The Potential of Using Augmented Reality (AR) Technology as Learning Material in TVET

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Abstract: In the field of education today, people can choose from a variety of ways and methods to acquire specific information and skills; here are some good examples: classroom lectures with textbooks, computers, hand-held devices, and other electronics appliances such as tablets and smartphones. In a rapidly changing society, there are countless sources of knowledge and a great deal of available information; hence, adopting an appropriate method and applying relevant information at the right time and place are important in both schools and business settings. The augmented reality (AR) technology is one of the most advanced developments in the education sector tailored for 21st Century learning. With so much to offer, it is worthwhile to investigate the potential of integrating AR into the teaching-learning processes. This study focuses on exploring the possibility of merging TVET learning materials with the AR technology; the survey was carried out among the lecturers to gauge their knowledge and perception of AR as well as the relationship between the two elements. This quantitative study includes randomly selected samples of 230 lecturers from Universiti Tun Hussein Onn Malaysia (UTHM). The respondents were given a questionnaire to answer. The SPSS version 22 software package was used to analyse the data collected. Overall, the mean score indicates that the lecturers' knowledge level for AR technology is high. The lecturers also have a positive perception of using AR as a tool to incorporate and present the learning materials. Finally, this study discovers that there is a positive relationship between the lecturers' information about AR and their perception of using AR as a vehicle to deliver the learning materials. AR is expected to achieve widespread adoption in schools, universities and colleges, TVET and other higher learning institutions. Therefore, this study may be useful to the developers and providers of augmented reality solutions, end users of these solutions, teachers and students, and the experimenting digital communities.

Keywords: Augmented Reality (AR), 21st century education, TVET, learning material

1.   Introduction

The National Education Philosophy states that Education in Malaysia is a continual effort to further develop the potential of individuals in a holistic and integrated manner in order to train individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious. This effort is to produce Malaysian citizens who are knowledgeable, virtuous, responsible, competent and capable of contributing to the betterment of the community and country. According to the philosophy, it is obvious that the Malaysian education system needs to have a good package of learning programmes that are capable of achieving the national goal, which is to produce well-balanced and knowledgeable students, and eventually productive workers. Therefore, it is the educator's job to harness the 21st Century technologies in designing an effective learning system and environment to achieve the goal. The practice of effective teaching today is associated with creative methodologies; teachers need to do more than just planning lessons, but to think about injecting innovative elements into teaching in the classroom (Mohammad and Mohammad Yasin,

2010). This step of the teachers' preparation is essential as it will determine the attractiveness of the lessons that will stir the students' interest and draw their attention to learning (Biney, 2015).

This study was carried out to delve more deeply into several issues about using technologies in the teaching and learning process. Some teachers hold the myths that technologies can cause addiction to the students and may reduce their self-esteem as well as confidence, but these teachers miss out on the benefits usefulness and usability of the technologies in education. The usability of learning methods or tools is an important technical factor that affects educational effectiveness (Chang et al., 2014). Students are easily distracted during lesson times in the classroom due to uninteresting or even outright boring explanations from the teachers, and sometimes wrongly chosen teaching materials (Mohamad, 2017). According to Majid et al. (2015), it is difficult to provide a learning environment that can engage students to learn continually because some materials are very theoretical and hard to visualise. The necessity to overcome the problem of engaging the students in learning complex subjects or topics has motivated the researcher of this study to investigate the use of augmented reality (AR) technology as a tool for the lecturers to deliver and present learning materials. Students do not know the way to obtain a blog that can be used in their learning process (Hashim, 2012). Ultimately, it is the employment of a variety of teaching aids that will assist teachers in conducting the teaching and learning processes smoothly and interestingly in the classroom (Hashim, 2015).

The transformation of teaching and learning brought about by the utilisation of technologies has certainly provided an exciting opportunity to design learning environments that are realistic, authentic, engaging and extremely fun (Kirkley & Kirkley, 2004). The current researchers also reveal that technologies hold great promises for captivating students with multimedia materials and increasing their understanding of the learning content (Di Serio, Ibáñez, & Kloos, 2012; Kreijns, Acker, Vermeulen, & Buuren, 2013; Roca & Gagné, 2008). Regardless of the kinds of technology used in the classroom, one of the most central considerations is for the educators to use dynamic means in delivering content through the enhancement of instructional practices (Saltan and Arslan, 2017). Educators need to master the technology first, and then they could implement the technology as a tool to deliver and present learning materials. With that idea in mind, the researcher of this study focuses on the potential of augmented reality as a vehicle for educators to deliver and present learning materials. Before any concrete implementation can be recommended, it is pertinent to survey the lecturers' knowledge and their perception of augmented reality as well as the relationship between the two elements.

1.1   Definition of augmented reality

Augmented reality (AR) can be defined as a technology that overlays virtual objects (augmented components) onto the real-world environment. These virtual objects appear to coexist in the same space of the objects in the real world (Azuma et al., 2001). AR was first introduced as a training tool for airline and air force pilots during the 1990s (Caudell & Mizell, 1992). Currently, AR is a popular technology that is widely used in the educational sector. This new role of AR in education has attracted much attention and research interest in recent years. Looking from another perspective, an AR virtual object appears as a real-time display; the system has visualisation of several layers of information taken from the user's environment, with diverse digital representation forms from text to image and multimedia (Tutunea, 2013).

1.2   The Potential of Augmented Reality as A Learning Material

Technologies are one of the essential elements that should be included in any educational setting or facility. Technology such as AR has become a medium to explore new knowledge, which is especially useful for students and teachers. The use of technological ways serves as a significant factor to attract students' attention in the classroom. As such, it is highly recommended that technologies be used to improve the teaching and learning methods as well as and the presentation of learning materials. Technologies act as a force multiplier for the teachers: students may access websites, online tutorials and many other services in cyberspace, instead of depending on the teachers as the only resource of knowledge. Education does not stop at the end of the school day because students have access to the teachers, resources, and assignments via the web, at any time and from anywhere. At the same time, students can get help and tutoring at any time from the teachers via email, online collaboration, or from a help website (Gunawardena, 2017**).**

The landscape of education has dramatically changed in recent times, especially in areas when technology is combined with adequate pedagogical foundations. Static traditional resources have been perceived as uninteresting compared with learning facilitated by augmented reality (AR) that conveys information in dynamic ways such as motion and continuous movements. To improve the learning outcomes, teachers try constantly to find ways to stimulate the students' interest and draw their attention to learning; in this aspect, AR has proven to be a very reliable method that not only captivates the students but also educates them on the importance of technology as well as increasing their academic achievements. Abd Majid (2014) said that AR is a human-machine interaction tool that presents information generated by a computer on the real world using a camera, and it also has the potential to draw students' attention to visualise a layer of information on real objects.

In 2012, Tang and Ou experimented by using AR and mobile technologies as an assistant tool for learning the butterfly ecology. The integration of AR in the project enabled students to breed their virtual caterpillars using applications in their smartphones. They subsequently became familiar with the butterfly's life cycle by observing the growth of their virtual caterpillars. The campus of the AR butterfly ecological learning system was then designed based on the butterfly's life cycle and was used for the learning purpose of the fourth-grade elementary students. At the end of the learning process, students are picked randomly to be assigned to the experimental group or control group. Statistical tests later show that the experimental group has better learning effectiveness compared with the control group. Thus, the results prove that the students learned the butterfly ecological system better with the integration of AR.

An example of AR awareness and implementation in education is a teacher's attempt to integrate the Google Earth with an AR tool to create a 3D virtual image for the recovery of the geological heritage of the "Las Batuecas Valley" Nature Park in Spain. The study was conducted by the Department of Geology of the University of Salamanca that involved the university's students. The objectives of the study were to identify, classify and evaluate different geosystems to establish an educational geological itinerary, and to implement the enhancement of the itinerary using 3D geomatics applications in the school, before its application in real-time (Saha, 2013). The task was simplified by the extensive use of new technologies, which were smartphones, tablets, and iPads. The study concluded that Google Earth assisted the students in the spatial visualisation of the thematic maps (geological, geomorphological, and stratigraphic). The implementation of the AR tools also stimulated creativity and knowledge for the rapid acquisition of a greater degree of collaborative, autonomous and interactive skills.

2.　　　Methodology

This quantitative survey includes samples of 230 lecturers from University Tun Hussein Onn Malaysia (UTHM). The participants are from six faculties of the UTHM and were chosen through the random sampling procedure. The six faculties are listed as follows: Faculty of Civil and Environmental Engineering, Faculty of Electrical and Electronic Engineering, Faculty of Mechanical and Manufacturing Engineering, Faculty of Technology Management and Business, Faculty of Technical and Vocational Education, and Faculty of Computer Science and Information Technology.

The respondents were given a questionnaire that contains 18 items gauging the lecturers' knowledge and perception. The questionnaire was adapted from The Feasibility of AR in Service and had been evaluated for its validity and reliability. The data collection process for this study was conducted in this manner: all of the questionnaire forms were distributed by the researcher to the respondents and the duly completed forms were collected within two weeks.

3.　　　Results

A descriptive statistical analysis was carried out to analyse the data obtained from the completed questionnaire forms. Altogether, 230 lecturers participated in the survey of this study. An analysis of the demographic data shows 86 (37.4%) respondents are male lecturers and 114 (62.6%) are female lecturers. Most of the lecturers are between the ages of 30 and 40 years and have 10 to 15 years of working experience.

3.1　　The Level of Lecturer's Information About AR Technology

There are eight items in the questionnaire used to estimate the lecturers' level of knowledge about AR, and how far AR technology can be utilised as to deliver and present learning materials. The mean scores were calculated and the values are shown in Table 1.

Table 1- Mean Scores For The Lecturers' Knowledge About AR Technology as A Tool To Deliver and Present Learning Materials

Item	Description	Mean score	Std. Deviation
1	AR technology is one of the criteria in Education 4.0	3.89	.991
2	AR technology is a direct or indirect view of which elements are added with computer-generated sensory input such as sounds, videos, graphics or GPS	4.02	.901
3	AR technology combines real world with computer virtual objects	4.12	.931
4	AR technology provides interaction with visual objects directly	4.02	.883
5	AR technology combines 2D or 3D virtual objects into a real environment	4.04	.931
6	Marker allows the tracker to read markers to be recognised by the application and display the desired object	3.87	.880
7	AR technology supports student-centred learning	3.98	.908
8	AR technology helps students give more attention in the classroom	3.83	.994

3.2 Perception of The Use of AR as A Tool To Deliver and Present Learning Materials

There are 10 items used to gauge the lecturers' perception of using AR as a tool to deliver and present learning materials. Referring to Table 2, overall the mean score of each item is high. This shows that lecturers have a positive perception of the use of AR as one of the learning materials.

Table 2 - Lecturer's Perception on The Use of AR as Learning Material

Item	Description	Mean score	Std. Deviation
1	The use of AR technology enables students to carry out various forms of experiments without high risk	3.75	.834
2	The use of AR technology can help teachings that encourage self-learning	3.98	.579
3	The use of AR technology as tool to present learning materials can facilitate the delivery of teaching	3.90	.660
4	The AR technology environment offers better learning opportunities through physical movement	3.83	.725
5	AR technology gives students the opportunity to interact with other friends	3.86	.752
6	AR technology makes teaching and learning session more enjoyable	4.14	.635
7	AR enriches my idea of teaching	4.03	.735
8	AR technology can help develop students' imagination	4.11	.706
9	AR technology can help develop students' creativity	4.08	.691
10	AR technology is suitable for problem-based learning	3.99	.718

3.3 Relationship Between Knowledge and Perceptions of Lecturers Concerning AR as A Tool To Deliver and Present Learning Materials

The Pearson correlation test was used to determine whether there is a correlation between the lecturers' knowledge and their perceptions of using AR technology as a tool to deliver and present learning materials. Overall, there is a strong positive relationship ($r = .60$, $p < .01$) between the two variables. This shows that the lecturers have extensive knowledge about AR technology, and they feel that this technology can be one of the best tools to deliver and present learning material to the students.

4. Findings and Discussions

This study was conducted among the lecturers to gauge their level of knowledge about AR and their perceptions of the use of AR as a tool to deliver and present learning materials. There are three objectives in conducting this study, and all of them show positive results. For the first objective, the overall mean score indicates that the lecturers' level of knowledge about AR technology is high. The lecturers have broad knowledge about AR, and recognise the potential of AR as a good tool to deliver and present learning materials to the students in the classroom. This finding coincides with the study by Wagner (2003) who found that lecturers' attitudes towards the use of applications and the developed AR system were very encouraging. Nowadays, educators put in lots of effort and attention to achieve critical learning outcomes during the teaching-learning processes; and it is suggested that the educators constantly utilise 'contemporary and cutting-edge' technological applications, one of which is AR (Saltan and Arslan, 2017).

For the second objective, the findings show that most of the lecturers are confident that AR can encourage the students to be more active in the classroom. According to Lu and Liu (2015) and Martin-Gonzalez et al. (2015), current research on the use of AR applications in formal education highlights the fact that such applications have a positive impact on learning and the learners' attitudes. The lecturers also believe that AR technology has many advantages and vast potential in the educational arena based on the high mean value for all the items. The findings of this study reinforce the statement by Merry (2008) that by using the AR system and application, lecturers can enhance their teaching creativity in the classroom, and students are actively interacting with their colleagues as well as with the lecturers. AR is viewed as having great potential to change the educational settings, such as, introducing progressive pedagogies, designing instructional strategies as well as the arrangement and delivery of learning content. Furthermore, the use of AR applications helps improve students' cognition and interaction skills, which will result in more effective learning (Lu, & Liu, 2015).

The last objective is to study the relationship between the lecturers' knowledge and their perceptions of AR as a tool to deliver and present learning materials; the results show a strong positive relationship between the two variables. This has proven that the lecturers, who have good knowledge about new technology in the field of education, are more likely to receive new kinds of learning materials in the classroom. The lecturers also keep abreast of the current trends in using new approaches that are in line with the education of the 21st Century.

5.   Conclusion

In conclusion, there are ongoing efforts in the education field to improve the effectiveness of technology integration in the teaching and training processes, which are required to produce professional human capital; and awareness of the current technological developments is certainly essential in establishing a high-quality education system. As research and developments are undertaken by the global academic community as well as corporate organisations continually, today's sophisticated technologies are growing rapidly and new inventions are streaming into the market. In such a situation, the educators have plenty of new technologies to choose from to improve the students' learning. According to this study, the lecturers' level of knowledge about AR is good, but since this technology is progressing and evolving fast, the lecturers should always update and upgrade their knowledge and skills of using AR. Their perception of AR as a tool to deliver and present learning materials is positive since many researches have proven that the use of AR technology in education can enhance the quality of the students' learning activities as well as the learning outcomes. AR is among the latest technologies that have tremendous potential, and are increasingly recognised by researchers as a very useful and effective tool of learning in the field of education. AR also is an alternative approach to deliver and present learning materials that have gained positive feedback from the end-users. Lastly, with adequate knowledge of AR, the lecturers or educators will have no qualms about using AR in their teaching, which is reflected in the positive relationship between the lecturers' knowledge and their perception. It can be concluded that the use of the AR environment in teaching and learning could provide extra benefits to the students as well as educators.

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