Studying the User Experience of a Tablet Based Math Game

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ABSTRACT

This paper presents the first findings from Math Elements user experience (UX) studies. Math Elements is a game that makes the whole Finnish maths K-2 curriculum (kindergarten and primary school grades 1 and 2) available for players all over the world. The game is based on teachable agent approach, which means that in the game players can teach math skills to their game characters. Research focused on evaluating the implementation of the game, exploring players’ opinions about the game, and studying how the game fits to classroom usage. The participants were Finnish (N = 111) and Irish (N = 42) primary school pupils. In both cases interviews, game log data and observation methods were used to evaluate the UX. The Finnish study was conducted in two phases. First, one first grade class (N = 23) participated in a focus group study in which they played the Math Elements game in small groups and finally eight of the pupils participated in an eye tracking study. Second, the class introduced the game in their school and after that all first and second graders of the school played the game daily during a three weeks period. The Irish case study was different from Finnish study and the results are not directly comparable. The Irish pupils (fourth and fifth graders) played the game for 50 minutes as a part of their regular schoolwork. In general, Math Elements was experienced as an engaging learning game in all studied age groups and it was found to fit well into classroom usage in certain contexts. The paper presents the details of the conducted UX studies and discusses the meaning of UX in educational games.

Keywords: Eye Tracking, Game, Learning, Tablet Personal Computer (PC), Teachable Agent, Usability Test, User Experience

INTRODUCTION

The evaluation of the subjective playing experience is a crucial part of the game development process. The aim of game designers is to create appealing experiences for all players. Thus, games can be seen as artifacts that arouse experiences (Schell, 2008). According to Dewey (1938/1997) experience can be described as a continuous interaction between human beings and their environment. Dewey states that the experience is a result of interplay between the present situation and prior experiences. Consequently, players do not have identical playing
experiences but each player’s experience is totally unique. Game designers cannot design the subjective experience directly; only the context from which the experience arises may be designed. Thus, the development of games that please as many players as possible and are still educationally effective is a big challenge.

Several models of user experience have been proposed (e.g. Buxton, 2007; Forlizzi & Battarbee, 2004; Forlizzi & Ford, 2000, Garret, 2003). The user experience is often paralleled with usability (Nielsen, 1993), although usability does not consider users’ subjective views or the emotional side of product use deeply enough. In fact, the user experience approach extends usability techniques (Lew, Olsina, & Zhang, 2010) that are aimed more at the removal of obstacles from a technical perspective than facilitating engaging and rewarding experiences. User experience is focused on the interactions between people and products, and the experience that results in certain contexts of use. The characteristics of the users, such as emotions, values and prior experience, determine how users perceive a game and the related learning goals. In general, user experience should be considered exhaustively from physical, sensual, cognitive, emotional, and aesthetic perspectives (Forlizzi & Battarbee, 2004). Thus, we argue that plain ease of use does not guarantee good user experience and engagement.

According to Fredricks, Blumenfeld and Paris (2004) engagement is seen as a multifaceted phenomenon that consists of three dimensions: behavioural engagement (involvement with activities), emotional engagement (positive and negative reactions to activities and actors), and cognitive engagement (investment). Within these dimensions engagement can vary in intensity and duration. Thus, engaged users show sustained behavioral and cognitive involvement in activities accompanied by a positive emotional tone. In general, it is crucial to understand that engagement with the educational game must be established before effective learning can be achieved (Whitton, 2011). The positive relationship between cognitive and motivational themes for example in mathematics learning has been widely studied (e.g. Rao, Moely & Sasch 2000; Lapointe, Legault & Batiste 2005; Mason & Scrivani 2004). However, there is no absolute understanding that increased motivation also automatically increases the learning outcomes. In the authors’ previous studies the positive learning outcome, as well as the high motivation towards game play have been shown (e.g. Ketamo & Suominen 2010).

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 (Schell, 2008). In the case of educational games, the learning objective is also included, which makes the design of the user experience even more challenging. As Quinn (2005) has argued, educational games have to be designed properly in order to incorporate engagement that integrates with educational effectiveness. Because there is no certain recipe that guarantees the success, user studies need to be conducted during the development process.

In this paper we report the results from two user experience (UX) studies in which a mathematics game called Math Elements was evaluated. Math Elements is a game that makes the whole Finnish primary school’s math curriculum available for players all over the world. In this study several research methods were used including observation, interview, and eye tracking. Because eye tracking is rarely used in educational game research we start by briefly describing the possibilities that it provides for researchers and game designers. After that the Math Elements game is presented and finally the results from the UX studies made in Finland and Ireland are presented.

**EYE TRACKING IN GAME BASED LEARNING RESEARCH**

Observing users’ eye movements has a long tradition in the field of usability as well as in psychology. In recent years, the adoption of eye tracking in various research fields has increased. Eye tracking is based on identifying
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