Feasibility Analysis of Integrating Augmented Reality Application into Education System to Improve Students' Learning Experience

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Abstract. Integrating Augmented Reality (AR) application into education system can improve students' learning experience, this study analyzes the feasibility of the application of augmented reality technology in education through literature review. It also commend the AR use survey of three disciplines in education industry, including potential advantages, challenges and learning experience, and takes PDCD mode as AR resource development mode. Then it analyzes the advantages and disadvantages of its intelligent learning environment and technology in education, the utilization of AR is considered a suitable tool to incorporate in the education industry.

1. Introduction

Augmented Reality (AR) is to create a virtual environment that affects human senses such as vision, hearing and touch by means of computers and other tools. With the cooperation of a variety of sensors, it makes the target personnel feel as if they are in the deliberately created environment, so as to enhance their perception of the target environment. As a new human-computer interaction technology, augmented reality technology can simulate the real scene landscape in the process of operation. It is an advanced human-computer interface based on interaction and conception. Users can not only feel the verisimilitude of "people on the spot" in the objective physical world through the virtual reality system, but also can break through the space, time and other objective restrictions, and feel the experience that cannot be experienced personally in the real world. The two technologies can realize directional conversion, and have a certain "inverse" relationship in essence\textsuperscript{[1]}. It's just the opposite of "Virtual Reality" by using AR technology. If the two technologies are fully integrated into the mobile Internet hybrid learning mode, the learning quality of students will be greatly improved\textsuperscript{[2]}. 
2. Literature discussion

2.1 Augmented Reality in Medical education
As previously discussed, AR nowadays is developed rapidly in the medicine. Anatomy education is one of the core courses in the professional surgery field. Ma et al. (2015) demonstrate an AR application which called “magic mirror” could aid the student to understand human anatomy in the learning process. To execute this application, it requires some inexpensive hardware, Kinect sensor and the screens which can reflect the result of the sensor. The camera sensor tracks user location and captures the user body image in real time. The user is shown on the screen as he/she stand in front of the mirror. As shown in Figure 1. In this study, the author investigates the satisfaction from the student of the anatomy field, the statistic show around 86.1% students agree this application could facilitate the learning experience.

2.2 Architectural Engineering Education
Geographical and spatial concepts are the two key elements in Architectural engineering education, in the traditional method; it is presented by the printed plan and physical models. These days, these core components could be visualized through the AR application. According to Sánchez Riera, Redondo experiment which carried out with students of Architecture and Planning, with this AR tool, students visualize the virtual information overlapping on the real site environment. The required hardware to implement this tool Are mobile device which has the camera, GPS and 3G connection function. Base on a Geographical Positioning System (GPS) to register virtual building in a real environment. In the first step, students create volumetric models and design its texture via 3D modelling programs such as Sketch-Up or 3dsMax. After, superimposing the virtual model on the real-time captured image, then the digital information of the model will be provided as shown in Figure 2.

2.3 Mechanisms education
Refer to the manufacturing industry, the mechanisms engineering is one of the fundamental concepts. Besides assembling a lot of physical components, it always conducted with complicated mathematics to design a machine. Wang and Nee (2018) demonstrate how the AR mechanism education system applied to the basic theory of four-bar linkages. This AR application required some accessible hardware such as the computer with camera and keyboard. First of all, students open the pages of four-bar linkages concept and place the book in front of PC-Camera. The virtual four-bar linkage follows by the detail explanation will then overlaying on the pages, where the students can control the animation with the keyboard. This aids student easily understands the delicate concept with visual animation. As shown in Figure 3.

The feedback of satisfaction is quite high where located 17 out of 20, which indicate the general agreement of usefulness of this application.
3. Research design and methods

3.1 Taking PDCD mode as AR resource development

Plan: Appropriate AR Resources can make up for the lack of practical teaching and overcome the difficulties of practical teaching. For those training scenes that need training consumables, actual training risks, long time span, insufficient equipment, lack of training places, invisible, intangible and unpresentable, AR resources can effectively improve the teaching effect, so its construction and application value is more prominent.

Do (Implementation method): Teachers can use AR resources to teach students the difficult points quickly, and students can easily learn the knowledge through AR resources. It provides the interaction function between teachers and students, and has the learning progress tracking function, which is convenient for teachers’ management and students’ learning. With desktop simulation as the main, immersion application as the auxiliary, mobile application as the supplement.

Check (Assessment criteria): According to the development difficulty and application depth, it is divided into three levels: As shown in Figure 4.

| Virtual assessment | Break through the limitation of training environment and time, learn from practice, and help students reach the stage of analysis and application of teaching content |
|-------------------|-------------------------------------------------------------------------------------------------|
| Imitates the real training | 3D demonstration of difficult points can visualize abstract problems, help teaching and help students understand problems quickly |
| Teaching demonstration | Consolidate knowledge, apply what you have learned, and really cultivate students’ ability to evaluate and innovate knowledge |

Fig 4. There are three levels of teaching application induction

Action (Feedback improvement): Any resource has a life cycle; a good AR application must support the secondary development, in order to be able to continue to improve. All model source files, project source files and development documents generated in the development process must be complete.

3.2 Augmented Reality resource development process

The first is to analyse the requirements and split them into several projects according to the purpose of the application. The idea of software engineering is used to organize the distributed implementation [6]. During the specific implementation, the development team is organized based on the curriculum. Each team is composed of subject teachers, teachers of educational technology and Information Centre, and enterprise development team. The enterprise team needs to report the progress of the project every week. The teachers of education and information centre control the overall progress of the whole project, and coordinate the contradiction between professional teachers and development enterprises in time [7]. The development process of each project is shown in Figure 5.

Fig 5. Augmented reality technology development process

4. Data analysis and results

4.1 Advantage and Challenge

Although the traditional classroom also has voice room, computer, can project PPT, audio or video images, but will not leave a deep impression on students. As a result, students' learning enthusiasm is generally low, and their understanding of knowledge often stays in the shallow meaning of words, let
alone the specific application methods. After AR technology is integrated into the hybrid learning mode of mobile Internet, under the effect of three-dimensional reality, virtual reality compatibility, human-computer interaction and other key technologies, the teaching scene changes directly, making the understanding process easier. As shown in Figure 6 (a) (b). AR application not only provides the self-studying environment, with the interactive teaching method, it meanwhile could potentially increase students’ learning motivation and interest.

Fig 6. (a)(b) AR technology is integrated into the hybrid learning mode of mobile Internet.

4.2 Ethical and Security issues
The privacy might be concerned as an ethical issue in AR application using. Despite the virtual information is considered legal, the physical property in real-world might own its rights to refuse been captured in AR application.

5. Conclusions
5.1 Conclusions
In the previous discussed, three disciplines, Medical, Architectural Engineering and Mechanisms Are proposed that could integrate the augmented reality application. The investigation found that AR application in the current education industry is agreed as the useful tools that enhance the student learning experience. Through the virtual information which superimposed on the textbook or physical object, where assist student links the knowledge with virtual practical.Integrating AR technology into the mobile Internet environment can present a vivid and detailed dynamic scene in front of students’ eyes, so that students can feel personally, and then deepen their understanding and memory of relevant knowledge. This way will gradually develop into a mainstream blended learning mode in the future.

Finally, the assessments of general advantage and challenges as well as ethical and security issue are carried out. The potential advantages are overall greater than the challenges. As long as paying attention to overcome the challenges and considering other issues properly, the utilisation of AR is considered a suitable tool to incorporate in the education industry.

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