Chapter 6
What Makes an Educational Augmented Reality Application Good?
Through the Eyes of Teachers, as Its Practitioners

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ABSTRACT

In recent years, teachers have started to integrate augmented reality (AR) technology as a potential learning tool into classroom activities. The main concern is the quality of the existing applications rather than brand-newness. Therefore, this chapter focuses on the components of a good educational AR application based on the experiences of teachers and to examine the current situation on the integration of AR to learning environments. Qualitative methodology was used in this study. The sample consisted of 24 teachers working in public schools in Turkey. The data were collected via semi-structured interviews and analyzed through the thematic analysis. The results showed that the components of a good AR application in education were gathered under four main themes: "analysis process," "design process," "teaching-learning process," and "evaluation components." Implications for the design and use of the AR applications in educational settings were also included in the study.

INTRODUCTION

Augmented reality (AR) is an interactive environment where the virtual objects (video, animation, 3D, etc.) are superimposed on the real-world settings. As an innovative technology based on the human-computer interaction (Wang, Ong & Nee, 2016), it has a visualization structure combining the computer-based information with the physical environment (Martin-Gutierrez et al., 2015). Azuma (1997) asserts that the AR enables the detection of virtual objects on the real world as a derivation of virtual reality (VR).

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Hence, it supports the existing reality by offering three main features (Azuma, 1997): (i) the combination of virtual and real objects (ii) real-time interaction, and (iii) 3D referencing.

The virtual contents of AR applications (apps) are created using various image, graph or video processing techniques. Thus, the real world setting becomes more functional by means of virtual objects (Siltanen, 2012). The main tools used for AR are displays, input and tracking devices, and computers (Carmigniani & Furth, 2011). Besides the mobile devices (smart phones, PDAs, tablets, etc.), head mounted displays and spatial images (holograms, optical elements, radio-frequency, etc.) are used as display devices, and specially designed gloves or wireless wristbands are used as input devices. On the other hand, GPS, digital camera, and wireless and optical sensors are used as tracking devices (Carmigniani et al., 2011; Johnson et al., 2010; Koutromanos, Sofos & Avraamidou, 2015). Kounavis et al. (2012) stated that the AR apps required the components such as mobile device, camera, high-performance processor, large-capacity RAM, and wireless network. Similarly, from a hardware perspective, Craig (2013) emphasized that the AR apps consisted of the basic components such as sensors (cameras, GPS, gyroscope sensors, etc.), processor units (computer, tablet, etc.), and displays (screens of computers, mobile devices etc.).

According to Azuma et al. (2011), the AR technology is the result of the visualization of the virtual objects along with the real world in the same space; however, it is not limited to the sense of sight. This technology has a structure that appeals to the primary senses such as touching, smelling, and hearing, and also has the feature of perceiving and recognizing the gestures and facial expressions. Johnson et al. (2010) summarized the technologies used in the AR systems as follows: (i) GPS technology in which the real world location is integrated, (ii) "image diagnostic software" in which the virtual objects are integrated by recognizing the marker, (iii) "speech and voice systems" that enable voice recognition and playing the related sounds, (iv) "internet access" that enables the content storing and sharing by using social media and Web 2.0 technologies, and (v) "intuitive interfaces" that provide a natural interaction with the touchscreen, gyroscope, and haptic input technologies.

It has become increasingly important to use the AR technology in the field of education as well as the sectors such as advertising, marketing, architecture, amusement, defense, travel, and health. Accordingly, it has become a potential technology affecting the teaching-learning process. The AR technology, one of the developing technologies for the educational settings, has aroused intense interest among researchers recently. In the 2020 EDUCAUSE Horizon Report, it was predicted that the AR/VR (referred to as extended reality that embraces both technologies) technology would be widely used for the teaching-learning process and the educational technologies would follow a trend in line with this technology (Brown et al., 2020). In this context, AR is among emerging technologies for the educational environments. AR provides a learning environment adaptable to the real life environment, ensuring flexibility in learning (Barsom, Graafland & Schijven, 2016). In addition, the AR apps differ from the traditional teaching technologies in terms of providing realistic visuals, effective and friendly interfaces, and interactive contents (Wang, Anne & Ropp, 2016).

AR technology has drawn attention especially in the educational environments in concretizing the abstract concepts and simplifying the complex situations. In addition, it increases the students' motivation for lessons and attracts their attention by making lessons more enjoyable (Singhal, Bagga, Goyal & Saxena, 2012). In education, it is mostly used in teaching the inaccessible and invisible objects and phenomena and in applying different options involving dangerous situations. It also contributes to the development of students' both cognitive characteristics such as course achievement and affective characteristics such as attitude and motivation (Akçayır & Akçayır, 2017). Specifically, AR is an immersive environment for learning in different fields such as mathematics (Kaufmann & Dünser, 2007), science