearly, research focusing on learning analytics in game-based learning is scarce and requires frameworks, methodologies, and experimental studies to shed light into the opportunities of analytics for game-based learning (Ifenthaler & Gibson, 2019).
- A final issue for future research concerns the design and development of game-based learning environments. As already mentioned in Sect. 18.3 of this chapter, this is a complex process that often demands distributed expertise. A profound understanding of this process is pivotal for assuring the quality of the emerging product and ultimately the learning effects of game-based learning environments. To garner such an understanding, the field of research on game-based learning across the disciplines could profit from incorporating insights from the so-called design science, a discipline concerned with the exploration of design processes in different fields of application. Design science, which has been heavily influenced by the groundbreaking workings of Simon (1996) and successfully implemented in other areas of technology-based learning environment design

(e.g., Aprea & Cattaneo, 2019), could provide an inter- and transdisciplinary lens to further investigate design processes in game-based learning. Besides the organization of design processes, this investigation should consider epistemological issues, and promote respective design recommendations and tools for designers and researchers.

We hope that our volume is helpful for all those interested in exploiting the benefits of game-based learning and understanding its effects on learning and performance in different domains. We also hope that it will serve as a stimulus for the above and other future research efforts.

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