The Use of Augmented Reality Technology for Primary School Education in Perlis, Malaysia

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Abstract. The advanced of the technology evolving currently enable the use of innovative learning tools for various fields especially in education. Different technologies have been implemented in the educational sector to enhance the method of teaching and learning. Augmented Reality (AR) is a technology with vast potential and great pedagogical that offers new methods for the purpose of education. AR with computer generated system allows user to see the real world environment with virtual objects superimposed or composite in real world. Although AR will enhance the educational outcome, the domain specific, pedagogical and psychological aspects have to be considered for real use in class. The strategies such as collaborative learning were considered when designing and engaging an AR learning environment. Collaboration is to work together from one to other party where they can communicate each other to learn and get some mutual benefits. This research gives a brief insight into the potential and challenge of Augmented Reality in education to enhance the method of teaching and learning from conventional to the technological by using the AR technology.

Keyword: Augmented Reality; Collaborative Learning; Learning Experience; Education.

1. Introduction

Education in Malaysia is overseen by the Ministry of Education where each state and federal territory has an education department to co-ordinate educational matters. Currently, the process of teaching and learning more to the traditional with verbal educational method and it is not necessarily effective [1]. The past studies have shown that student who received verbal method is very difficult to understand and to solve the problem compare than the explanation in verbal and visual method [2]. In fact, many of educational institution still use the ineffective method to deliver their lectures which will cause the lack of student interest. To measure the effectiveness of learning, retention (remember presented information) and transfer (able to use information to solve the problem) are the factors that can help students understand what they have learned. Thus, educators have to find the appropriate method in order to deliver the teaching to the student and to give better approaches to improve their learning experiences.
Primary school education in other word, the place for student development and playing, activities, experience and social interaction practiced. In Malaysia, primary education begins at age seven and lasts for six years which is also known as Standard 1 to 6. The primary school divided into two levels, year 1 to 3 are classified as Level One while years 4 to 6 are considered as Level Two. Generally, this place is to prepare student before enrolling to secondary school.

Learning experience is very important part in the process of teaching and learning for primary school education because of student in this age need to get more attention in order to increase their motivation and satisfaction in classroom [3]. The one way method of teaching and learning must be change to be more sense as such as sight, hear, sound and touch. The past researcher believed that the use of Augmented Reality technology as a promising tool to enhanced the student motivation and interest, then support the teaching and learning process in educational context.

The AR technology is a computer generated system that allowed user to see the objects in the real world environment. Refer to [4] Games can be a new approach to implement for children in term of learning compare than lectures. Regarding to the past studies, games can be a part of teaching programming to preschool children. Educators must be consider to bring this emerging technology to support and enhance learning by integrated with the use of computers, multimedia materials, internet, simulations game and immersive technology such as 3D virtual world and Augmented Reality [5]. The creative strategies should be implemented as such as organize sets of activities to support learning and at the same time to meet pedagogical practice [6].

Awareness of the critical process to acquiring, storing and applying the information towards student nowadays, the emergent technologies should be utilize for educational context to deliver the course content so that fit to the human cognition [7]. The evolving of technology recently, especially in audio and visual become a new approach to the educational field to implement and gives possible impact on teaching and learning process as well as to offer new environment for primary school education. Nevertheless, augmented reality technology has their potential compared then other technology as such as multimedia, game and online learning. Although AR has provided new opportunities to enhance the education system, it depends to the educators to identify the new technologies to ensure the improvement in education [8].

The subjects tested in Primary School are Malay Comprehension, Malay Writing, English Comprehension, English Writing, Science and Mathematics. Regarding to the Wikipedia, teaching is the imparting of knowledge by a teacher or other knowledgeable person. Teaching method comprises the principles and methods used for instruction. An application is a method that used or designed to help student to perform specific task. The teaching application is the method that the way how the teacher used to the student by using the materials that can support the teaching. The material is including documents, graphic, software, audio and visual that performed to the classroom. To ensure the process of teaching and learning running smoothly, collaboration among teacher and children must be perform as well. Previously, teaching and learning in today’s classroom become complex and daunting [9].

The advanced of the technology enable the use of innovative learning tools for education such as Augmented Reality. Augmented Reality (AR) is a variation of Virtual Reality. AR allows the users to see the real world, with virtual objects superimposed upon or composited with the real world. AR for interactive learning in education is the greater context of immersive virtual learning environment. Through the use of advanced technology an empty space is turned into a very rich educational experience. AR commonly capable to overlay computer graphics onto the real world and allow users to see the real world at the same time as a virtual imagery attached to real location and objects [10].

Virtual Reality (VR) is an experiential medium, which is combines with advances in image processing, tracking mechanisms and intuitive human computer communication. To develop the educational application using this approach, domain specific, pedagogical and psychological aspects have to be considered for real use in classrooms [10]. Learning in classroom for children by adapting to the games is becoming effectiveness to the process of learning in term of make collaborative task among teacher and student. Collaboration is working together between one party and another party to seek mutual benefit. Collaborative task in education allow teacher and children to communicate each
other and learn through play and exploration. Children also enjoy an enhanced experience by use the multiple input devices [11].

The Augmented Reality (AR) for interactive learning in education is a new approached in Malaysia. This research paper concentrated on the use of Augmented Reality for primary school education. The use of these applications, particularly in education has great potential to enhance teaching and learning and at the same time to create a collaborative task among teacher and student.

Currently, teaching and learning in Malaysia start from primarily to high school, where the teachers have total control of their student. The problem statement of this study are more to the process of teaching and learning in primary school, where the conventional methods used is not effective for children such as by using chalk to write, book to story and image to explain. The appropriate equipment is needed in response to instructor activity without the need for manual control [9]. Using AR paradigms for teaching student is becoming increasingly popular because student are moving towards a new level of interaction with technologies and there is a need to student to educational contents through the use of attractive technologies. According to Jim Scrivener, the teacher’s main role is to “help learning to happen” which includes “involving” students in what is going on “by enabling them to work at their own speed, by not giving long explanations, by encouraging them to participate, talk, interact, do thing, etc. [12].

A creative and comprehensive developmentally appropriate primary curriculum designed to build skills and facilitate option learning experiences, while enhancing self-concept and preparing student for future educational success. Nowadays, teaching and learning methods in primary school more to the one way process. The elements of 5 sense methods such as sight, hear and touch will be applied in term of teaching and learning. Students will be excited and able to adapt themselves to the class environment with fun and interactive games. It needs to meet the minimum quality in term of minimum inputs (facilities, teaching materials, qualified teachers and community support), processes (effective leadership, monitoring and evaluation accountability, community participation, effective teaching and learning and student assessment) and outputs such as high student learning, social and individual returns [13]. The curriculum will be divided into modules from low to high levels. So that, to enhanced traditional teaching and learning methods for primary school education in classroom for future using Augmented Reality tools is needed.

The rapid expansion of the education system will cause the improving quality of education by employing interactive teaching and learning process with the limited resources, which is also one of the cost effective ways of improving quality of education [14]. The emerging of AR in education system enable to reduce the previous problem and make it enhanced from traditional to the new technology using AR application and to create collaborative task among teacher and student. Augmented Reality (AR) is the ideal solution for all educational application and potential to explore. The improvements of the technology nowadays make me aware and try to enhance the educational fields with the effective ways. Based on the studies, AR has potential to engage, stimulate, and motivate student to explore class materials from different angles.

Using this application, teacher can help student to teach subjects where they could not feasibly gain real-world first-hand experience and to enhance collaboration between teacher and student. By using the technological approach, hopefully it can help to foster student creativity and imagination to the subject. Besides that, this method also can help student to take control of their learning at their own pace and on their own path. The adaptation of this application will change the process of teaching and learning where it can create an authentic learning environment suitable to various learning styles.

The research is focusing on the teaching and learning in education for Primary School Education. The research will be focuses on the best way to develop application system using AR in term of teaching and learning for Primary School education. Besides that, to enhance the conventional system to the technological approached in Augmented Reality environment with the evolving technology and to ensure that the process of learning become fun and effective.

Basically, lessons at primary school based on subjects that provided by the Ministry Of Education. For this study, Syllabus will be divided into modules and sub-modules for Science subject. The research will involve surveys, questionnaires and detailed studies involving framework and collaboration with the selected Primary Schools in Perlis.
Currently, the teaching method is based on the syllabus provided to the teacher where the lectures is more to explanation by using white board, books, still photo and other materials. The lacking of the previous method is where student only hear and try to understand the lesson. Unfortunately, level of the maturity among them is different where some of student can easily to understand, and some of them are difficult to understand. By using Augmented Reality tools, teaching and learning process is become fun where student can play game by using marker provided such as alphabet, then when the marker is show to the camera, the monitor will display that alphabet and including audio and video which is can make interactive learning and create learning experience.

2. Augmented Reality

Augmented Reality (AR) is a live, direct or indirect, view of a physical, real world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. AR interfaces offer seamless interaction between the real and virtual worlds, a tangible interface metaphor and a mean for transitioning between real and virtual worlds [15]. Augmented Reality (AR) is a variation of Virtual Reality (VR). AR allows the users to see the real world, with virtual objects superimposed upon or composited with the real world.

![Milgram's Reality-Virtuality Continuum (1994)](image)

Figure 1. Milgram’s Reality-Virtuality Continuum (1994)

Augmented Reality (AR) can be defined as a system of tools that allows a person to view one or more virtual objects in real world environment. AR technology allows for viewing things in real environment that impossible to others see the real world as an imagery attached to real location and objects. In other word, this application enables person to interact with the real world. AR is extension of Virtual Reality (VR) which is known as Mixed Reality (MR). AR is a kind of application and technology where by using computer generates image or object and mixed them into real environment. This technology has already been applied in various fields such as engineering, industrial design, military, medical science, education and others.

Currently, the term AR is defined differently by researchers. The article entitled Augmented Reality in Education by Mark Billinghurst, has defined AR as a situation where user can see virtual imaginary or objects in the real world by computer generated where the user view the world through a handheld or head mounted display (HMD) either see through or overlays graphics in a real time [16]. Furthermore, AR can categorize by three properties which is a combination of real and virtual objects, interactive in real time and 3D registration of the virtual and real objects [17]. However, AR is a type of application and technology through computer and generated the image and mixes them into real environment [18]. Figure 2 show the diagram of Augmented Reality system.
Moreover, AR is quiet similar with Virtual Reality, because AR is a variation or extension of VR [19]. The AR will strengthen the visualization by image or object generated blend into the real environment [20]. The user can’t see the real world around him in VR, while AR technology allowed the user to see the real world environment with the virtual image overlaid.

There are two taxonomies of AR application in term of development. Marker based AR and Markerless AR. Marker based AR need the marker registration the position of a virtual object to be displayed into the user perception of the real world. AR may operate with devices, software, sensor, camera and display device. Markerless AR operates by incorporating global positioning system (GPS) that identifies coordinates or locations.

3. Studies

The technological advances enable the use of innovative learning tools for education. To ensure the implementation of this technology in education more effectively, various factors need to be considered, particularly traditional teaching methods and technological methods using AR. Refers to the previous study entitled Traditional vs. Modern Teaching Methods: Advantages and Disadvantages of Each, the traditional method of teaching is deeply teacher-centered, where the methods puts the responsibility totally to the teacher and it is believed that, if students are present in the lesson and listen the explanation and examples, they successfully understand. According to this study, the traditional method is not the best mode of delivery for the purpose of communication [21]. Compared with the traditional method, modern methodology is much more student centered, where based on the research made, 12.5% of the teacher prefer traditional method, 25% of them demanded to use both, and 62.5% believe that modern technology is more effectively.

To achieve more effective in term of teaching and learning, the appropriate strategy should be implemented and requires the use of appropriate methodologies and pedagogies to meet the demands of the current generation of students, new technologies and changing the educational environments [14]. The advancement of technology, particularly in education has resulted in the teaching and learning process has been blended with a variety of methods and strategies. Refers to the past studies, Blended Learning (BL) or known as hybrid learning describes a learning environment that either the combination of teaching methods, delivery methods, media formats or a mixture of all these. This new dimension expected that to provide student with more control over learning. Students at this level are prefer something that would appeal to them, such as an interactive game and containing multimedia elements.

The introduction of graphics-oriented computer has great changes in education, particularly in animations. The use of multimedia elements in education such as using animated images will attract the children in term of helping them understand and remember the content. The object oriented animation features have better understanding compare with the complex explanation and it can help children learn faster and easier [22]. At the same time, this element will foster the teaching and learning process and increase the attention rates. Besides, a good educational technique in augmented
reality learning system for kindergarten through the graphical images such as 2D, 3D and animation would make both of teacher and children to collaborate each other.

This research give a brief insight into the potential and challenges of using collaboration Augmented Reality (AR) in education within the greater context of immersive virtual learning environments. Nowadays, the conventional process of learning in Malaysia based on the MyGovernment.com the official website, the subject of education is truly vital to the establishment of a developed and knowledgeable society. In term of AR system development, the appropriate equipment or devices need to be considered and to ensure the system implementation successful. The element of devices which is consist of input device such as computer or laptop and webcam, monitor or screen as an output and AR tools software to generate objects to the real environment when the marker is shown to the webcam. Marker is very important part to design and the complexity of pattern should be reduced because of each marker is unique and it would facilitate the webcam to captures and identify the marker [18]. Users can operate the marker whether turn and move around as long as the printed surface must face to the webcam. The object would disappear when users occlude marker of the AR pattern with hand.

According to the enhance the traditional teaching and learning process methods in education, AR technology has matured to the point where it can be applied to a much wider range of application domains, and education is an area where this technology could be especially valuable. The educational experience offered by Augmented Reality is different for several reasons including to support of seamless interaction between real and virtual environments, to use of a tangible interface metaphor for object manipulation and the ability to transition smoothly between reality and virtuality [16]. The implementation of this technological method to enhanced the process of teaching and learning method, collaborative task should be consider in order to perform AR system.

To enhance the collaborative task in education using AR applications, one of the most important purposes of an educational environment is to promote social interaction among users located in the same physical space [10]. To become a successful of learner, communication and collaboration are essential part to ensure the involving of students in real world task through the dialogue and interaction among them, curriculum objectives will come alive where learning group in classroom can accomplish meaningful learning and learning experience to children [23]. Working with collaborative peer-work groups is more effective because student try to reach a common goal, sharing tools and activities. These elements show the positive children interdependence when they try to use marker together and learn something among them.

The visualization technique is interesting method that enable users especially children not only to observe how objects behave and interact, but also provide children with visual that they may capture, and preserve the essence of physical phenomena with effectively compare than do verbal descriptions [24]. Furthermore, to perform the AR in education specifically for Primary School, there are several things should be provided to ensure the process of teaching and learning through the AR application running effectively. Student in Primary school should be exposed to the AR application where teaching methods are more to the fun games to interact them. In response to the frustration with this situation, we need augmented the classroom technology with various sensors and computer processing [25].

The process of teaching and learning should be enhanced parallel with technology evolving to ensure children in future exposed to the varieties of aspect especially in augmented reality fields. Learning should be continued to ensure that our community is rich with useful knowledge, particularly in the field of AR and being able to create something new. Regarding to the past researcher, they believe many advantages when integrating AR technologies toward teaching and learning process. The AR technology enable supports seamless interaction between real and virtual environments and allows the use of a tangible interface metaphor for object manipulation [26]. Hence, AR technology will provide instructors with high students’ understanding in the classroom by augmenting physical devices with virtual annotations and illustrations [27].
4. AR Collaboration

Based on the studies in [11], there are two different experiments were performed using the AR games as a prototype for answering two research hypotheses. First, the role of immediate feedback and size of the display on the levels of collaboration and the effects on learning and motivation levels is made. The first step was to make sure the prototypes were well tested. For this, they used the University’s Laboratory, under different lighting conditions. The augmented reality would not function in totally dark environment because it is based on the camera recognition of the black and white printed marker.

The main procedure was divided into two issues and two different experiments aimed at studying those two issues. The issue are the effects of the game had on learning and the effects different design variables had on collaboration levels. This research also investigated the effect on student’s motivation. This was also due to the importance that promoting successful collaborations has on the Primary School environment. The first experiment is about an initial school aimed at knowing if the game really aids student in novel knowledge acquisition. Each class went through three different phases. A pre-test phase, where students answer random set of questions about the subject being taught. It consisted of playing the game in groups of four children. Next, a post test was performed and the measure of different in results, which will be described in the next section. The second experiment was performed to assess the collaboration levels and to investigate the influence of the following variables on those levels of collaboration which are the display size and the immediacy of the feedback. During both experiments, and whenever the game play started, a screen of recording software was automatically launched and kept running in background. Therefore, the children were being digitally videotaped while they played the game.

The participants of the experiment aimed at assessing the effects on learning were different from the participants and school of the second experiment, aimed at investigating effects on collaboration levels. The participants of the first experiment were twenty-two children aged from 5 to 6 years old who interacted with the system in a collaboration setting using projector as display device. The participants of the second experiment were thirty-six different children aged from 3 to 5 years old, who played the game in groups of four or five.

Finally, based on the results, motivation levels were high because children never gave up the game. Even when feedback showed them they were wrong, nobody quit the game until reaching the solution. The children’s overall reaction to the system was very positive in both experiments and most importantly, they conclude that the system didn’t make the learning process go wrong. The results suggest that immediate feedback may play a role in increasing the number of collaboration behaviours and interactions among kindergarten children.

The research from [28] was designed Alien Contact! Simulation. The AR game developed for middle and high school to teach math, language arts, and scientific literacy skills. Basically, the AR game concept based to the Alien invasion where the student require to work in group four, carrying four roles which is a chemist, a cryptologist, a computer hacker and an FBI agent. Student had to solve the problem given by collaborating with their team and sharing information with them. This simulation game show the positive impact especially in collaborative task among them and increase their high level of student engagements.

SMART (System of Augmented Reality for Teaching) is a collaborative AR system designed for the purpose of teaching 2nd grade level student about different modes of transportation and types of animals. This study included a devises such as AR marker, laptop, software, web camera and projector. To achieve the target of study, they conducted with the 54 students (aged 7-8) from three local primary schools. For each school, the participants were divided into two groups. The First group, for control group which used a traditional teaching and learning method. Second group used the SMART system as a learning tool. The result show the positive impact on students’ motivation, learning experience and collaboration among student.

Based on the previous reviews, most of the researchers believed the AR technology will give potential for educational benefit and positive impact for student in order to deliver the teaching and learning process. The advantage of using AR technology to generate objects or virtual information in
the real world environment is the unique technic for this technology. The AR provides a combination of real and virtual environments to the system that is unachievable for other technologies.

Besides, the AR technology enable the use of 3D object registration of the virtual and real objects in an AR allows users to view the learning content in 3D perspectives. Regarding to [11], the AR technology can help students who have difficulty visualizing complex learning concept and the AR can assist student to understand and learn new concepts with new environment that cannot be viewed in real world.

5. Conclusion

The augmented reality system has very positive impact on the whole class collaboration. Motivation, enjoyment and curiosity are important ingredients for any kind of educational game. Augmented reality technology and tangible interfaces are well accepted by today’s Primary School Education children and by their teachers as well. Interactions among teacher and children with AR system will enhance the motivation and collaboration.

By utilizing proper instructional strategies, AR may provide students with numerous benefit and lead to the effective learning experiences. The AR technology also give the opportunities to create educational experience that are more engaging and attractive.

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