

A Study of the Interactive Mathematics Mobile Application Development

^{1,2,a}Wen-Hung Chao, ³Ching-Yu Yang, ^{4,c}Rong-Chi Chang

¹Department of Digital Media Design, Chienkuo Technology University, Changhua City, Taiwan, R.O.C.

²College of Creative Design, Asia University, Taichung City, Taiwan, R.O.C.

³Department of Creative Product and Game Design, Chienkuo Technology University, Changhua City, Taiwan, R.O.C.

⁴Department of Technology Crime Investigation, Taiwan Police College, Taipei, Taiwan, R.O.C.

Email: cwh@ctu.edu.tw^a, roger@mail.tpa.edu.tw^c

Abstract

This study has developed an interactive learning App through Augmented Reality (AR) technology. This AR math learning App provides with interactive operations such as combination, stacking, dismantling, multi-angle rotation, and so on. Teachers can apply this App to teach by replacing teaching materials like traditional stack cartons or videos. Students can repeatedly hand-operate and practice through mobile devices to increase the understanding of the concept of space and understanding 3D body. The study has adopted standard way of experiments to implement the learning effects evaluation of 5th grade elementary students and finds there are significant differences in learning outcomes. The study also applies the technology accepting models and semi-structured interviews to understand how teachers and students react after applying the App. The experiments indicate that the AR mathematics learning App developed by the study can make learners easily apply and maintain a positive attitude, which shows it can improve the motivation of learning.

Keywords: Interactive learning, Augmented Reality, Mobile App, Mathematics

Introduction

Mathematics is a subject that constructs knowledge by applying symbolic language to implement quantity, structure and variety. Cognitive activities like abstraction and logical reasoning help students obtain the ability of abstract applications in specific counting and calculating. Math is widely used in various fields, such as science, medicine and economics, etc., which shows the importance of learning Math. Therefore, young children require starting their Mathematics education to develop their strong motivation and interest in learning Math.

5th grade and 6th grade elementary school students study Mathematics to understand the geometric properties of simple plane and three-dimensional shape as a teaching goal so as to cultivate their abilities in calculation, abstraction, reasoning and communication. [1]

From a cognitive perspective, many studies emphasize the importance of providing a constructive environment of knowledge when assisting school children in learning Mathematics [2]. Meanwhile, the academic community has strongly introduced digital technology to help establishing the basic Mathematics abilities of school children. It also develops many learning systems, teaching mechanisms and related theories that are used at teaching sites.

The research shows that amusing-way learning can induce learning motivation by guiding learning system and also enhance learners' abilities of creative thinking, reasoning and critical thinking. As information technology booms, Augmented Reality (AR) provides a system for human-computer interaction and is applied in digital technology-assisted learning. It is a digital technology that has drawn much attention in recent years. The AR technology enables learners to go through contextual learning and enrich their knowledge-building experience through overlapping experiences of actual and actual scenes (Billinghurst, Grasset, & Looser, 2005).

Therefore, this study uses the characteristics and advantages of Augmented Reality to construct an interactive "Mathematics Learning App". This learning system supports elementary school students in Math teaching or self-learning. In order to assess the impact of this learning system assisted learning activities on Math learning, 102 5th grade students of our country were selected as the research targets and actually introduced into the teaching site as well as to understand the impact of digital technology applied in elementary Math learning from the feedback response of the learning effectiveness, interactive participation in the learning process, system satisfaction.

Research methods

A. Teaching material design

In order to make students more proficient in using AR Math learning app, the content of the teaching materials in the study is mainly based on the Math questions of the textbooks. The design of teaching materials is jointly developed by experienced Math teachers so that students can maintain their familiarity when they use the materials to enhance their confidence. Digital teaching example is shown as Figure 1.

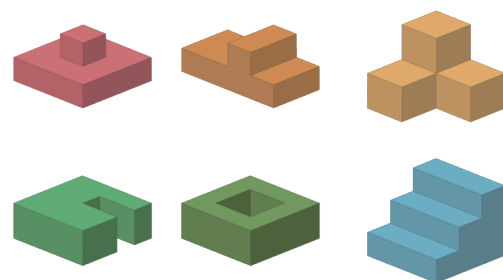


Fig. 1: Example of volume unit learning materials

B. System development

This AR application was developed using the Unity 3D IDE and the Vuforia SDK to guide students into Volume Learning modules via an AR chart. The system is divided into “Learning Fun” and “Challenge Fun” in two parts. Learning Fun has various types of volume topics. When a handheld device reads an AR card, you can create three-dimensional objects and enter interactive learning. Learning Fun provides interactive features such as interactive rotation, object stacking, and object removal (Fig. 2), allowing students to observe and understand the three-dimensional structure. “Challenge Fun” is a computational problem of volume that allows learners to solve problems and verify learning outcomes. Due to the diverse structure of three-dimensional objects, through the 3D presentation, will help students observe and experience objects (Fig. 3). The learning process students can operate their own, without the special guidance of teachers. Let students learn by themselves, observe the three-dimensional structure and think about how to calculate the volume.

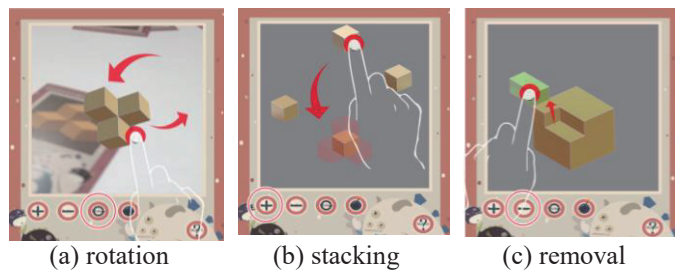


Fig. 2: Example of AR interactive learning function



Fig. 3: Students using AR math learning app to assist their learning

Experimental results and analysis

The test object is 5th grade students with a total of 102. Each participant has “volume” basic Mathematical knowledge. This lab introduces a Math learning app to enable students to learn “Volume” unit in a “self-learning” way. In this study, the result of Math test is the pre-test score, which is compared with the difference of learning result after using digital tools.

After the experiment statistics, pre-test average result is 88.19; after using Math Learning App, the average result of post-test is 92.59, which shows an increase of 3.4. The overall results of students have made a significant progress and the learning effect varies (Table 1).

TABLE 1: BEFORE AND AFTER THE TEST RESULTS OF DIFFERENCES IN PERFORMANCE ANALYSIS

	Numbers	Mean	S. D.
Pre-test	102	88.19	15.075
Post-test	102	91.59	16.476

In order to understand the effect of students' interactive response and learning on AR Math app, questionnaires and interviews were conducted for the students. The questionnaire design of this study divides its questions into three major aspects: ease of use, practicality and acceptability. According to the questionnaire analysis, 85.1% of students think this Math learning App is easy to use; 87.9% of students think that using AR digital textbook helps to understand the calculation of volume; 83.5% of students think there is no pressure to learn Math by using this App so they can easily learn Math and face Math problems.

Conclusion

Nowadays educational philosophy is constantly refurbished, expecting to give students a diverse learning environment. In recent years, with the progress of science and technology and the popularization of education environment, the education environment has been gradually introduced into digitized learning materials. Learn through digital tools, computer devices or mobile devices to provide students with different learning modes. The purpose of this study is to improve the interest of school children in Math learning. With the convenience and mobility of mobile devices, interactive digital learning software is designed. The development of this App allows teachers to have more diverse teaching aids and multimedia applications in teaching. Students are allowed to learn by themselves after class. After the experiment, we found that students gave a positive affirmation and a positive learning attitude toward the interactive AR Math App. There are truly obvious differences in learning outcomes.

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