User Experience in Educational Virtual Worlds

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Abstract
This paper explores user experience (UX) in educational Virtual Worlds. A two-month user experience evaluation was conducted where 37 learners used an educational Virtual World for a problem-based learning task. Two user experience measurements were performed at two distinct phases so as to assess users' perceptions of the Virtual World environment over time. Results reveal that all UX qualities were rated lower at the second measurement mainly due to the many technical problems that users faced throughout the study. However, only the decrease in pragmatic quality was found to be statistical significant. To this end, results indicate that the environment needs usability improvement in terms of efficiency and effectiveness and technical stability so as to provide a better user experience.

Keywords
User Experience, Virtual Worlds, Problem-based Learning, Education, AttrakDiff2.

ACM Classification Keywords
H5.2. User Interfaces: Evaluation/Methodology.

General Terms
Design, Human Factors

Introduction

The evolution of Virtual Worlds (VWs) (e.g., Second Life) has extended research and development on learning technologies and distance learning. Virtual Worlds have a great impact on technology enhanced learning [9], providing prospective learners unprecedented ways of collaboration and feelings of immersion and social presence. Despite the attention they have received as new learning environments there is a lack of validated design principles and guidelines for developing learning spaces within VWs. Accordingly, user experience evaluation studies are scarce. Very few studies have been reported in the literature [16, 14] while most of the relevant research is still anecdotal.

In this empirical study we conducted a user experience (UX) evaluation where learners used an educational VW for two months for a problem-based learning task. Two UX measurements were performed at two distinct phases so as to assess users' perceptions of the VW environment over time.

The remainder of the paper is organized as follows: Section 2 discusses the related work. In Section 3 and Section 4 we present the methodology and results of this empirical investigation, respectively. Finally, Section 5 concludes the paper with a discussion on the experimental results.

Background and Related Work

In this section we present related research work on User Experience and Virtual Worlds for education, both of which lie at the foundation of our study.

User Experience

User Experience (UX) studies the feelings and thoughts of an individual about a product (e.g., interactive system). UX is dynamic, because it changes over time as the circumstances change [4]. Being a multi-dimensional and complicated area a universal definition has not been agreed to date. Nevertheless, most of the definitions given to UX [20, 2] agree that UX focuses on the hedonic and affective aspects of human-computer interaction (HCI), but it also includes a person's perceptions of the practical aspects such as utility, ease of use and efficiency of a system.

Effective HCI design and evaluation involves two important qualities: i) usability (i.e., traditional HCI), and ii) hedonic, beauty and affective [2]. Based on Jordan [3], the latter complements traditional HCI qualities (i.e., pragmatic) by suggesting a fixed hierarchical structure of qualities that contribute to positive experience. That is, a product has to provide functional and usability qualities before hedonic aspects can take effect. In contrast to Jordan, Karapanos et al. [4] assume the importance of these different qualities to vary with several contextual factors, i.e., individual differences, type of product, situation the product is used, and change of experience over time.

Recent research on HCI extends traditional task-based analysis and evaluation (e.g., usability evaluation), but rather focuses on hedonic and affective (e.g., surprise, diversion, intimacy) aspects of HCI design and evaluation. Mandic and Kerne [5] demonstrated an addition to email (called faMiliar), which visualizes "rhythms in social engagements" (p. 1617) and builds on intimacy as a core construct. In laboratory studies of users' preferences of Media player skins, Tractinsky and

Lavie [6] and Tractinsky and Zmiri [7] showed the choice of personalised user interfaces (i.e., media player skins) to be driven by usability, aesthetic and symbolic considerations. Desmet et al. [1] demonstrated how affect could become a design goal. Zhang and Li [8] found the perceived affective quality of a course management system to be an antecedent of its perceived usability, usefulness and the intention to use. Germanakos et al. [19] have shown that users' cognitive and emotional characteristics have significant impact in the adaptation and personalization process of web environments by increasing usability and satisfaction during navigation and learning process.

Regarding UX evaluation, one of the most influential models is the one proposed by Hassenzahl [22]; according to this model each interactive product has a pragmatic (related to usability) and hedonic quality that contribute to the UX. Based on this model a very well known and widely used instrument has been developed, the AttrakDiff, which has been employed in our empirical study (version AttrakDiff2). It is composed of four main constructs with seven anchor scales (total 28 items). The constructs are [21, 22]: Pragmatic Quality (PQ), which is related to traditional usability issues (such as effectiveness, efficiency, learnability, etc.); Hedonic Quality Stimulation (HQS), which is about personal growth of the user and the need to improve personal skills and knowledge; Hedonic Quality Identification (HQI), which focuses on the human need to be perceived by others in a particular way; and Attraction (ATT) which is about the global appeal of an interactive system or product.

3D learning spaces and educational Virtual Worlds

Virtual Worlds (VWs) or MUVEs (Multi User Virtual Environments) are computer-generated (not exclusively in 3D or animated graphics) environments, in which multiple users navigate, interact and communicate having a form of embodied representation [17].

This study considers VWs as learning and educational environments. VWs quickly captured the attention of the educational community as a highly engaging medium and a prospective learning environment that supports synchronous and asynchronous collaboration and user (learner) immersion in realistic or imaginary environments. There are numerous distinguished characteristics in VWs that can transform and enhance the quality of learning and educational activities. As Dalgarno and Lee [9] argue, VWs provide five important learning affordances as they facilitate learning tasks that: *"…lead to the development of enhanced spatial knowledge representation of the explored domain" (p.18); "…would be impractical or impossible to undertake in the real world" (p.19); "…lead to increased intrinsic motivation and engagement" (p.20); "…lead to improved transfer of knowledge and skills to real situations through contextualisation of learning" (p.21); "…lead to richer and/or more effective collaborative learning than is possible with 2-D alternatives" (p.23).*

A strand of research has investigated issues related to social and motivational aspects of educational VWs [23, 24]. Another strand of research has focused on the use of VWs as collaborative and problem-based learning environments [13, 18]. Other researchers have focused on interaction with technological features of VWs, e.g., multisensory representation can help learners' interest,

fun, ability to navigate [12, 11], interaction with data gloves [10], etc.

Methodology

A total of 40 students (57% male, 43% female, age varying from 20-24) from the University of Cyprus participated in a two-month problem-based learning study. To undertake the learning tasks and activities, a learning space was built in Second Life where the users had to use in-world collaboration tools and techniques (i.e., live text and voice chatting, forums for comments, etc.). Most of the users did not have any previous experience with such a VW. Before starting the empirical study, a series of introductory tutorials on Second Life were conducted (i.e., how to configure an avatar, how to create objects, etc.). During the first week groups of 3-4 students were assigned to design and develop interfaces for several interactive systems (e.g., Realtor's Agency, Online Game Shop, University's Management System, Smart Home Management System, etc.) utilizing Second Life.

The interface design of each system was based on the Logical User-Centered Interactive Design (LUCID) methodology. Some indicative tasks the students had to undertake throughout the design/development cycle were: i) literature review on similar systems, ii) determine the typical users of the system, iii) analyse the interface's design, following the Hierarchical Task Analysis (HTA) methodology, iv) design and develop the system's interface prototypes, v) design users' navigation model.

Users were asked to evaluate their experiences using and collaborating through the VW at two distinct times by employing an online version of AttakDiff2; the first was at the end of the second week and the second at the end of the eighth and last week (henceforth time 0 and time 1, respectively).

Results

A paired sample T-test was performed in order to compare the user experience evaluations at the two different times. The analysis showed that difference in mean scores for the time 0 and time 1 was significant in PQ (mean difference=.436, t=2.651, p=.012).

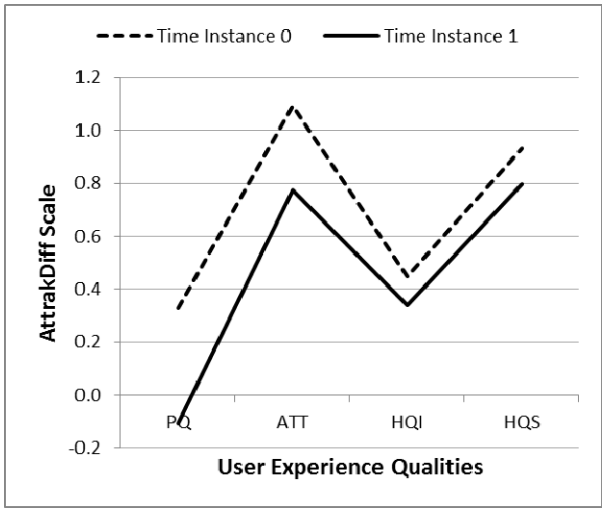

figure 1. Overall Results

Differences found in other scales were not significant: ATT (mean difference=.320, t=1.966, p=.057), HQI (mean difference=.108, t=1.004, p=.322) and HQS (mean difference=.135, t=1.456, p=.154).

Discussion

According to the results, all the evaluations at time 0 were higher than the evaluations at time 1 (figure 1). Nevertheless, only the difference in Pragmatic Quality (PQ) was found to be statistical significant. Several technical problems emerged during this 2 month period which caused service unavailability and sometimes led to loss of users' objects and artifacts. That was the main reason for users' frustration and irritation. In addition some users kept complaining about usability issues of the environment. To this end, PQ which refers to usability and functional aspects of interaction was rated quite low at both times of evaluation. Such finding calls for improvement of usability design mainly in terms of efficiency and effectiveness (focused on objects' manipulation). It is also remarkable that according to the analysis all the other UX qualities such as Attraction (ATT), Stimulation (HQS) and Identification (HQI) were rated lower at time 1 (end of the two-month period). It is very likely that users' frustration because of the several technical problems they faced was getting bigger as the time was passing and this led to a lower perception of HQS, HQI and ATT. Especially for the attraction, a preliminary interpretation can provide an explanation because of the low rating of PQ. This is in accordance with prior research [21] that has found that pragmatic quality influences attraction. In any case results reveal that there is a lot of room for usability improvements of such an educational environment so as to provide better UX.

Two main limitations have been identified regarding this study: a) a larger sample of users is needed in order to be more confident with the results of this investigation, and b) several technical problems emerged during the study; if there were a better operation of the server it is very likely that results and overall evaluation would be much different.

In conclusion, this empirical work performed two UX measurements so as to assess users' perceptions of an educational Virtual World. The relevant research is in its infancy and further empirical studies are needed to investigate UX issues in such environments. This work focused on measurements at two distinct times. A future research prospect is to employ methods and tools [4] that can assess UX perceptions over time in order to shed light on this complex, dynamic and unexplored phenomenon.

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