Chapter 13
From Usability to User Experience:
Evaluating the Educational and Motivational Value of an Augmented Reality Learning Scenario

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ABSTRACT

Augmented Reality (AR) is merging real and virtual environments within a single interaction space. This tight integration of computer technologies into a real environment is creating new opportunities and challenges for the designers of e-learning systems as well as a new kind of user experience (UX) for the learner. More recently, AR-based educational systems were developed that are implementing learning scenarios for primary and secondary schools. An important goal of these novel teaching platforms is to enhance the students' motivation to learn. This chapter reports on the perceived educational and motivational value of an AR-based learning scenario for chemistry based on the results of a user-centered formative usability evaluation. Quantitative and qualitative data were collected during two experiments with students from secondary schools. While the comparison between the two types of measure increases confidence in the evaluation results, the qualitative measures also provide a detailed description of the user learning experience.

INTRODUCTION

The integration of real and virtual environments within a single interaction space is challenging the designers in many application domains such as medicine, education, entertainment and industry. While the configurations based on head mounted displays (HMD) are integrating specific AR devices into a real life environment, the desktop AR configurations are bringing real life objects into a computing environment. The choice of the viewing configuration depends on several conditions such as

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cost, task requirements or maintenance problems (Shim & Kim, 2006).

The user experience with a specific technology depends on how the designers take advantage from the opportunities created by a particular application domain. More recently, AR-based educational systems were developed that are implementing learning scenarios for primary and secondary schools. The increasing interest in using these technologies for the development of e-learning systems is mainly due to their suitability to support new learning paradigms, such as active and collaborative learning.

On another hand, bringing various real life objects into a computing environment is increasing the complexity of the human-computer interaction and requires the development of suitable interaction techniques. In order to prevent usability problems, the interaction components of the AR system have to be tested with users early in the development process. The earlier these problems are identified the less expensive is the development effort to fix them.

According to Theofanos & Quesenbery (2005), formative usability testing is performed in an iterative development cycle and aims at finding and fixing usability problems as early as possible. This kind of usability evaluation is called "formative" in order to distinguish it from "summative" evaluation which is usually performed after a system or some component was developed (Scriven, 1991). Formative usability evaluation can be carried on by conducting an expert-based usability evaluation (sometimes termed as heuristic evaluation) and / or by conducting user testing with a small number of users. In this last case, the evaluation is said to be user-centered, as opposite to expert-based formative evaluation.

This work is based on results from a user-centered formative usability evaluation of an AR-based learning scenario for chemistry which has been developed in the framework of the ARiSE (Augmented Reality for School Environments) research project. The main objective of the ARiSE project is to test the pedagogical effectiveness of introducing AR in primary and secondary schools and creating remote collaboration between classes around AR display systems. An important research goal is to investigate the extent to which each learning scenario is enhancing the students' motivation to learn.

The project is carried on in a consortium of five research partners and two school partners. ARiSE developed a new technology, the Augmented Reality Teaching Platform (ARTP) in three stages thus resulting three research prototypes. In order to get a fast feedback from both teachers and students, each prototype is tested with users during an ARiSE Summer School which is held yearly. The second prototype implemented a chemistry scenario and was tested during the 2nd ARiSE Summer School in Bucharest.

The usability results were useful and revealed several strengths and weaknesses of the implemented scenario (Balog & Pribeanu, 2008). The motivational value of the learning scenario was also analyzed and reported in a previous work (Pribeanu & Iordache, 2008). The results were interesting from both the quantitative and qualitative data but the confidence in our findings is low due to the small number of users and the special context created by the summer school. Therefore we repeated the user testing with a relatively larger number of more representative users.

The basic idea of our approach was to conduct user testing during the summer school in order to get a fast feedback from students having good knowledge in chemistry and to repeat the user testing in different conditions and with a relatively larger number of representative users. The purpose of this chapter is to present, analyze and compare the results of both experiments from the perspective of educational and motivational value. In this respect, we will broaden the scope of traditional usability evaluation to address issues related to perceived utility and attitude towards the system and we will focus on the positive aspects mentioned by students that are describing their