Educational Serious Games Design

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INTRODUCTION

Initially, digital games targeted mainly entertainment. The idea of combining fun and learning led to edutainment, the pairing of entertainment with education. The latest trend, serious games, marginalize entertainment and brings education into the spotlight. Serious games are games not exclusively designed for fun, serving non-entertainment goals in many diverse fields such as military, government, corporate, health-care, and education (Michael & Chen, 2006).

Digital games have become a defining phenomenon of contemporary culture. Over the last two decades, the educational interest in digital games has skyrocketed. This interest has taken two main forms. First, game-based learning that is entertainment-driven. This trend involves the use of commercial games for learning. Second, education-driven game-based learning that is currently manifested in trends such as gamification and serious games. The former refers to the application of game design elements to educational settings (Deterding, Khaled, Nacke, & Dixon, 2011; Kapp, 2012). The latter refers to the ad hoc development of games that bring education in the spotlight without excluding entertainment. Serious games are games not exclusively designed for fun, serving non-entertainment goals in many diverse fields such as military, government, corporate, health-care, and education (Michael & Chen, 2006).

Game design is an inherently interdisciplinary endeavor, involving experts from various disciplines such as graphic, audio, product, and interaction design, programming, animation, writing, and content area expertise (Salen, 2007). The game industry has developed highly sophisticated narrative, artistic, and technical methodologies for creating engaging and immersive games (e.g. Salen & Zimmerman, 2004; Schell, 2014; Adams, 2010). Currently, the field of digital game design is mature, being in a paradigm state (Kuhn, 1996).

As the emphasis has gradually shifted to serious games, however, new requirements emerged. Compared to traditional digital game design, the main complication that emerges in the case of Serious Game Design (SGD) is that learning has priority over entertainment. Consequently, in addition to all other types of expertise required for digital game design, SGD necessitates professionals whose expertise is related to learning. Such professionals include educators, content experts, and learning sciences professionals in general. To design effective serious games, game design professionals would need to collaborate with learning sciences professionals (Charsky, 2010; Lim et al., 2014; El Mawas, 2014). Such a collaboration, however, might not be directly possible because a common vocabulary is missing (Arnab et al., 2014). As it has been stressed, the main limitation characterizing the field of serious game design pertains to the disconnect between established game development models and the design of learning (Arnab et al, 2014; Bellotti, Berta, De Gloria, D'ursi & Fiore, 2012; Van Staalduinen & de Freitas, 2011). To address this limitation, Moreno-Ger et al., (2014) argued that serious game development methodologies are needed that will eventually help systematize the creation of games. To bridge the game design - educational design gap, a number of serious game design models have been advanced over the past few years. To date, there has been no systematic review of such SGD models. Consequently, the extent to which these models address the major

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challenges the field of SGD faces is unknown. The present work has two main objectives. First, it presents the state of the art in SGD by briefly introducing 13 models. Second, it acknowledges contribution these models make and identifies 5 principal challenges that remain open for the field of SGD. The chapter is concluded with an examination of the extent to which every model meets the design challenges and an outline of the road map ahead.

BACKGROUND: SERIOUS GAME DESIGN MODELS – STATE OF THE ART

In this section 13 SGD models that have been advanced in recent years are briefly introduced. An overview of the models is given in table 1.

While all models aim at SGD, they have different origins and constitute different solutions to the problem of design. For convenience, the SGD models are presented in chronological order.

Table 1. An overview of SGD models

Model	Sources	Features
Experiential Gaming Model (EGM)	Kiili (2005)	experiential learning influence; links gameplay with experiential learning
4 Dimensional Framework (4DF)	De Freitas & Oliver (2006); De Freitas & Jarvis (2009)	provides 4 dimensions for game design: learner, pedagogy, representation, and context
Game Object Model (GOM), GOM II	Amory & Seagram (2003); Amory (2007)	object-oriented programming influence; game components are described in terms of abstract (pedagogical) and concrete (design) interfaces
Document-Oriented Design and Development for Experiential Learning (DODDEL)	McMahon (2009)	extension of a generic ADDIE model comprising of the following stages: situation analysis, design proposal, design documentation, production documentation, prototype, development, and implementation
Is	Annetta (2010)	encapsulated model comprised of 6 elements: identity, immersion, interactivity, increasing complexity, informed teaching, and instructional
Game-Based Learning framework (GBLF)	Van Staalduinen & de Freitas (2011)	4DF extension with 25 game elements that improve memory and learning
Design Patterns Framework (DPF)	Kelle, Klemke & Specht (2011)	4 step procedure for mapping game design patterns on teaching and learning functions
Game Discourse Analysis (GDA)	Wouters, Oostendorp, Boonekamp & Spek (2011)	uses (a) information flow (resources needed in the game) and (b) game discourse (presentation of resources in the game) to inform game design
Six Facets Framework (SFF)	Marne, Wisdom, Huynh-Kim-Bang & Labat (2012)	6 design elements: pedagogical objectives, domain simulation, interactions with the simulation, problems and progression, decorum, conditions of use
Architecture for Representations, Games, Interactions, and Learning among Experts (ARGILE)	El Mawas (2014)	design methodology that employs Web 2.0 practices for SGs
Learning Mechanics – Game Mechanics (LM-GM)	Arnab et al., (2014); Lim et al., (2013); Lim et al., (2014)	associates ludic elements (game mechanics) with pedagogy (learning mechanics)
Cognitive Behavioral Game Design Model (CBGD)	Starks (2014)	Social Cogitive theory and Flow theory influences; combines (a) social cognitive elements and (b) multiple intelligences elements to promote flow
Activity Theory-based Model of Serious Games (ATMSG)	(Carvalho et al., 2015)	Activity Theory influence; extension of the GM-LM model that distinguishes 3 types of activity: (a) learning, (b) gaming, and (c) instructional; each activity type is further represented in terms of actions

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