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Flow framework for analyzing the quality of educational games ☆

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ABSTRACT

The challenge of educational game design is to develop solutions that appeal to as many players as possible, but are still educationally effective. One foundation for analyzing and designing educational engagement is the flow theory. This article presents a flow framework that describes the dimensions of flow experience that can be used to analyze the quality of educational games. The framework also provides design-support for producing good educational games, because it can be used to reveal ways to optimize learning effects and user experience. However, the framework only works as a link between educational theory and game design, which is useful for game analysis but does not provide the means for a complete game design. To evaluate the elements included in the proposed framework, we analyzed university student's experiences in participating in a business simulation game. We found that the students' flow experience in the game was high and the findings indicated that sense of control, clear goals and challenge-skill dimensions of flow scored the highest. Overall, the results indicate that the flow framework is a useful tool to aid the analysis of game-based learning experiences.

1. Introduction

The purpose of games is to create appealing and compelling experiences to players. Thus, games can be seen as artefacts or a cultural form that arouse meaningful immersive experiences [1,2]. According to Dewey [3] experience is a result of interplay between the present situation and our prior experiences. More recently, neuroscientists such as Gerard Edelman have explained learning as building upon existing mental 'maps' [4]. Consequently, players do not have identical playing experiences, but each player's experience is totally unique. Thus, the analysis of the subjective playing experience is crucial part of the game design process. The enjoyment level that an educational game offers is a key factor in determining whether the player will be engaged in the gameplay and achieve the objectives of the game. Thus, the ability to quantify the playing experience is important goal for both industry and academia.

In general, we need a reliable way to measure the overall engagement level of games and to pinpoint specific areas of the experience that should be improved. Several constructs have been proposed to describe playing experience, but definitional agreement has not been achieved. The most common concepts that have been linked to playing experience are flow [5,6], immersion [7], presence [8], involvement, and arousal, which have overlapping but also distinctive characteristics. According to Procci et al. [9] the concept of flow is one of the most popular constructs to describe the playing experience. Flow describes a state of complete absorption in an activity and refers to the optimal experience [5,10]. During the optimal experience, a person is in a psychological state where he or she is so involved with the goal-driven activity that nothing else seems to matter. An activity that produces such experiences is so pleasant that the person may be willing to do something for its own sake, without being concerned with what he will get out of his action. Csikszentmihalyi's [5,10] flow theory subsequently has been applied in several different domains including, for example sports, art, work, human–computer interactions, games and education. In fact, according to [11] preliminary research suggests that game-playing experience is consistent with the dimensions of the flow experience.

The basic elements that comprise every game are: mechanics, story, aesthetics and technology. These are all essential and none of the elements is more important than the others [1]. In educational games the learning objective is also involved, which makes the game design more challenging. Educational games have to be designed properly to incorporate engagement that integrates with educational effectiveness. While work on existing learning theories is well developed, in recent work, three areas of learning theory

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have been outlined for game-based learning: associative (more task-centered approaches to learning), cognitive which rely upon constructivist approaches to learning and situative (more socially-based learning) [12]. These learning approaches create a theoretical foundation for our current work.

The aim of this article is to propose a flow framework that facilitates the analysis educational games and provides design-support for game developers. The design principles of engagement [6] provide a starting point for this work. The paper starts with a background section that discusses the elements that constitute user experience and the pedagogical theories that frame the desired learning process and experience. The following section describes the proposed flow framework. Finally, in order to evaluate the usefulness and the relevance of the flow framework, its attributes and potential to indicate success of a game design, the analysis of students' experience with an educational business simulation game, RealGame, is reported.

2. Background

2.1. User experience

There have been some efforts in creating models of user experience [e.g. 13–16]. In particular there is a need for designers of educational artefacts to understand how users interact with different types of artefacts and how this interaction affects users' educational experiences. While some work in simulation design [e.g. 17] has explored this, the need to consider this from an educational gaming perspective is relatively under-theorized, which presents problems for replicating good design and developing improving standards of design.

The user experience is often paralleled with usability [e.g. 18], although the user experience does not consider enough the deeper principles of experience design or the emotional side of product use. It is obvious that user experience approach extends usability techniques [19] that aim more at the removal of obstacles from technical perspective than at providing engaging and rewarding experiences for users. In this paper usability or playability in a game context is considered as being only one factor among others that affects user experience. This view is in line with Forlizzi and Battarbee [14] who have argued that user experience should be considered also from physical, sensual, cognitive, emotional, and aesthetic perspectives.

Fig. 1 shows the authors' macro-level conception about user experience. The aesthetical, emotional and sensual aspects are not distinguished in macro-level. However, in micro-level they are seen as integral parts of game artifact that affect user experience.

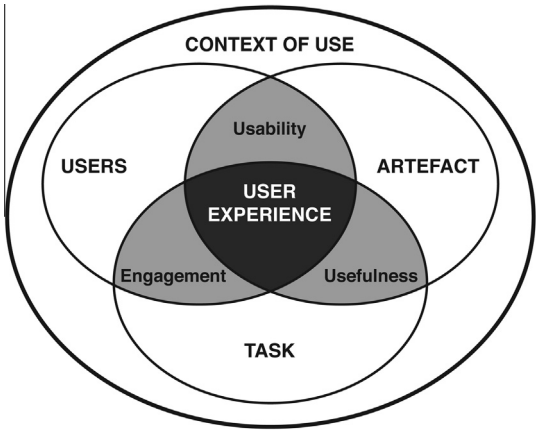

Fig. 1. The macro-level elements of the user experience.

The user experience consists of three main elements: users, an artefact and a task. The user experience emerges from the interplay between these elements in a certain context of use. This context of use is the actual condition under which a given artefact is normally used. The characteristics of the users, such as emotions, values and prior experience, determine how users perceive an artefact and the task at hand. We want to note that we understand the task concept broadly and thus it also refers to the goals of the user related to a certain activity. The usability of an artefact is determined base on the interaction between the users and the artefact. Usefulness refers to the design of an artefact containing the right functions required for users to perform their tasks efficiently and to accomplish their goals easily and efficiently [20].

If the task is engaging, the user is willing to use more effort in accomplish the task. Skinner and Belmont's [21] definition of engagement in the educational context can be applied to user experience. According to them, engagement refers to the intensity and emotional quality of a user's involvement in initiating and carrying out activities. Engaged users show sustained behavioural and cognitive involvement in activities accompanied by a positive emotional tone. To summarize, good usability, a useful artefact and an engaging task (challenges that the game provides) create prerequisites for a good educational experience. However, we want to emphasize that designers cannot design the subjective experience; only the context from which the experience arouses may be designed.

2.2. Constructivism and cognitive load theory

Wu et al. [22] in their recent study found that until 2009 the majority of published studies on game-based learning were not based on any specific learning theory – in their study only 91 of 567 studies based their investigations on a learning theory. They also found that the development of learning theory orientations has prompted more studies to focus on constructivism and humanism (i.e. experiential learning, which has had a central role in simulation game research; see Lainema [23]) than on behaviorism and cognitivism. A look at the very recent research on game-based learning (especially in research that takes place in the discipline of education) reveals a plethora of game studies that base their argumentation on constructivism. For example, constructivism has recently been referred to when studying learning in virtual worlds [24,25], business simulation games [23,26,27], primary schools and elementary education [28,29], educational game development [30], and debriefing of game learning [31].

In fact, for example Mayer [32] has argued that constructivism has become the dominant view of how people learn. The underlying premise of constructivism is that learning is a process in which learners are active sense makers who seek to construct coherent and organized knowledge [3,32,33]. This means that in games learning occurs when the players' active exploration (i.e. exploring the game world and testing discovered solutions to game's problems) makes them develop a knowledge representation of their experience or discover an inconsistency between their current knowledge representation and their experience. Attributed to view of social constructivism, learning usually occurs within a social context in which interactions between other people will activate collaborative exploration, articulation, reflection, and hence assimilation or accommodation for improved knowledge representations [34,35]. However, according to Kirschner et al. [36] constructivism is too often implemented using minimal guidance approach that wrongly assumes that people learn best in an unguided or minimally guided environment – the recent instructional design research has clearly shown that guidance support learning.