THE USE OF AUGMENTED REALITY (AR) AMONG TERTIARY LEVEL STUDENTS: PERCEPTION AND EXPERIENCE

Jessnor Elmy Mat-jizat*, Juliana Osman Zainal Abidin, Rusliza Yahaya, Norsamsinar Samsudin
Universiti Pendidikan Sultan Idris, Malaysia

ABSTRACT

The aim of this study is to explore the use of augmented reality (AR) among tertiary level students. Previous research on the Malaysian education system had always criticised the exam-oriented culture in this country, which was believed to cause a lack of leadership and lack of creative and innovative thinking among students. Amidst the rapidly changing technological environment, AR was advocated as one of the new technologies that could initiate active learning and at the same time promote creative and innovative thinking. This paper examines the educational use and impact of AR experiences with an undergraduate trainee teacher. Students were given a task to create a short video and use free AR apps to set up their own AR presentations. The students later gave their AR presentations in a mini exhibition where they explained their creations to other students. The students' perceptions and experiences in using AR were discussed. This discussion can serve as a starting point for further dialogues among researchers and educators interested in researching and using AR in their teaching and learning activities. Educational implications and future research directions for improving teaching and learning 21st century skills are proposed.

INTRODUCTION

The implementation of information and communication technology (ICT) tools in an educational environment has been widely investigated. In the literature there are many research studies that concentrate on aspects of ICT in education and training. For instance: the impact on students and teachers (Albion 2001; Cuckle & Clarke 2002); factors that may influence the efficiency of ICT as an instructional design tool; ICT infrastructures and organizational factors; and, software designs (Markauskaite 2003).

Albion (1996, 2001, 2003a, 2003b) conducted studies on computer use and self-efficacy beliefs of trainee teachers using ICT for their teaching. The outcome of one of his studies proved that trainee teachers do have positive attitudes regarding the usage of computers in teaching and learning activities. However, lack of confidence in their own knowledge is always a hindrance. In another study, Albion suggested that self-efficacy when using a computer will increase the more the computer is used. The more experience trainee teachers have with using a computer, the more confident they will be in applying ICT tools to their teaching and learning activities. Using examples and support from supervising teachers during their practical experience in classrooms also plays an important role in increasing trainee teachers' computers skills in a classroom.

Previously, it was thought that computers were used exclusively for manipulating data; however, for the younger generation, particularly those who were born in the 1990s, ICT tools have become part of their social life. In one of his most debatable articles, Prensky (2001a) strongly suggests that the generations of today are changing. Prensky states that these new generations "think and process information fundamentally differently from their predecessors" (Prensky 2001a, p. 1). He refers to them as digital natives. Others describe them as the Net Generation (Tapscott 1998) or Generation-Y (Holley 2008). These new generations are assumed to be techno-savvy, where they possess knowledge and skills of new media that older generations have difficulty coping with. For these digital natives, giving them a new ICT gadget is no problem because they will be able to work it in a matter of minutes. This tendency is due to their ability to 'assimilate' technology, while for the older generations they need to 'accommodate' new technology (Tapscott 1998). The newer generations were 'born' with the new technology. To them, "digital technology is no more intimidating than a VCR or a toaster" (Tapscott 1998, p. 1).

The digital skills that the new generation possesses today are said to influence their skills and interests in ways significant for education (Bennett, Maton & Kervin 2008). According to Prensky's observation, many of today's tradition-bound educational systems seem to try to ignore their eyes, ears and intuition, and pretend that this issue does not exist (Prensky 2001b). To educate this new generation, schools are in need of new pedagogical strategies. There is a substantial disparity between the technological skills and interests of the new generation and the limited methods of teaching used by educators (Levin & Arafeh 2002; Prensky 2005).

THE CURRENT SITUATION

In Malaysia, the current educational systems are exam-based, with centrally controlled, national curriculum from primary school to secondary school. This means that primary and secondary school students throughout the country learn about the same topics, and the students are subjected to a standardised exam, the outcome of which will determine the students' entry into colleges or universities. A report by the World Bank (2003) described these drawbacks as ill-suited to providing people with appropriate skills and knowledge. The report continues to argue rote-learning, exam-based schooling and the high cost of private education as having been policy concerns in some Asian countries for quite some time. On the other hand, in order to participate effectively in 21st century society, an individual needs to be better-informed, have greater thinking and problem-solving abilities, be more self-motivated, have a larger capacity for cooperative interaction, possess more varied and more specialised skills, and be more resourceful and adaptable than ever before (Field 2006).

In some countries, these changing views have prompted the abandonment of the 'traditional view' of education, where the schooling years are the time in which students learn all the skills and knowledge that a productive individual would require in a lifetime. Instead, it has been replaced by a new view of education, where the students are actually being prepared with necessary skills and knowledge during their schooling years, in order for them to effectively participate in 21st century society. Hence, the Malaysian Smart School (MSS) concept proposal in 1997 was perceived as the catalyst for changing the 'traditional view' of how Malaysian school systems operate.

In Malaysia in 1991, in its effort to become a fully developed nation, Tun Dr. Mahathir Mohamad, former Prime Minister of Malaysia (1981-2003), presented a working paper outlining his 30-year vision of a fully developed Malaysia known as 'Vision 2020'. He identified nine challenges that Malaysians need to overcome in order for the country to become a fully developed country (see Mahathir 1991). One of the nine challenges is to become a knowledge-based society. Creating an ICT-literate society is the central platform in achieving that transformation. The MSS project was regarded by the former Prime Minister as a specific response to Malaysia's need to make this critical transformation. As such, in July 1997, he launched the MSS implementation plan, which aimed to achieve a unified and stabilised usage of technology as the key enabler for teaching and learning by 2020.

Since then, ICT literacy has been actively promoted in Malaysian schools by various agencies of the Malaysian Ministry of Education. The Ministry has also made it compulsory for all trainee teachers to be exposed to ICT tools, and by implication, the use of ICT literacy in their pedagogical strategies (Chan 2002), which has curricular implications. Nevertheless, around the year 2006, the MSS project was halted due to the economic downturn and political and policy changes that occurred. Although the pilot schools were successful and the outcomes positive, the project's national rollout failed to launch on schedule.

This, however, does not mean that the project was a failure. In fact, lessons learned from the pilot project were valuable, and the delay offered Malaysia time to reflect on the project's weaknesses and discover newer, more suitable technologies. A consultative report based on feedback from the pilot project was written. The feedback came from the Ministry of Education, which conducted the technological and infrastructure review of the pilot project, together with a group of experts from the local universities, commissioned to evaluate the project's human aspects.

In the report, the most important recommendations that emerged were in the areas of technical maintenance and in the need for more supportive monitoring of schools. The report also highlighted seven areas concerning human aspects that included: 1) teaching-learning materials; 2) teacher training; 3) response to change; 4) technology infrastructure; 5) help desk; 6) the Smart School Management System (SSMS); and, 7) student/parent feedback (Multimedia Development Corporation 2005). Some concerns emerged related to the limited use of the teaching-learning materials, since some materials could not accommodate the students' needs and did not reflect the complete curricula. Almost half of the teachers surveyed agreed that in-house training provided by schools was only moderately successful in achieving their objectives. Training was also lacking in how to teach the 'smart' way for newly trained teachers who transferred to the MSS. In addition, problems were reported with three of SSMS' 31 components, and only 16 of 31 components were being used by principals and heads of schools. Parents were also not well informed about the unique features of their children's 'smart school,' though they knew that their children attended such a school.

The most significant feedback relates to teachers, since they were the crucial factor in the project and had direct contact with students. Limited use of ICT-based teaching and learning materials, ineffective in-house training, and lack of training for new teachers were among the difficulties highlighted by the report. It was felt that the best way to resolve these problems was to treat the root cause of the problems, specifically during a teacher's university training years.

Current trainee teachers are not confident with their own abilities, though most agree that it is important for teachers to be ICT-literate (Mat-jizat 2012, 2013). Some are ill prepared and are not skilled enough because the integration of ICT skills into their instructional strategies was not modelled sufficiently

enough for them (Wilson 1990; Zhang & Martinovic 2008). Albion (2003a) suggests that experience contributes to the development of enhanced skill and attitude towards ICT tools, thereby increasing the possibility of trainee teachers applying those acquired skills in the future.

Hence, this study aims to introduce AR to undergraduate trainee teachers as another ICT tool that they can explore and use. AR was chosen as it is still a new technology to be explored and many researchers have reported positive outcomes when they tried to implement AR for teaching and learning purposes.

AUGMENTED REALITY

Augmented reality (AR) is a technology that allows an image, video or animation to overlay a chosen image known as trigger image, in a real-world environment in real time (Chang, Morreale & Medicherla 2010; Carmigniani et al. 2011). It was anticipated that AR would strengthen students' motivation for learning and enhance their educational realism-based practices with virtual and augmented reality (Chang, Morreale & Medicherla 2010).

Previously, studies had shown that AR had been a successful tool in supporting teaching and learning from pre-schools to institutes of higher education (Kaufmann & Schmalstieg 2003; Dunleavy, Dede & Mitchell 2009; Wu, Lee, Chang & Liang 2013; Dunleavy & Dede 2014). However, studies of the use of AR as teaching and learning tools in Malaysia are quite limited. The technology is still new, and many researchers are excited to explore its possibilities.

THE GAME PLAN

A group of undergraduate trainee teachers were given a task to: 1) create a video, and 2) create AR 'auras' using Aurasma, a free mobile-based application. The students came from two groups of the same class, and each group were given a different topic for their video. Group B had 30 students and were asked to create a smaller group of three to four students per group. Group B were instructed to create an education-based video, where the audience could learn something. Group C had 25 students and were also asked to create smaller groups. Group C were asked to create an advertising-style video. They needed to think of a product or service that their 'company' would to produce, and create a video promoting the product or service.

In the next step, the students had to create an account with Aurasma, and using Aurasma Studio or the mobile-based Aurasma, they needed to select a trigger image and link their video with the chosen trigger image. Finally, each group presented their auras in a mini exhibition, organised within the faculty.

METHODOLOGY

This was a mixed-method study using questionnaires as the instrument. Each student was given questionnaires before they began their assignments (QA1) and after they completed their assignments (QA2). QA1 was a close-ended questionnaire, asking them about their background, experience in creating video and also their perception of their own ability to create a video and an AR aura. QA2 was an open-ended questionnaire, trying to understand the students' experiences and getting their views on the assignment.

FINDINGS

There were 48 female students and only 7 male students in total (Group B + Group C). Since this course was an elective course, the students ranged from semester 4 to semester 8 students, and they came from eight different majors (Table 1).

TABLE 1. NUMBER OF STUDENTS DIVIDED BY SEMESTER / MAJOR

Semester	No of students	Major	No of Students
4	28	Business	25
5	8	Multimedia	6
6	8	Information Technology	10
8	11	Accounting	2
TOTAL	55	Economy	6
		Entrepreneurship	1
		Early Childhood Education	4
		Special Education	1
		TOTAL	55

Students' Perceptions

Have you ever created your own video? Have you ever uploaded a video to the Internet? Name the website(s)

76% (42) of the students answered 'yes' to this question. But, only 42% (23) of the students had experience in uploading videos to the Internet. When asked which website(s) have they uploaded their videos to, nine students answered YouTube, eleven students answered Facebook, two students answered Instagram and one student answered Twitter.

Have you ever heard of Augmented Reality? Where from?

Only nine students answered 'yes,' and they had heard about AR from a different class that they had taken previously (Graphic Design). The rest of the students had never heard of AR.

In your opinion, do you think you will be able to create the video / AR auras?

In general, we can summarise that the students were quite positive about creating their own video and AR auras. Most of the students were confident that they were able to create a video and upload it to the Internet. However, when asked about creating the AR auras, ¾ of the students were not sure, but they were willing to try and somewhat confident that they could do it (Table 2).

TABLE 2. GENERAL PERCEPTION ON CREATING A VIDEO AND AR AURAS

	No of students (video)	No of students (AR auras)
I am confident that I can	26	5
I am not sure, but I am confident that I can do it	24	37
I am not sure, but I hope that the other group members can help	5	13
I am not confident that I can do it	0	0

Students' Experience

Can you describe your experience in doing the assignments?

Most of the students were very excited and could not believe how fun and easy it was to create auras using the Aurasma application. Their comments were as below (the comments were direct quotes from the students, thus may contain grammatical or spelling error):

o *The video creation was challenging, but the Aurasma was fun. We enjoy doing the assignment.*
o *I really enjoy doing this assignment. It was something new. I learn a lot. Hope we can have more of this kind of assignment.*
o *I never know about augmented reality. Now I can see how this can be use in my future.*
o *As a group we decide to create a video to promote our product MEEGI. We created a storyboard and where approve by the lecturer. The advertisement start with demonstration of how easy it is to cook MEEGI and end by showing the people how our product looks like. It was fun when we try to 'act'. We definitely cannot become actor. When the video was complete, we need to choose trigger image. We choose our logo that we design. The exhibition was fun. We had the opportunity to look at what other group had done. We enjoy doing the assignment.*
o *For this class we have to create a video and create augmented reality. The lecturer helps a lot. We learn how to create video and upload to Youtube. We also use Aurasma to create augmented reality.*
o *The assignment was okay. But during the exhibition we have a problem when people come to our booth and we do not have enough mobile phones. It takes time when the audience need to download the apps first. Our wi-fi is not fast enough.*

A few students even had the opportunity to learn how to use new video-creating software and styles.

o *We learn a lot. My group used Pow Toon online software to create a video to promote our bookshop. It was fun and creating the aura was not as hard as we thought in the beginning.*

o *The assignment was interesting. We tried many ways and software to create the video. We tried acting, using Pow Toon, using Video Scribe and stop motion style. We finally choose to act. Our product is SELFIE bug spray. We create our own logo and paste them on the bug spray. We had fun. The aurasma part was easy. We just use our logo as the trigger image and link our video with the logo image.*

Conversely, two students did not feel the same way as the other students. Upon inspection, the two students came from the same group, and they might have had an inter-group problem that the lecturer was unaware of. However their comments were taken into considerations.

o *Creating video takes a lot of time. The due date was too short.*
o *I don't think this assignment is suitable. Most of the time I don't know what we are doing.*

Do you think that you can use augmented reality in the future? In what way?

Since all the students are undergraduate trainee teachers, most of them suggested the use of AR as a teaching and learning tool. Fourteen students suggested the use of AR in advertising and eight students proposed the use of AR as a substitute for the traditional class presentation. Others suggested the use of AR as advertisement tools and marketing tools.

o *Yes. As teaching and learning tool in class.*
o *Yes. As teaching and learning tool, for example in teaching alphabets to pre-school children. We can record the sound of each alphabet, or maybe how to write the alphabet. Or we can learn to name animals using alphabets.*
o *We can use augmented reality in many ways. One example is as a teaching and learning tool. It would be a new and exciting experience for the school children to learn, and a new way to incorporate ICT into our class.*
o *Yes. Teaching and learning tools, advertising, awareness campaign, poster.*
o *Probably yes. However, we need to think about the hardware (mobile-computer) that is needed for this to be successful.*
o *It will be interesting to use them as teaching and learning tool and advertising tool. An alternative to the traditional method.*
o *Maybe it can be use in flyers that we send to customer. Usually people throw away these flyers. Now they can see augmented reality in the flyers.*
o *Yes. Instead of the boring, normal way of doing presentation, we can now do our presentation using augmented reality and other people who want to watch our presentation can use mobile phones.*

DISCUSSION

Though the students' acceptance of AR was encouraging, there were a few issues that we need to consider if we want to implement the use of AR in our classes. One of the main issues was the hardware needed to view the auras. During the mini exhibition, each group member was asked to prepare their mobile-phones/tablets/iPads to be used by the visitors, and make sure that they downloaded the Aurasma apps in their mobile gadgets beforehand. However, unexpectedly during the day of the mini exhibition, we received a very positive and huge response from other students and academic staff who wanted to see what AR is about. Therefore, some of the visitors were disappointed as they were not able to have a 'hands-on' experience with the auras. It might be helpful if we had told the visitors to download the apps to their own mobiles before they came to the mini exhibition.

Aside from that, the lecturer/ teacher must play an active role in the beginning of the assignment to promote the idea. Most of the students were not really sure of their own ability, especially when it involved ICT. By trying to frame the assignment in a positive light, it gives the student the little push to try harder and be confident. The lecturer/ teacher also showed a few examples of auras via Aurasma apps at the beginning of the semester in order to explain and to let the students grasp what they needed to create.

However, this might not be true for some students. Some might need more guidance for them to really able to completely understand and finish the assignment. As previously discussed, it may be because these students were not confident of their own abilities (Mat-jizat 2013), or may be because they had assimilated the 'spoon-feed', exam-oriented culture for so long during their school years that they were unable to function when the lecturer / teacher refuse to give them straight answers.

During the whole process, the lecturer/ teacher did not interfere with their ideas and creativity, but instead supported them to make the idea more manageable. The aim was not to 'spoon-feed' them with our

ideas, but to let the students think for themselves and be creative. Whenever a student asked a question, the lecturer/ teacher showed them where to find the answers, and let them interpret the answers themselves.

Prior to creating the actual video, each group were asked to create a storyboard for their video. The lecturer/ teacher showed how and what a storyboard is at the beginning of the semester. The use of the storyboard helps the students plan and manage their video, and since they had to get the lecturer/ teacher to endorse their storyboard prior to recording their video, the final product (video) was 'solid', 'clean' and did not divert from the assignment requirements.

This assignment also showed that when a student is excited or passionate about a certain thing, they do not mind the extra work (and study) that they need to do, which coincides with the idea proposed in the Theory of Reasoned Actions and the Technology Acceptance Model (Fishbein & Ajzen 1975; Bagozzi, Davis & Warshaw 1992). The students were even willing to do self-learning / collaborative learning on topics that they did not understand (e.g., how to use video creation software). To the researcher, this was an interesting finding. This was a group of undergraduate students who normally would do their studies just for exams. Now they were telling the researcher what they had learned and even showed others what they knew.

CONCLUSION

Overall, the results of this study indicate that the students perceive AR as interesting, useful and something to be used as a teaching and learning tool, as an advertising tool, as marketing tools and as a substitute for traditional class presentation tools. This study shows that these students are ready to embrace this tool to be part of their learning environment. However, a few issues with regards to the technical aspects and implementation aspects need to be addressed first.

Finally, the study showed that incorporating the elements of 'fun' and technology in a task can be the key to promoting active learning, creative and innovative thinking among Generation-Y students. This new generation can easily relate to technology, as long as enough guidance is provided along the way. Teachers of today need to be able to 'speak the new technology language' and 'learn new ways to do old stuff' if they want to attract this new generation of students, and speaking their language of technology can do that.

REFERENCES

Albion, P 1996, 'Student-teachers' Use of Computers during Teaching Practice in Primary Classrooms', *Asia-Pacific Journal of Teacher Education*, vol. 24, no. 1, pp. 63 - 73.

---- 2001, 'Some Factors in the Development of Self-efficacy Beliefs for Computer Use Among Teacher Education Students', *Journal of Technology and Teacher Education*, vol. 9, no. 3, p. 321.

---- 2003a, 'Graduating teachers' dispositions for integrating information and communications technologies into their teaching', paper presented to Society for Information Technology & Teacher Education 14th International Conference (SITE 2003), Albuquerque, New Mexico, USA, <http://eprints.usq.edu.au/979/ >.

---- 2003b, 'Graduating teachers' reflections about teaching with Information and Communication Technologies', paper presented to Society for Information Technology and Teacher Education International Conference 2003, Albuquerque, New Mexico, USA.

Bagozzi, RP, Davis, FD & Warshaw, PR 1992, 'Development and Test of a Theory of Technological Learning and Usage', *Human Relations*, vol. 45, no. 7, pp. 659-86.

Bennett, S, Maton, K & Kervin, L 2008, 'The 'digital natives' debate: a critical review of the evidence', *British Journal of Educational Technology*, vol. 39, no. 5, pp. 775-86.

Carmigniani, J, Furht, B, Anisetti, M, Ceravolo, P, Damiani, E & Ivkovic, M 2011, 'Augmented reality technologies, systems and applications', *Multimedia Tools and Applications*, vol. 51, no. 1, pp. 341-77.

Chan, FM 2002, 'ICT in Malaysian Schools: policy and strategies', paper presented to Seminar/Workshop on the Promotion of ICT Education to Narrow the Digital Divide, Tokyo, Japan, 15-22 October 2002, <gauge.u-gakugei.ac.jp/apeid/apeid02/papers/Malaysia.doc>.

Chang, G, Morreale, P & Medicherla, P 2010, 'Applications of Augmented Reality Systems in Education', paper presented to Society for Information Technology & Teacher Education International Conference 2010, San Diego, CA, USA, <http://www.editlib.org/p/33549>.

Cuckle, P & Clarke, S 2002, 'Mentoring student-teachers in schools: views, practices and access to ICT', *Journal of Computer Assisted Learning*, vol. 18, pp. 330-40.

Dunleavy, M & Dede, C 2014, 'Augmented Reality Teaching and Learning', in JM Spector, MD Merrill, J Elen & MJ Bishop (eds), *Handbook of Research on Educational Communications and Technology*, Springer New York, pp. 735-45.

Dunleavy, M, Dede, C & Mitchell, R 2009, 'Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning', *Journal of Science Education and Technology*, vol. 18, no. 1, pp. 7-22.

Field, J 2006, *Lifelong Learning and the New Educational Order*, Trentham Books Limited, Staffordshire.

Fishbein, M & Ajzen, I 1975, *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*, Addison-Wesley, Reading, MA.

Holley, J 2008, 'Generation Y: understanding the trend and planning for the impact', paper presented to 32nd Annual IEEE International Computer Software and Applications Conference, Turku, Finland, 28 July - 1 August 2008, <http://conferences.computer.org/compsac/2008/pdf/KEY-COMPSAC-jean-holley-GenYTrends.pdf>.

Kaufmann, H & Schmalstieg, D 2003, 'Mathematics and geometry education with collaborative augmented reality', *Computers & Graphics*, vol. 27, no. 3, pp. 339-45.

Levin, D & Arafeh, S 2002, *The digital disconnect: the widening gap between Internet-savvy students and their schools* Pew Internet & American Life Project, Washington DC.

Mahathir, M 1991, *The way forward - Vision2020*, viewed 23 April 2009, <http://www.wawasan2020.com/vision/>.

Markauskaite, L 2003, 'Critical Review of Research Findings on Information Technology in Education', *Informatics in Education*, vol. 2, no. 1, pp. 65-78.

Mat-jizat, JE 2012, 'Investigating ICT-literacy assessment tools: developing and validating a new assessment instrument for trainee teachers in Malaysia', Thesis thesis, RMIT University.

---- 2013, 'Developing an ICT-Literacy Task-Based Assessment Instrument: The Findings on The Final Testing', paper presented to International Conference e-Learning 2013, Prague, Czech Republic, 23-26 July.

Multimedia Development Corporation 2005, *Malaysian Smart School Roadmap 2005-2020: An Educational Odyssey*.

Prensky, M 2001a, 'Digital natives, digital immigrants', *On the Horizon*, vol. 9, no. 5, pp. 1-6.

---- 2001b, 'Digital natives, digital Immigrants part 2: do they really think differently?', *On the Horizon*, vol. 9, no. 6 pp. 1 - 6.

---- 2005, '"Engage me or enrage me": what today's learners demand', *EDUCAUSE review*, vol. 40, no. 5, pp. 60-4.

Tapscott, D 1998, *Growing up digital: the rise of the net generation*, McGraw-Hills, New York.

The World Bank 2003, *Lifelong Learning in the Global Knowledge Economy: Challenges for Developing Countries*, The World Bank, Washington.

Wilson, B 1990, 'The Preparedness of Teacher Trainees for Computer Utilisation: the Australian and British experiences', *Journal of Education for Teaching: International research and pedagogy*, vol. 16, no. 2, pp. 161 - 71.

Wu, H-K, Lee, SW-Y, Chang, H-Y & Liang, J-C 2013, 'Current status, opportunities and challenges of augmented reality in education', *Computers & Education*, vol. 62, no. 0, pp. 41-9.

Zhang, Z & Martinovic, D 2008, 'Teacher Candidates' Needs, Expectations of, and Attitudes toward Information and Communication Technologies (ICT) Learning and Integration', paper presented to Society for Information Technology and Teacher Education International Conference 2008, Las Vegas, Nevada, USA.