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How the Type of Content in Educative Augmented Reality Application Affects the Learning Experience

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Abstract

Nowadays, the use of technology to improve teaching and learning experiences in the classroom has been promoted. One of these technologies is augmented reality, which allows overlaying layers of virtual information on real scene with the aim of increasing the perception the user has of reality. In the educational context augmented reality have proved to offer several advantages, i.e. increasing learning engagement and increasing understanding of some topics, especially when spatial skills are involved. Contents deployed in an augmented reality application are of two types, static, i.e. text, or dynamic, i.e. animations. As far as we know no research project has assessed how the type of content, static or dynamic, can affect the student learning experience in augmented reality applications. In this article the development and evaluation of an augmented reality application using static and dynamic content is described. In order to determine how the type of content affects the learning experience of the student, an experimental design in which the student interact with the application, using static and dynamic contents, for learning topics related with an electronic fundamentals course was performed.

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Keywords: static and dynamic contents, augmented reality, fundamentals of electronics.

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1. Introduction

In recent years, the use of technology to improve teaching and learning experiences in the classroom has been promoted[1]. One of these technologies is augmented reality, which allows overlaying layers of virtual information on real scene with the aim of increasing the perception the user has of reality[2]. In the educational context augmented reality offers several advantages as: (i) it has an ability to encourage kinesthetic learning, (ii) it can support students by inspecting the 3D object or class materials from a variety of different perspectives or angles to enhance their understanding, (iii) it increases the student level of engagement and motivation in academic activities, and (iv) it allows to provide contextual information, that is data about real objects of the scene related with the learning activity[3]. The contents deployed in an augmented reality application are of two types, static or dynamic[4]. Texts, visual cues or 3D models whose appearance does not vary during interaction with the user are defined as static contents, besides dynamic contents vary their appearance during interaction with the user, and animation are an example of them. Dynamic visualizations such as animations or videos are depictions that change continuously over time and represent a continuous flow of motion (e.g., of an object), whereas static visualizations do not show any continuous movement, but only specific states taken from such a flow of motion[5]. Which type of content must be deployed in an augmented reality application depends on the topic and the learning experience that will be provided to the student[6,7].

Most of the research projects involving the design and evaluation of the static and dynamic content have considered the framework of the Cognitive Theory of Multimedia Learning and of the Cognitive Load Theory (CTML)[8]. This framework establishes that a learner has to select, organize and integrate new information to fully understand any instructional material. According to CTML, select and organize verbal information involves the construction of a verbal mental model, while the selection and organization of visual information involves the development of a visual mental model. This framework also states that the construction and integration of these two mental models allow a deeper understanding of a specific topic and an improved linking with prior knowledge, which promotes the storage of new knowledge more easily in the long-term memory. For this reason, several studies have explored whether there is a difference in learning when the contents are presented in textual, visual way or integrating both ways[9,10].

Different learning strategies or cognitive activities applied by students when they use text or diagrams-based contents have been explored[11]. For measuring or evaluation of these processes the use of think-aloud protocol and coded cognitive activities such as: inference, background knowledge, vocabulary, among others, has been proposed. From experimental tests performed in learning subjects like biology, the authors found that students perform more elaborate cognitive activities when learned through diagrams than using text, however they did not determine whether the level of learning was better in some of the two modes[11].

Other works have focused on evaluating whether there is an effect on learning when the student uses static or dynamic contents. An analysis of how different abilities, skills and knowledge of student affect the understanding process of dynamic content has been described[12]. Additionally, the authors of this research work reported eight studies in which the understanding of a complex mechanical system using static and animated diagrams is evaluated, with and without verbal instructions. From the results they were able to determine that the space ability has no significant effect on the understanding of the content, and possibly this kind of ability is more useful when the content is textual or verbal and the student has to mentally create a visual representation of it[12]. Finally, the authors determine no significant impact on learning when static or dynamic content is used.

Additionally, the effect of static and dynamic contents on understanding the physical principles of locomotion of fish has been determined[13]. Specifically, three conditions defining how the content is showed have been tested: text only, text with dynamic visualizations, or text with static visualization. In this research work the authors proposed as metrics for measuring the level of learning, the use of think aloud protocol and the grade of exams involving text or graphics. The results obtained is that both visualization conditions are better than text-only when pictorial recall or transfer tasks were evaluated, but not for factual knowledge verbal tasks.

As far as we know no research project has assessed how the type of content, static or dynamic, can affect the student