

Application of Augmented Reality Technology to Promote Interactive Learning

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Abstract

In recent years, the learning tools based on AR (Augmented Reality) technology have been highly recommended to be applied in educational sites. Teachers display abstract scientific changes in specific images by applying AR technology. By way of applying AR inter-operation to enhance students' interests in learning as well as reduce their cognitive load. This study has applied AR technology to establish a virtual biological laboratory App to be provided for college freshmen to carry out biological experiments as a curriculum preview and experiencing. The content of Virtual biology laboratory App includes units such as virtual microscope, biological anatomy concept, cell division process, and frog's bones. Through the introduction of digital technology into the general biology curriculums are then emerged with AR technology so as to confer how AR technology affects students study effects and biological experimental knowledge recognition. The study has implemented an experiment in object to college freshmen and the experiment results indicate that the integration of AR technology with teaching has made students' attitude towards learning more positive. Through interactive operation and learning, students are better able to master knowledge of fundamental biological experiments. Through the process of the study, the researcher has found the importance that students study scientific knowledge with interactive technology. Consequently, the Institute has designed a virtual biology laboratory App to achieve the benefits of action learning, situational simulation and interactive experiencing.

Key words: Augmented Reality, Biology Experimental Curriculum, Interactive learning

Introduction

3D is an innovative digital application, which presents an object in a visual scene after being three-dimensional, so that users can actually observe and operate. The virtual object can be designed as a controlling trigger event to achieve real-time interactive effects. In comparison with the traditional physical interface, AR can provide users with more on-the-spot experience. Therefore, among numerous teaching materials making technologies, AR technology is regarded as one with promising development direction. In the real world, the virtual objects are added into AR technology so as to provide people with richer fantasy environment. Designers can build a series of interactive experience scenarios [1] with AR technology. By applying the rapid detection technology and computing power of AR's to feel the ubiquitous and fascinating real experience with mobile devices or mobile phones integrated with the environment features (objects like buildings, tags, or natural landscapes). In recent years, researches indicate that AR technology is applied to the teaching site, which can enhance the acceptance of learners. Kye & Kim[2] studied by targeting on 260 5th-grade students with five factors perception of

immersion, guidance, operation, display, and fluency to confer the factors relation how AR is beneficial in enhance the study effects. The study indicates factors like perception of immersion, operation, display, and fluency will affect students' satisfaction, understanding and knowledge, and application of study outcomes, especially operation has direct relationship with the satisfaction and the study effect of knowledge application.

Chiang et.al [3] applied AR technology to teaching experiments to simulate the reactions and changes of different materials under different conditions (i.e. high temperature burning). Students could choose their own material definition card to observe the burning situation so as to understand the chemical reaction of its material. Through the feature of AR, small-scale experiments could be easily done in the general classrooms, so that students were able to observe and practice, and get positive feedback. Therefore, enhancing AR user interface could promote learning satisfaction and effects. Martin-Gutierrez et al. [4] applied AR to improve the spatial identification capability of engineering students so that students could better understand the contents of the drawings. Aiming at the study satisfaction of AR in college education and the validity of science technology application, the results indicated that this system could effectively help students develop spatial ability when making engineering drawings. The basic biology course is a compulsory subject for students in the fields of natural sciences. When college freshmen apply the laboratory equipments for the first time, teachers or assistants need to particularly guide them and demonstrate for them. Thus, a virtual platform established by a digital technology can be applied to train students to use experimental equipments so that students can practice repeatedly. The purpose of this study is to construct a basic biological experiment study App to be provided for students in the classroom as a preview or after-school practice. Through the digital technology integrated with teaching to confer how the developed AR App affects students' learning process.

Materials and Methods

Basic biology is a compulsory curriculum for the first year of the Department of Biology. At the beginning of this curriculum, students need to understand the correct method of using a microscope, and observe and measure a variety of cell size through the microscope. Students need to repeatedly practice and observe these basic operation procedures. In order to strengthen the basic knowledge and capability students', by applying AR technology, students are able to experience themselves anytime and anywhere. This study has designed an interactive biological experimental study APP to guide students into the learning unit by applying the basic biology AR pattern experimental teaching materials. There are five learning units in the system, namely, microscope structure, microscope operation, animal and plant cell observation, frog anatomy, and frog bone structure. Students can learn the structure and

function of the microscope through an interactive process, and, with the real operation, understand the difference between animal and plant cell structure. Besides, through the media displaying the effect, students can observe the frog anatomy and the various organs of the frog. Each unit is designed with a study test and students can answer by following the instructions and further verify the results of learning. Figure 1 shows an example of interactive bio-experiment learning AR card; Figure 2 shows the effect of interactive learning App media.

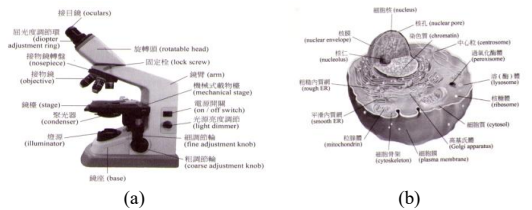


Fig 1. Biology experimental teaching materials (AR image card) (a) Microscope; (b) Cell Structure.

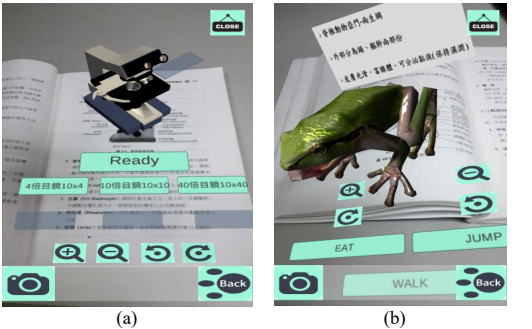


Fig 2. Interactive learning App media effects (a) Microscope unit; (b) Frog anatomical unit.

Experiment and Discussion

This study has made an experiment by targeting on 120 college freshmen who major in Bioscience related departments to understand the learning efficiency and App interface function after the students have applied AR learning App in fundamental biological experiments. Each student's mobile device is installed with this learning App and then the teacher describes the purpose of the experiment and applying methods. The experiment lasted for 4 weeks. Before the bio-experiment curriculum was carried out, the students self-studied according to the units designated by the teacher.

The questionnaire of the study is designed according to six aspects of Short Feedback Questionnaire (SFQ) developed by the scholars like Kizony[5] and so on. In Kizony's study, they considered that SFQ was an effective assessment tool used to collect participants' subjective responses to VR learning experience. The experimental questionnaire adopted a five-point Likert scale, wherein Table I indicates disagreement and 5 indicates highly agrees. The result of the questionnaire analysis is shown in Table I.

The questionnaire analysis result of Table I indicates that the tested each question gave a high score. This means the students have high interest and experience in the interactive AR learning model. While interviewing the tested about learning

experience, the tested considered that they could self-study by way of AR learning App and that could help them memorize the experimental equipment structures and functions. In the process of interactive operation, students were able to repeatedly observe animals' and plant's cells, and frog anatomy by the changes of animation and virtual situation. They consequently had different learning ways and experience in biological experiments.

Table I. Results of the SFQ (Experimental result)

Aspects	(N=120) Mean
Feeling of enjoyment	4.61
Sense of being in the environment	4.28
Success	4.40
Control	4.53
Perception of the environment as being realistic	4.02
Comprehension of computer feedback	4.54

Conclusions

On the basis of AR technology, this study has developed a fundamental bio-experimental learning App by applying interactive media features. If this learning App is collocated with fundamental bio-experimental textbooks, students can self-study without time and space limit. From the result, the study has found that by integrating AR technology with the biology fundamental knowledge learning, it helps to improve students' learning outcomes and motivation. In general, students believe that AR tools can stimulate their attitudes of active learning as well as their experience in exploring learning. With this study, we are able to understand the potentiality and acceptance of exploratory AR learning tools. In the learning process of the microscopic structure in biology, AR learning tools do significantly enhance students' academic performances.

Acknowledgments

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