Understanding Engagement in Educational Computer Games

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Abstract

This paper presents an empirical study to understand engagement in educational computer games. Engagement is defined as an experience that occupies an individual's attention and captures one's interest. The nature of engagement is viewed as comprising conditions, actions, and outcomes of engagement. The data collection method includes in-depth interviews with 12 educational computer game players who have experienced engagement in playing these games. We used the Grounded Theory (GT) approach to develop an understanding of user engagement in the computer game-based learning context.

Keywords: engagement, educational computer games

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Introduction

Computer gaming has become a common activity among young people (Wechselberger, 2009). Computer games are frequently used as a means of education to promote the learning process. Instructional and educational applications of computer games, known as educational computer games, are increasing in appeal and popularity (Garris, Ahlers, & Driskell, 2002). To enhance game-based learning, researchers have been studying the effectiveness of educational computer games. However, many educational computer games are not designed with user engagement in mind. To maximize the efficacy of these games, it is important for users to feel engaged in their gaming experience.

Hence, the focus of this research is to study and understand: (i) which aspects of educational computer games can contribute to players' engaging experience, and (ii) the characteristics of engagement in players. We hope that our research can provide guidance for game developers in designing highly engaging educational computer games.

Background and Related Literature

In reviewing the literature, we came across the Engagement Theory which highlights that engagement influences students' learning process (Kearsley & Shneiderman, 1998). According to Kearsley and Shneiderman (1998), "students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks" (p. 20). Kearsley and Shneiderman believe that engagement can be achieved through the use of technology by not only making learning more collaborative and project-based but by also having a realistic focus. Similarly, Walshaw (2004) studied the effects of active engagement on learning mathematics and suggested that this new interpretation of active engagement enabled productive work. Malone (1981) suggests that for learning to be intrinsically motivating in an educational gaming context, challenge, fantasy and curiosity should be satisfied.

Other related works include a study by Pace (2004) that examined Web usage in the context of flow. According to Pace (2004), flow is “a state of consciousness that is sometimes experienced by people who are deeply involved in an enjoyable activity” (Csikzentmihalyi, 1990, p. 329). Pace developed a concept map depicting a grounded theory of the flow experiences of Web users. Another concept in the literature that is highly related to engagement is cognitive absorption (Agarwal & Karahanna, 2000). Agarwal and Karahanna developed a theoretical model of cognitive absorption based on the literatures on flow, personality trait dimension of absorption, and cognitive engagement.

Researchers and practitioners are seeking to understand the characteristics of engagement in an effort to increase and enhance the effectiveness of using educational computer games for learning. Games can be an effective and powerful means of knowledge transfer or discovery. We hope that our research findings will help to further enhance and extend the Engagement Theory and provide a more complete understanding of user engagement in the computer game-based learning context.

Research Methodology

Grounded Theory (GT) is an inductive approach that helps researchers to build theory from data. We use this research approach to provide a systematic approach for data gathering and data analysis with the goal of developing a grounded theoretical framework to explain and understand user engagement in the computer game-based learning context (Strauss & Corbin, 1998). Walls, Parahoo and Fleming (2010) indicate that GT can be applicable to any type of research irrespective of the nature or type of data collected and the theoretical perspective or discipline. Hence, it allows a researcher much flexibility in adapting GT to their research. In this research, we employed the qualitative GT approach proposed by Strauss and Corbin (1998).

We used in-depth interviews to collect data and analyzed them using the three coding procedures proposed in GT: (1) open coding; (2) axial coding; (3) selective coding. The fundamental notion of this approach is to analyze dissimilarities between descriptions, and carry out conceptual ordering and theorizing.

Data Collection

We interviewed participants who have experienced engagement in playing educational computer games. Based on the interview guidelines by Strauss and Corbin (1998), we developed a set of semi-structured interview questions that provided flexibility for the researchers to extract relevant and related data. For this research, we only consider educational games that are played on desktops, tablets or mobile devices.

At the beginning of the interview, we provided the definition of an educational computer game as one that fits one or more of the following three criteria: (1) a game that teaches a certain subject, concept or topic; (2) a game that reinforces or furthers one's intellectual pursuit in an area or discipline; (3) a game that assists people in learning a mental skill as they play the game (i.e., physical and motor skills are excluded). We then asked if they have played any of such games and if so, we asked them to identify an educational computer game that they had previously played that they found most engaging. We then used that game as the subject for the interview to elicit concepts related to their engaging experience.

Coding Procedures

There are three main steps in the coding procedures of the GT approach. The coding procedures involve naming and grouping the phenomenon of interest. The following explains the coding procedures used in this research.

Open coding. Open coding is the first step in the coding procedures. It is an act of conceptualizing or naming the phenomenon. In this process, data will be broken down, closely examined, and compared. There are three main sub-steps in open coding: (1) Naming concepts; (2) Defining categories; (3) Developing categories in terms of properties and dimensions.

The first sub-step is concerned with conceptualizing (i.e., naming concepts) that covers the process of labeling every phenomenon that is found in the data. The purpose of this step is to group similar events, happenings, and objects under common headings (Strauss & Corbin, 1998). The second sub-step is discovering categories (i.e., defining categories). In order to group concepts under more abstract and higher order concepts, researchers will have to look through each concept generated from the first sub-step, and categorize them into higher-order concepts. The third sub-step is to develop categories. We developed categories based on properties and dimensions, which will further assist us to relate all the categories when proceeding to the next step of the coding procedures. In this process, researchers can also develop subcategories to support and explain main categories.

Axial coding. The second stage of analysis, known as axial coding, relates categories to subcategories based on comparisons of their properties and dimensions (Strauss & Corbin, 1998). The main purpose of this step is to reassemble all the data that was fractured during the open coding process. The process of linking these categories is no longer descriptively indicated but conceptually developed.

Our final results follow the paradigm model that was suggested by Strauss and Corbin (1998), which emphasizes the three main components that will help to answer the *why, how, when, where and what* questions about the phenomenon of study. The three components are conditions, actions/interaction, and consequences. Conditions refer to a set of events that triggers situation/issues/problems related to a phenomenon, and that helps to explain why and how a phenomenon happens. Actions/interactions explain the event that would take place by action in the phenomenon. Consequences refer to any alteration of any action in the process that would affect the phenomenon and ultimately provide a more complete explanation about the phenomenon.

Selective coding. The final step of the coding procedures, known as selective coding, is a process of refining and integrating the categories to form theory based on the grounded data. The three main sub-steps in selective coding are discovering a central category, integrating the concepts, and refining the theory (Strauss & Corbin, 1998).

The central category must have the ability to pull all other categories together to form an explanatory whole. After successfully identifying the core category or categories, concepts are integrated into the core category or categories, and represented in a diagram. Lastly, final reviews were carried out to ensure that there is consistency and the diagram makes logical sense.

Data Analysis

Participant Demographics

12 subjects who are undergraduate university students voluntarily participated in 1-hour interview sessions. Seven of them are females and five are males. All of them are between 19-25 years old. Table 1 summarizes the respondents' demographic information.

Table 1
Summary of Participants' Demographic Information

Sub-ject	Gender	Age	Year in Program	# of yrs of computer experience	# of yrs of computer gaming experience	Average # of hrs spent on computer games per wk	# of hrs spent on Internet per wk
1	Female	19-25	Senior	15	5	3	70
2	Female	19-25	Junior	15	8	1	50
3	Female	19-25	Senior	16	12	5	20
4	Female	19-25	Sophomore	4	1	2	15
5	Female	19-25	Senior	13	10	1	14
6	Male	19-25	Senior	16	16	1	35
7	Male	19-25	Senior	14	14	20	35
8	Male	19-25	Senior	15	15	5	10
9	Male	19-25	Senior	12	12	8	30
10	Female	19-25	Senior	8	2	5	27
11	Female	19-25	Senior	16	8	7	70
12	Male	19-25	Senior	17	17	10	70
			Mean	13.42	10	5.67	37.17
			Median	15	11	5	32.5
			Std. Dev.	3.82	5.33	5.38	22.61

Findings

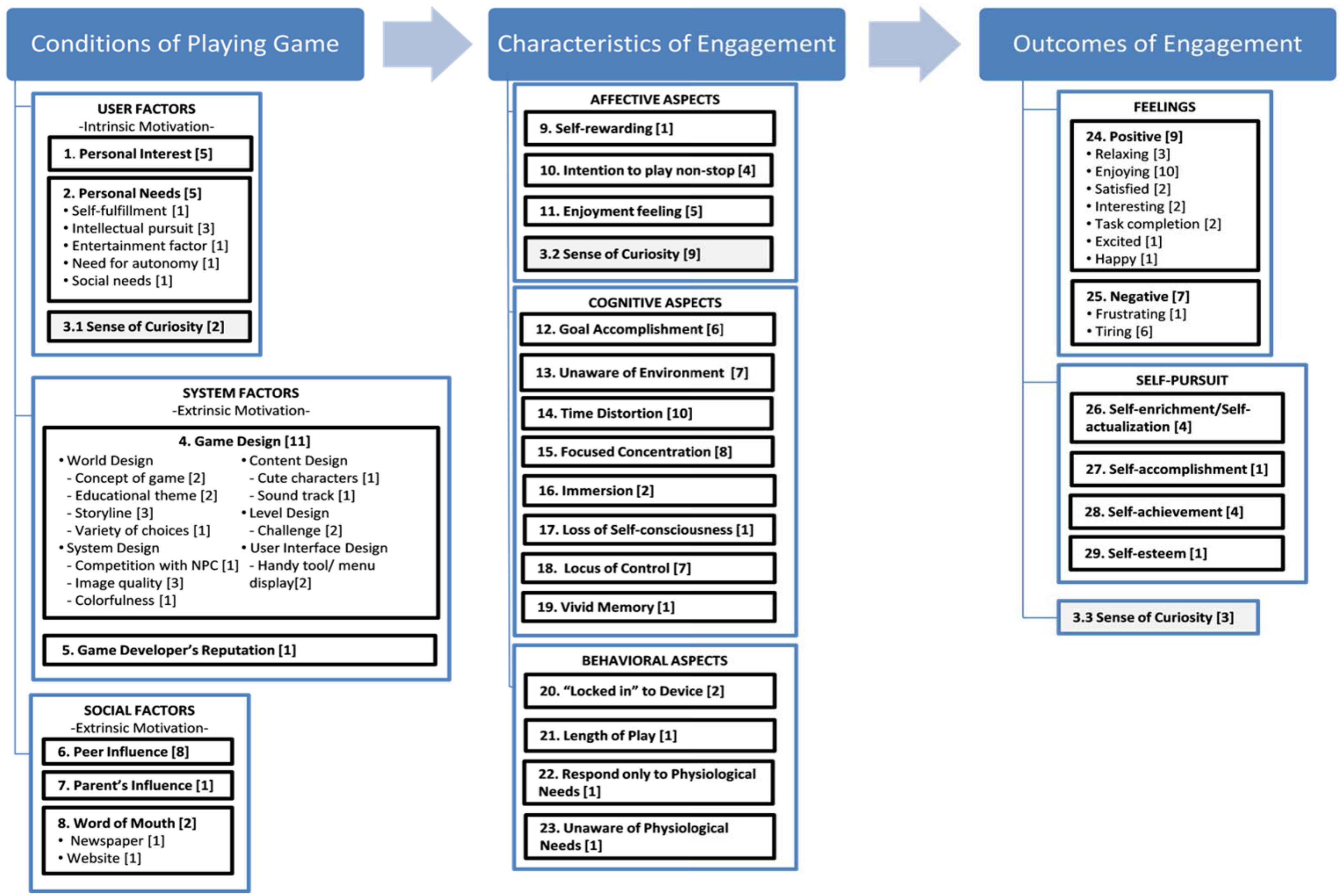
After completing all three steps of the coding procedures, we derived the model in Figure 1. The numbers in square brackets following each concept or category represent the number of subjects who mentioned that particular concept or category. However, these numbers do not necessarily mean that the higher the number, the more important the concept.

The results (presented in Figure 1) consist of three high-level categories: conditions, characteristics and outcomes of engagement. These three core categories explain the phenomenon of engagement. The results suggest that motivation is a key factor in fostering users' interest in educational computer games. Such motivation can be self-generated or generated from users' external environment. We also characterize the elements or characteristics of engagement into affective, cognitive and behavioral aspects. Characteristics of engagement include feelings of enjoyment, wanting to play non-stop, losing awareness of the environment and time distortion. The outcomes of engagement comprise the user's feelings and self-pursuit. Another key factor is sense of curiosity which emerged in all three categories. The findings suggest that sense of curiosity is a major factor that sustains user engagement in educational computer games.

Conclusion and Future Research

This research presents a model of user engagement in educational computer games based on the data from 12 subjects who were interviewed for this study. We plan to continue the data collection to provide a more complete understanding of user engagement in the game-based learning context and to offer considerations that are helpful for designing highly engaging educational computer games.

Figure 1
Model of Engagement in Educational Computer Games



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