Chapter 2
Digital Games for Computing Education:
What Are the Benefits?

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ABSTRACT

Digital games are considered an effective and efficient instructional strategy for computing education. However, there are few empirical studies providing sound evidence on the benefits of such educational games. In this respect, the objective of this chapter is to present a comprehensive analysis in order to summarize empirical evidence on the benefits of digital games used as an instructional strategy for computing education. The analysis is based on data collected from 21 case studies that use the MEEGA model, the most commonly used model for educational games' evaluation, evaluating 9 different games, involving a population of 344 students. The results indicate that digital games can yield a positive effect on the learning of computing, providing a pleasant and engaging experience to the students and motivating them to study. These results may guide instructors in the selection of educational games as instructional methods and guide game creators with respect to the development of new games.

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INTRODUCTION

In the last years, digital games have been used as an innovative instructional strategy in order to achieve learning more effectively in computing education (Gresse von Wangenheim & Shull, 2009; Hakulinen, 2011; Gibson & Bell, 2013; Battistella & Gresse von Wangenheim, 2016). Digital games are electronic games that involve human interaction with a user interface to generate visual feedback on an electronic device such as smartphones, computers, tablets, etc. (Prensky, 2001; Prensky, 2007; Mitamura et al., 2012). For educational purposes, these games are specifically designed to teach specific concepts or to strengthen competencies (Prensky, 2001; Abt, 2002; Prensky, 2007) and, typically, involve competition organized by rules and restrictions to achieve a certain educational goal (Dempsey et al., 1996; Gresse von Wangenheim & von Wangenheim, 2012).

Driven by the need to provide more hands-on opportunities for computing students, various digital educational games have been used to contribute to the learning process in different computing knowledge areas (Gresse von Wangenheim & Shull, 2009; Gibson & Bell, 2013; Marques et al., 2014; Sedelmaier & Landes, 2015; Battistella & Gresse von Wangenheim, 2016; Kosa et al., 2016; Petri & Gresse von Wangenheim, 2017). For example, games for teaching Software Engineering include SimSE (Navarro & van der Hoek, 2005; Navarro, 2006; Navarro & van der Hoek, 2007; Navarro & van der Hoek, 2009), Requirements Collection and Analysis Game (RCAG) (Hainey et al., 2009; Hainey et al., 2011), X-MED (Gresse von Wangenheim, Thiry & Kochanski, 2009; Gresse von Wangenheim et al., 2009a), and Tower-Defense (Rusu et al., 2011), for teaching Software Project Management (e.g., ProDec (Calderón & Ruiz, 2013) and SimSoft (Bavota et al., 2012)), for teaching Software Development Fundamentals (Wu's Castle (Eagle & Barnes, 2009), Program your robot (Kazimoglu et al., 2012a; Kazimoglu et al., 2012b), and Light-Bot (Gouws, Bradshaw & Wentworth, 2013)), or for teaching Security (e.g., Cyber-CIEGE (Raman et al., 2014), CounterMeasures (Jordan et al., 2011); Security Protocol Game (Hamey, 2003), Anti-Phishing Phil (Sheng et al., 2007)). Most of these digital games for computing education are simulation games, which allow students to practice competencies through the simulation of real-life situations in a realistic environment while keeping them engaged in the learning activity (Battistella & Gresse von Wangenheim, 2016). Several games are also designed to teach computing focusing on lower cognitive levels, being used to review and reinforce knowledge taught beforehand (Battistella & Gresse von Wangenheim, 2016).

In this context, educational games are believed to result in a wide range of benefits, like increasing learning effectiveness, interest, and motivation (Garris et al., 2002; Barnes et al., 2008; Gresse von Wangenheim & Shull, 2009; Boyle, Connolly, & Hainey, 2011). Digital games are expected to provide a fun and safe environment, where students can try alternatives and observe the consequences, learning from their own mistakes (Pfahl et al., 2001; Prensky, 2001; Prensky, 2007). They are supposed to be an effective and efficient instructional strategy for computing education (Backlund & Hendrix, 2013). However, these claims seem to be questionable (Hays, 2005; Gresse von Wangenheim & Shull, 2009; Caulfield et al., 2011; Connolly et al., 2012). In practice, games for computing education seem to lack the empirical evidence of either the expected learning impact and/or the engagement they promise (Hays, 2005; Akili, 2006; Gresse von Wangenheim & Shull, 2009; Caulfield et al., 2011; Ibrahim et al., 2011; Connolly et al., 2012; Backlund & Hendrix, 2013; Boyle et al., 2016). Thus, these claims seem not to be rigorously established as most evaluations of games are performed in an ad-hoc manner in terms

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