Towards Modelling Effective Educational Games Using Multi-Domain Framework

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INTRODUCTION

The use of game-based learning (GBL) as a common medium for educational deliverance, as opposed to pure entertainment, has gained immense popularity in recent years. Main attention has recently been diverted towards the impact of gaining knowledge, engaging, and motivating learners through playing educational games (Azadegan et al., 2014; Romero, 2015). Game-based learning (GBL) is an act of appropriate game mechanics, scenario recreation, and problem oriented learning processes to ensure learning objective is accomplished (Poulsen, 2011). Designers and developers need to enhance the educational tools by integrating game domains and elements to maximize the tools' effectiveness, hence, increase learning outcomes, level of engagement and motivation. To understand the link between multiple domains and elements of GBL, there is a need to fit multiple widely known instructional approaches with experts such as game designers, developers, educators, and software engineers.

For GBL development process to be effective and reliable, it is vital to provide emphasis on involving theoretical foundations with game rules, and fun with authentic learning for learners, thus, providing an precise base for learners to gain knowledge (Hays, 2005; Kebritchi & Hirumi, 2008). The innovative learning approach derived from EG possess educational values or even different kinds of software applications that compiles into knowledgeable aspects such as teaching enhancement, assessments and evaluation of learners (Tang & Hanneghan, 2010). Nevertheless, game technologies are specifically used for accessibility of simulated and modelling environments and visualization.

Educational games are designed through a process of modelling, depending on diverse criteria such as how one element can relate to another element or types of domains used in EG. When the game developers initiate the development of EG, challenges occurs in terms of planning from gathered requirements, verifying, and cross-check to ensure several possibilities occurrence. This is due to a mixture of pedagogical, educational, and fun elements needed to be collaborated accurately. Furthermore, an effectually designed pre-model unfolding the relationships amongst game elements, and their domains is highly recommended. Therefore, a modelling technique is needed to conceptualise the elements/components in the EG and provide a holistic idea based on

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how domains and their related components can be modelled to provide a promising modelling and developing process.

The objective of this chapter is to study the relationships among EG elements in order to provide game developers, software engineers, and game designers; a medium of understanding connections, interrelations, and interactions between game elements and game domains. Furthermore, they should be able to map the relationships to model out an effective educational games during developing process.

BACKGROUND

This section mainly explains how the evaluation and modelling strategies adopted or proposed in designing of EG to provide a unified modelling techniques during development process of EG.

EG Evaluation and Modelling Languages

GBL evaluation is carried out to ensure design quality (Di Loreto & Gouaïch, 2010), identify usage(Djelil, Sanchez, Albouy-Kissi, Lavest, & Albouy-Kissi, 2014), and verify instructional outcomes(Casey, Baghaei, & Nand, 2014). However, the complex nature of GBL is not well-structured (Djelil et al., 2014). Certainly, the evaluation has to undergo a definitive number of steps to measure variables and provide appropriate analysis of these variables. Although not all evaluations provide coherent results (Annetta et al., 2013; Von Wangenheim, Thiry, & Kochanski, 2009), a few existing methods for data collection and analysis have proven their efficiency and reliability in practice. Even though, the evaluation of EG is time consuming and complex; it is the only reliable aspect to verify the goals and detect malfunctions throughout the EG. Therefore, a learning game ought to be evaluated prior to being used as a learning material (Djelil et al., 2014). A recent study implements a six-phase methodology, HEXA-GBL, for designing and evaluating GBL activities from learner centered perspective (Romero, 2015). The phases are: 1) game design activity, 2) learning objectives definition, 3) the learner-centered need analysis, and the definition of the game modalities, 4) mechanics and rules, 5) the play activity evaluation from the learning outcomes, assessment and feedback, and 6) learners' gaming and learning experience during the GBL activity. While overcoming the barriers of GBL costs and focusing on game mechanics, HEXA-GBL also prioritized the educators to operationalize with adapting processes.

Modelling processes can be a powerful 'tool' to boost student's perceptive activities, hence, refining their scientific conceptual minds (de Jong & van Joolingen, 2008). A recent and a wide range of discussion of a potential value using model-driven engineering (MDE) approaches for EG has been recorded(Dormans, 2012; France & Rumpe, 2007). Furthermore, UML-based game specifications such as Statecharts(Sauer & Engels, 2001); offer a rigorous state machine foundation, which may be difficult to use for some stakeholders (e.g., game designers). With respect to GBL, MDE can provide an environment for domain experts to produce EG via modelling without upsetting the sophistication of game development process. Moreover, it provides an increased productivity value, portability among different platforms, an easier software maintenance, reliability of mapping from model to code, and minimized modelling error (Kelly & Tolvanen, 2008).

Game designers experienced in using Storyboards prefer using tabular Use Case (UC) method (MDE) due to the similarity of presentation (Truong, Hayes, & Abowd, 2006); as it is understood, well-established, maintainable, and straightforward to define. A recent research used MDE to integrate elements of game design, pedagogical content, and software engineering methodologies to provide a storyboard with textual description of the learning objectives and game play to user interfaces. Due to iterative development process, it transforms the model into UML UC model (visual