

Augmented Reality 3D Pop-up Book: An Educational Research Study

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Abstract— Augmented Reality technology in education is in high demand for its innovative potential since its fascination grows ubiquitously across the world. This research article reports on an educational innovation which utilizes, as teaching material, the Augmented Reality 3D pop-up book in the hybrid mode of learning for Grade Three students in Bangkok, Thailand. The story contained in this children’s book is “the Seed Shooting Game”. The Augmented Reality 3D pop-up book can be used in both online and off line modes. The developed media is an edutainment in multimedia format consisting of: text, voice, graphics, animation and interaction. This research was funded by an educational innovation grant in 2011 from the Office of Education, Bangkok Metropolitan Administration. This paper reports on the major findings which presents students’ attitudes towards two representations of educational innovation: Augmented Reality and 3D pop-up book.

Keywords— 3D, Assumption University of Thailand, Augmented Reality, Children story, elementary school, English as a second language

I. INTRODUCTION

This research article aims to report on some findings of a study of students’ perceptions after using, as teaching material, an Augmented Reality (AR) 3-Dimensional pop-up book titled “The Seed Shooting Game” in the hybrid mode of learning for Grade Three students, in Bangkok, Thailand. This paper is organized into three main parts: I) Augmented Reality (AR) and Virtual

Reality (VR), II) AR at the Assumption University of Thailand, and III) the results of the study in preferred type of the AR 3D pop-up book. The main research questions for this article focused on what is the preferred media of Grade Three Students comparing two different presentations: AR (Figure 1) and 3D pop-up book (Figure 2).



Fig. 1 Augmented Reality pop-up book



Fig. 2 3D pop up book

Augmented Reality or AR in short refers to a computer technology that manipulates and displays 2D or 3D objects, or multimedia, or a movie to be shown simultaneously so that the reality on the computer screen appears when the camera of

the device which installs the software captures the marker or objects through Radio Frequency Identification (RFID) [1]. In order to view AR, there is the need to prepare the following equipment: 1) a web camera plugged to a computer or mobile device, 2) the computer or device to install AR media player software and AR application and 3) a marker if needed [1].

AR is a futuristic technology which has been created and used globally in many fields. AR technology becomes an amazing tool since it enhances the human eye to see more information through a simple web camera which works along with a computer device. The popularity of AR has been influenced from the availability of a mobile device embedded with a camera universally. Additionally, the readiness of AR software and applications is also ubiquitous. This means that the hardware, software and peopleware are ready to support the use of AR.

The results from the study show that AR technology is the most fascinating of technologies especially the mobile AR applications [2]. The Mobile AR has grown dramatically, forecasted by Juniper Research to reach US\$1.5 Billion by 2015 [3]. The installed base of AR capable smart phones increased dramatically from 8 million in 2009 to more than 100 million in 2010 [3]. Moreover, the potential of AR support is guaranteed, since AR can function now by voice recognition, gesture recognition, paper marker-based, markerless, Global Positioning System (GPS), 2D recognition and 3D recognition [4]. AR is going to be pervasive and knowledge of this dimension of technology is growing extensively. AR has become the 'talk of the town', for example, on social networking platforms such as Twitter, AR has been mentioned at least five times an hour, [4].

AR was invented in the 1960s by Tom Caudell, to solve problems of presenting complicated information about an object on the limited space of the board [5]. Thus, with the potential of technology, AR has become a powerful computer application that is very

useful in many areas. It has been predicted that AR will be widely used for educational purposes within 2-3 years by the Horizon Report 2010, which is the annual report of the New Media Consortium and the EDUCAUSE Learning Initiative, which focuses on modern learning and teaching technologies [5]. Similar to the Emerging Technology Hype 2010 by the Gartner Firm from the United States of America, the study explored more than 1,800 technologies and the result on the Gartner Hype indicated that AR is at the peak of inflated expectations or close to the highest point [6]. The results of the Gartner Firm confirmed that AR will be the mainstream adopted in 2-5 years from 2010 [6]. As the result, AR for general purposes has become popular. Therefore, AR for educational purposes will need to be researched and developed to supply the best of learning quality. There are many concerned for AR educational projects, especially the production part since it is not straightforward and requires sound planning and resources.

II. AR AND VIRTUAL REALITY (VR)

The concepts of AR and VR have some similarity and yet they are different. Fig 3 demonstrates AR as the computer application manipulates digital information to be augmented in reality.

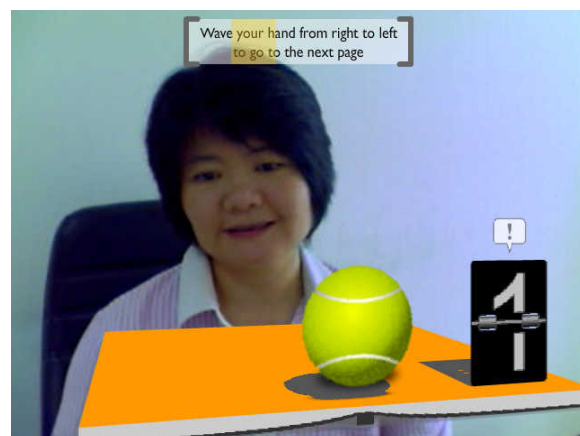


Fig. 3 Augmented Reality



Fig. 4 Virtual Reality

Fig. 4 reveals VR as the reality virtually augments in the computer application. Based on Fig. 5 re Google Insights for Search reported that, from 2009, AR has become a more interesting topic in both search volume index terms and news reference volume than Virtual Reality [7]. This result might be reflected from the ubiquitous growth of mobile technology as well as featured camera technology and the ease of touch screen mobile phones with GPS such as the iPhone and Android phones as the main effect on the development of AR projects. Before 2009, the popularity of Virtual Reality increased dramatically when the Second Life bloomed and the Multi User Virtual Environments (MUVes) emerged as the new kind of web browser.

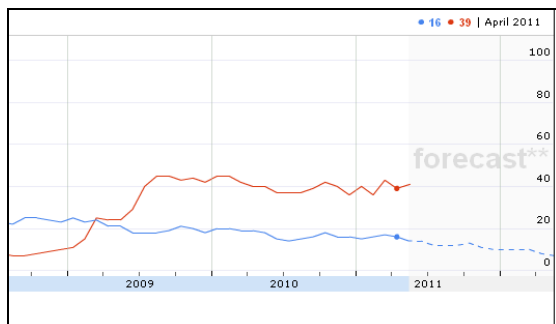


Fig 5. Augmented Reality was over than Virtual Reality in terms of Web Search interest by Google Insights for Search [7]

The output of AR projects can be ranged from simple which present text, 2D graphic and 3D objects to advanced which presents multimedia, movie and games. At the Assumption University of Thailand, the AR marker-based projects present the 3D

buildings; they have been used for public relation purposes. The next section details the AR projects of Assumption University which is the first time AR technology has been deployed in a Thai institution and provide good examples of applying AR in practice.

III. AR AT ASSUMPTION UNIVERSITY

The main objective for creating AR projects at the Assumption University of Thailand has been to introduce the novel technology of AR and to simulate the beautiful architecture of the main buildings of Suvarnbhumi Campus. All these AR projects, the 3D buildings of Assumption University have been downloaded from 3D warehouse by Google SketchUp and then complied to be the AR projects. These three projects use the same marker and all can be downloaded freely from the author's web site [8]. The three AR projects of Assumption University are shown in Figure 6-8.

A. Cathedral of Learning



Fig. 6 Augmented Reality of Cathedral of Learning, Assumption University of Thailand

Fig. 6 is a capture of the Cathedral of Learning in the AR environment. The actual building is of Assumption University, a 39-story, 522 foot (159 m) tall building that is modeled and serves as the centerpiece of Suvarnbhumi Campus.

B. Museum and Dormitory



Fig. 7 Augmented Reality of Museum and Dormitory, Assumption University

Fig. 7 is a capture of the Museum and Dormitory at Assumption University in the AR environment. The actual building is located at Suvarnabhumi Campus.

C. Srisakdi Charmonman IT Center



Fig. 8 Augmented Reality of Srisakdi Charmonman IT Center, Assumption University

Fig. 8 is a capture of the Srisakdi Charmonman Information Technology Center at Assumption University in the AR environment. The actual building is also located at Suvarnabhumi Campus. It is the head office of the College of Internet Distance Education (CIDE). This building is named after Prof. Dr. Srisakdi Charmonman, a founder of CIDE.

These three AR Projects of Assumption University has been presented as the technology innovation to Her Royal Highness Princess Mahachakri Sirindhorn on December 7th, 2010 on the 40th Anniversary

Celebration of Assumption University. These three AR Projects represent the icons of Assumption University and they demonstrate the geographic information better than a still image since they are 3D. The next section describes the impact of educational innovation of the AR 3D pop-up book in a hybrid learning environment.

IV. PREFERABLE PRESENTATION OF AR AND 3D POP-UP BOOK

The AR 3D pop-up Book created for this research employed a research and development process through the storytelling technique with colourful cartoons based on multimedia innovation which consisted of pop-up cartoon graphic as 3D presentation, text, animation of flip book, sound narration and interaction. The completed AR 3D pop-up book contains 32 pages. The sound of each item was separately controlled. This innovation has been designed for usage as a teaching material for the hybrid environment together with the paper-based test and exercise form. The package can be downloaded from the author's web site [9].

The developed media has been implemented in the real classes separately. Both media are different - to implement an AR pop-up book, it needs a web camera, and the book was controlled by moving a marker and the users were able to see themselves in the reality of the environment on the computer screen. The 3D pop-up book, on the other hand, does not need a web camera, for the book was controlled by the computer mouse and the users saw the background and some floating objects.

Class A which has 37 students participated with an AR pop-up book (Figure 1). Class B which has 36 students participated with 3D pop-up book (Figure 2). Both classes studied in the same process and used the same package of teaching material. After the post-test students were surveyed for their opinions about the media. The researcher presented to the students who used the AR pop-up book, what does the 3D pop-up book look like and showed them how

to control the media. To the other class, the researcher presented to the students who used the 3D pop-up book, what does the AR pop-up book look like and showed them the method to control the media. This was to make sure that both classes knew the difference between the presentations. Then, they were asked to answer the last question "Which presentation did they prefer?" There were three response options: 1) AR pop-up book, 2) 3D pop-up book and 3) both. The results (Fig.9) reveal that Class A students (n=37), who studied from the AR pop-up book indicated they prefer both (70.3 %), as against the 3D pop-up book (21.6%) and AR pop-up book (8.1%) respectively. Class B students (n=36), who studied from the 3D pop-up book indicated their preference for both (86.1 %) with 3D pop-up book (5.6%) and AR pop-up book (8.3%) respectively.

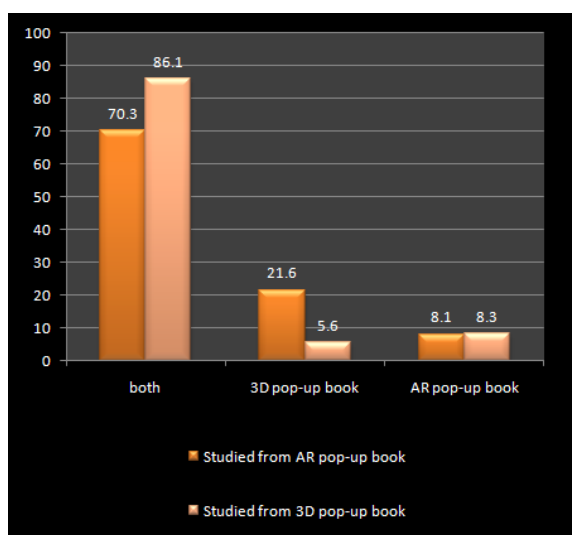


Fig. 9 Preferred Presentation of AR and 3D Pop-up Book: Results (%)

This reflects that both presentations of AR and 3D pop-up book are similarly preferred by the Grade Three students who have experienced participation in both media. The reason seemingly for this is both are innovations appropriately adapted to the age of the students. Further research to explore the issues is needed.

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