REVIEW OF *ASSESSMENT IN GAME-BASED LEARNING*
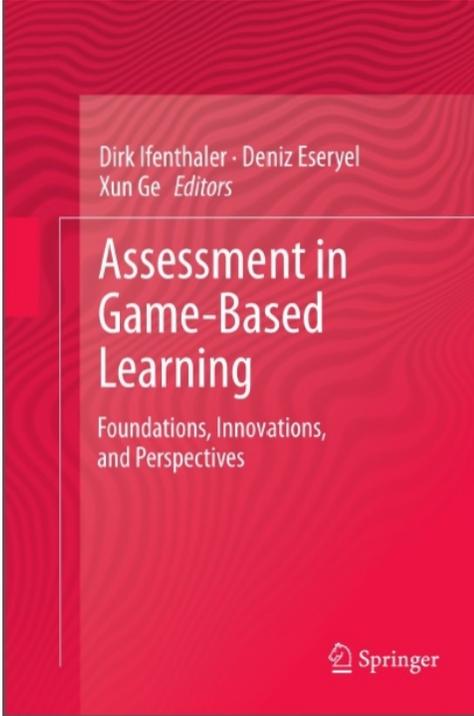
Assessment in Game-Based Learning:
Foundations, Innovations, and Perspectives

Dirk Ifenthaler, Deniz Eseryel, and Xun Ge (Editors)

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Far from being a new concept to computer assisted language learning (CALL), gaming is attracting growing interest due to the increasing variety and sophistication of digital games, and more importantly, to the development of game-based learning (GBL) (Prensky, 2001) as a research field that has acquired academic credibility through a research agenda, scientific events, and specialized publication means (for a list of GBL journals, see SEGAN, n. d). Complementarity with concomitant educational fields in a collective attempt to understand learning in its various aspects is an ongoing exercise, and the research and practice of GBL are evolving in interdisciplinary ways that can add to this inquiry. The CALL community demonstrates its interest in GBL through numerous monographs, special journal issues, and edited books that have recently been published (Cornillie, Thorne, & Desmet, 2012; Peterson, 2013; Reinders, 2012; Reinhardt & Sykes, 2014).

There are three motivations to review *Assessment in Game-Based Learning* for a CALL audience. The first is the cross-sectoral potential that the book may have for studies on CALL in general, and particularly those on game-based language learning. The second motivation is the lack of a solid body of empirical studies on curricular, task-based integration of digital games in formal learning contexts (Thomas, 2012) and the relevance of the book in respect to this type of evidence. The third motivation relates to the emerging trend of gaming in non-game digital environments. These motivations will be raised in the conclusion.

Book objectives and content

The book responds to a clearly identified need: to bridge game-based learning and game-based assessment, particularly in assessing complex problem-solving processes and outcomes in a digital game-

based learning environment. The book covers assessment in GBL from a theoretical, methodological, and technological perspective.

The editors opt to not define *learning* and *assessment* in their preface, which may be intentional, as this choice would reflect a willingness to leave this task to the various contributors in relation to each book chapter. Indeed, the definitions of learning and assessment in a cross-disciplinary book such as this is challenging, even impossible, as the book gathers contributions from researchers in educational psychology, educational diagnostics, computer engineering, educational technology, and the learning sciences. This interdisciplinarity does not imply that a consensus of those crucial to the topic of the book should be met by all contributors. It does, however, illustrate the various understandings that the combination of the two terms can take in the different learning contexts in which they apply. As an indication, throughout the book "learning" takes on several meanings, understood variously as behaviour, skills, digital activity patterns, knowledge, emotions, mental models, or processes in a schooling environment. Accordingly, the book contributions reflect a range of understandings of the term "assessment", linked to a problem-based gaming model, a set of achievement indicators, a response to computer-adaptive testing, or automated measurement artefacts—all depending on the theoretical perspective taken. Research foci also vary. These are reflected in how each chapter approaches the literature review, the development of assessment artefacts within game environments, the analysis of GBL practices online and offline, and curricular integration of gaming. From this point of view, Daniel T. Hickey and Ellen Jameson, in Chapter 20, offer an insightful contribution into the ways that various disciplines examine assessment in GBL. Their chapter offers an understanding of the tensions that emerge when designing, using, and assessing educational video games from these points of view.

The book's content is structured in three sections: a) foundations of game-based assessment, b) technological and methodological innovations for assessing game-based learning, and c) realizing assessment in game-based learning.

In Part 1, Ifenthaler, Eseyrel and Ge (Chapter 1) provide the background of learning and assessment in game-based environments through a historical synopsis, followed by a critical review on implementation of assessment into games. In Chapter 2, "Are All Games the Same?", Schrader and McCreery examine three paradigms of serious game research (games as interventions; games as interactive tools; and immersive games) and explain the theoretical and methodological underpinnings of *Brain Age*, a game on mental fitness; SPORE, a science education game; and World of Warcraft, [provide brief descriptor for parallel structure here]. In Chapter 3 Brian Bellard raises the question of how formative assessments might be designed to measure student progress during games. He describes a crucial step in this process: the specification of learning goals and associated constructs. In Chapter 4 Shute and Ke address the question of how to embed assessments within games to provide a way to monitor a player's current level on evaluated competencies, and then use that information as the basis for support. This first section concludes with Chapter 5 by Mislevy, Behrens, Dicerbo, Frezzo and West that defines three things game designers need to know about assessment: compatibility of principles of assessment design with those of game design; structure of reasoning as fundamental in assessment design; and necessity of addressing key constraints of assessment design from the very beginning of the design process.

The second part presents technological and methodological innovations for assessing game-based learning. Chapter 6, by Klaus Jantke, discusses patterns of game-playing behaviour and the ways these behaviours can function as indicators of mastery. In the next Chapter, Shelton and Parlin identify a set of design decisions as the result of building an automated assessment prototype within an open-ended 3D learning environment (OELE). In Chapter 8, Christian Loh shows how the *information trails approach* represents a next step for in-process assessment of game-based learning, which refers to an ongoing formative assessment conducted throughout the game-based learning while the game session is ongoing. These information trails can serve for remote tracking and data collection. Chapter 9, authored by Reese, Seward, Tabachnick, Hitt, Harrison and McFarland, explores *The Timed Report tool* (synopsis of player

behaviour at 10-second intervals), which represents another sensitive measurement of learning within games. In Chapter 10, Clark, Martínez-Garza, Biswas, Luecht and Sengupta explore computer adaptive testing and hidden Markov modeling as a methodology for driving assessment of students' explanations in game dialogue. The Technological Pedagogical Content Knowledge (TPACK) framework regarding the role of genre and content for game-based assessment is further developed in the Play, Curricular Activity, Reflection and Discussion (PCaRD) model, by Foster (Chapter 11). In Chapter 12, Gosper and McNeill provide a guide to learner-centered design and assessment for implementing game-based learning with the MAPLET framework (matching aims, processes, learner expertise and technologies). Finally, Csapó, Lörincz and Molnár address the assessment technology ODAS (Online Diagnostic Assessment System) in educational games designed for young students.

The third part provides an insight into the latest empirical research findings and best practice examples of game-based assessment. Eseryel, Guo and Law (Chapter 14) discuss the interactivity design and assessment framework for educational games to promote motivation and complex problem-solving skills. The rapidly emerging field of computer-based assessment for gaming from the perspective of sound measurement principles is highly important for future principles of game-based assessment (Scalise & Wilson, Chapter 15). Challenges and recommendations for using institutional data to evaluate game-based instructional designs are highlighted next (Warren & Bigenho, Chapter 16). The seemingly incongruous use of 2D media avatar drawings and 3D media-math-based digital gameplay is reported on by Katz-Buonincontro and Foster in Chapter 17. Ghergulescu and Muntean describe current trends in the assessment of learner motivation (Chapter 18), and emotion assessment methods are covered by Novak and Johnson in Chapter 19. A design model for obtaining diverse learning outcomes in innovative learning environments is exemplified by Hickey and Jameson in Chapter 20. To close the volume, Frey (Chapter 21) makes a critical contribution by questioning computer games as preparation for future learning.

CONCLUSION

Overall, *Assessment in Game-based Learning* is a highly recommended book and one that fills a gap in existing literature, as it provides a range of evidence-based studies in a research field with a need for what Peterson (2012) has called a "balanced and critical approach to development that acknowledges the potential of computer games and builds on previous research while also recognizing the challenges associated with their use" (p. 132). The book covers assessment in GBL from various aspects of empirically driven research, which is undoubtedly an asset, especially in this rapidly evolving field. In addition, assessment is conceptualized as a complex phenomenon calling for research in several areas, and this is highlighted by the choice of editors to embrace this variety. A monograph on GBL from the perspective of assessment is an invaluable contribution to the GBL research community, which is eager for insightful and well-documented studies in this field.

The book does offer insightful contributions on curricular, task-based integration of digital games in formal learning contexts. There are several chapters in this direction. To take the example of only two, in Chapter 21, Rick Frey critically raises the point of how to leverage knowledge acquired in a digital game environment in a formal assessment environment by highlighting the role of instructional activity. In Chapter 12, Maree Gosper and Margot McNeill suggest a framework consisting of three phases (early, intermediate and late), each associated with an outcome, a process, a possible game, and an assessment mechanism. Alignment with the curriculum is discussed through analysis of the framework with an actual computer game.

What might be regretted is the lack of investigation into assessment of GBL in non-game contexts. Due to their impact on online human activity, game components (or game mechanics) have started to appear in non-game environments, generating the concept of gamification that can be defined as "[the incorporation of] game elements into a non-gaming software application to increase user experience and engagement"

(Domínguez et al., 2013, p. 381). The most common game mechanics are recommendation systems, rating systems, badges, and scores (for a review in a CALL setting see Zourou & Lamy, 2013). Several CALL researchers stress the interest of further exploring gaming in non-game environments and of embracing these "peripheral" gaming/learning contexts in the GBL agenda (Reinhardt, 2013). As an example, Reinhardt and Sykes (2014) have recently augmented their *Framework for examining research and practice in digital games* by adding a third type of research—*game-informed* research that pertains to "game and play principles applied in digital and non-digital contexts outside the confines of what one might typically consider a game" (p. 3). Their previous 2012 study (Reinhardt & Sykes, 2012) included two types of research, one *on game-enhanced* research (regarding L2 affordances of commercial games in formal pedagogical environments) and a second on *game-based* perspectives (related to pedagogical digital games explicitly designed for pedagogical purposes). This third dimension, added within just a two-year span may well reflect the research interest in addressing gaming and its learning potential in a broader way, independently of whether learners use self-contained games or non-game settings. Along the same lines, Peterson (2013), in his monograph *Computer Games and Language Learning*, among key areas and issues for investigation in future research, also points out that informal network based computer gaming has potential to afford authentic opportunities for task based language learning (p. 140). It may be claimed that these current studies point to an understanding of gaming as a concept that embraces not only games, but also game mechanics that are appearing more frequently in informal social network-based learning contexts. A web conference on this topic was organised by IATEFL LTSIG & TESOL CALL-IS (2014) and recordings of talks are available online.

Assessment In Game-based Learning is an invaluable, collective endeavor that addresses learning and assessment in designed gaming environments, both commercial and educational. As gaming spreads in non-gaming environments, this book offers a solid piece of research on which studies on gaming, be it gaming or non-gaming environments, can be grounded.

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