Associations of Subjective Immersion, Immersion Subfactors, and Learning Outcomes in the Revised Game Engagement Model

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ABSTRACT

Serious Educational Video Games (SEGs) play a large role in education for both children and adults. However, the budget for SEGs is typically lower than traditional entertainment video games, bringing with it the need to optimize the learning experience. This article looks at the role game immersion plays in improving learning outcomes, using the Revised Game Engagement Model (R-GEM) to determine whether learning outcomes were associated specifically with Immersion itself, or with the various prerequisites to achieving immersion. A sample of 125 undergraduate university students which played an educational video game and were assessed on Immersion, subjective System Usability, Creative Imagination, and learning performance. Immersion and System Usability were shown to be associated with higher learning outcomes, but, after controlling for other factors, it seems that System Usability is only helpful inasmuch as it promotes Immersion. This article concludes that further study is needed to determine whether the same association can be found with different populations and with different types of learning.

KEYWORDS
Creative Imagination, CyberCeige, Game Engagement, Immersion, Serious Educational Games, System Usability

INTRODUCTION

Video games play a large role in the daily lives of millions of people around the world. Rapid advances in technology have enabled games to become more sophisticated and, with the advent of gaming for mobile devices, video games have become practically ubiquitous for a large segment of the population. According to the annual report of the Entertainment Software Association (ESA, 2015), 42% of Americans (or 155 million people) reported playing video games for more than three hours per week. These players engage with these games in an increasingly diverse fashion, as games have come to occupy positions in home entertainment, industry, and education.

In particular, Serious Educational Games (SEGs) are frequently used in order to better engage students and employees in schools, businesses, and even the military. SEGs are defined as any game with “an explicit and carefully thought out educational purpose” (Abt, 1987). The intention of an SEG is to use advances in video gaming technology and design in order to make learning a more engaging activity for the learner, and in so doing, to improve the learner’s experience and learning outcomes. In an informal survey published by David Michael (2006), the developers of SEGs reported having...
created games targeted in equal measure at students (53%) and the general population (47%), and were used to teach a wide variety of subjects from history to technical skills.

While there is a temptation in developing SEGs to pour resources into making the most polished game possible, de Freitas and Jarvis (2007) warn that without careful study of the aspects of games which make them effective learning tools, as opposed to high-intensity entertainment spectacles, there is great risk of generating games and simulations which “require large investment but negligible return on investment.” This advice is especially salient now, as the cost of development for entertainment video games has ballooned into the multi-million-dollar range in many cases (Khoshosy, 2011).

As such, much work has been conducted in order to determine the correct array of characteristics that are required to make SEGs especially effective. Garris, Ahlers, and Driskell (2002), for example, present an Input-Process-Outcome model on which the design of instructional games can be based and in which properties of the game itself feed into a cyclical process in which users act, receive feedback, and form subjective evaluations which drive further action. This model places a high level of importance on the user and the subjective states which the user experiences in driving learning and retention of information in game-based instruction. By this reasoning, the study of subjective user states is essential for improving game-based instruction.

**Subjective Immersion**

In the scientific literature surrounding video games and virtual environments, the term “Immersion” is used to denote two different but related constructs. Slater and Wilbur (1997) conceptualize Immersion as an objective quality of virtual environments (VE) which is characterized by the technologies used the present the VE. In this conceptualization, Immersion can be manipulated directly by adding or subtracting technologial elements, such as head-mounted displays, which increase the level to which the user’s senses are engaged in the VE.

The second usage of Immersion refers to a subjective, experiential state which users experience during their interactions with the VE (Witmer & Singer, 1998). This usage usually refers to a state posited by Brown and Cairns (2004) to “describe the degree of involvemnt with a game.” It is thought to be a less extreme state than Cscentmihalyi’s (1990) “Flow,” which requires a significantly higher level of emotional involvement than simple immersion. Brown and Cairns (2004) described immersion as occurring at three progressively more involved levels, called Engagement, Engrossment, and Total Immersion. This conception of immersion was derived from semi-structured interviews with gamers asking them to reflect on their experiences with their favorite video game. This element of Immersion cannot be manipulated directly, although it is affected by the technological elements of the system.

The Revised Game Engagement Model (R-GEM) was proposed by Procci (2015) as a logical extension of the progressive, hierarchical conception of game engagement in Brockmyer et al. (2009). This model seeks to synthesize and clarify the widely varied conceptualizations and sets of terminology which have typified the study of subjective game experience. R-GEM defines subjective Immersion as a low-level state of game engagement which describes the player’s experience of being enveloped by the sensory and cognitive experience of the game. As feelings of subjective Immersion intensify, the player progresses to a subjective experience of Presence, a higher level of engagement which is characterized by the player accepting the virtual environment as their primary environment and feeling as though they are physically in the game. In this framework, subjective Immersion also corresponds to the first two levels of Immersion put forward by Brown and Cairns (Engagement and Engrossment) and Presence, corresponds with the third level, Total Immersion (Brown & Cairns, 2004).

Procci (2015) validated this model in an experiment in which she manipulated game difficult (Hard Mode or Easy Mode) and Immersion using objective technological means by creating conditions with high and low levels of graphical realism. She then measured constructs related to game engagement, including subjective system usability and subjective Immersion, and tested the model using stepwise regression to establish the biggest predictors of engagement at each level. The relationships between
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