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THE KINECT-BASED EDUTAINMENT APPLICATION IN A CLASSROOM: A PILOT STUDY FOR SCIENCE PRIMARY ONE IN MALAYSIA

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Graphical abstract

Abstract

Kinect technology which works in four ways of sensing through a natural user gesture and spoken command interfaces: motion sensor, skeletal tracking, facial recognition and voice recognition.is potentially suitable to be implemented in educational game application. In this paper, we investigate Kinect sensors type that could be used in learning that resulting interactive fun-learning environment. A prototype system which implementing the sensors has been developed and tested in teaching Science Primary One at Sekolah Kebangsaan Taman Tasik, Ampang, Selangor, Malaysia. The Kinect application let the student explore and participate physically during learning period and by providing good multimedia content, they can understand the syllabus easier and in a fun way, thus creating good bond between teachers and students. Natural interaction could be suitable to be implemented for learning in the classroom, however, the implementation of Kinect in classroom has technical limitations for example it requires large classroom space. But still, living in the 21st century where the technology is emerging, the education also needs to be one step ahead. Therefore it can be said that Kinect and education are able working together well.

Keywords: Kinect sensor device, educational game, teaching in classroom

1.0 INTRODUCTION

Kinect device has four sensors which are motion sensor, skeletal tracking, facial recognition and voice recognition. Motion sense the movement, skeletal tracking detect the human body where it capable in interpret body based on the range depth and specify the joints that might involve such as, joint at the elbow, at wrist, and head. The face and voice recognition enable to recognize face and speech that help in creating a simple yet interesting application. The Kinect has four strategically placed microphones within the sensor to recognize and separate users' voice from the other noises in the room [1]–[5]. The world is moving forward and so does the technology. However, learning system nowadays seems like a bit layback. A new application should be introduced as another alternative to attract the students to learn and gain valuable knowledge in interesting ways. Most of the current teaching approaches in the classroom require the kids to strictly static behind their desk. There might be two ways communication but no physically-active participation. Due to this, students tend to get bored, lose focus or probably sleepy while in class. This problem can lead to the lack of interest in learning and can make the students think that the learning process is hard especially for subjects that need memorizing and understanding such as Science. Kinect has great potential to enhance classroom interactions and to ignite student creativity [6].

According to the LEGO Group in their article on The Whole Child Development Guide, children between ages of four and eight have an amazing eye-hand or perceptuo-motor integration coordination and skill. They have the ability to synchronize their body movements to the movements of what she sees, or hears or to others performing [7]. This shows that, at this stage of development, kids are really in a state of being excited in trying a new thing, develop new skills and able to solve problem they encounter. Based on an article from the University of Michigan Health System website, a child development refers to how the child able to do or solved complex things as their age increasing [8].

The childhood development from age five to seven years is the period where the children learn skills needed to become a self-sufficient person. At this age, the kids are eager to communicate, to learn and explore new things. Therefore, this study aims to use pervasive computing to enhance the in-the-classroom learning style to create natural interactions where the kids are able to response to the questions given virtually with the help of Kinect. The students have the opportunity to learn and perceive things in more actively way using constructed learning structure that is aligned with brain exploration and active learning. Furthermore, this pilot study create a virtual reality edutainment program that goes along with the development of technology and education in Malaysia, which helps to bring life to the teachers' teaching plans. The pilot study has been developed conducted for Science subject of Primary One at one of Malaysia primary school in Selangor.

2.0 BACKGROUND

There are many existing applications that have been created using Kinect to be used at school as learning & teaching tools as well as games tools. These application tools are shown able to improve the learning experience in classroom [9]–[12]. At Los Angeles Unified School District, Chicago Public Schools and Houston Independent School District, Kinect games are added to the teaching plan on certain subject likes mathematics, language arts, science and special education. Through this, Kinect enables the teacher to connect the contents with learners in a way that more interesting and easy to demonstrate in the classroom. It is believes that Kinect able to educate the kids as how the kids gains experience while they are playing the games. This is where the kids learning their mistakes after failing in a game. They will keep coming back again and again in order to succeed in the game. Microsoft Education Team believes that if the educators or developers put the characteristics of gaming and apply it into the classroom, kids will bring the same passion to their learning and possibly make them think creatively outside the box. Kinect really brought such a good impact to the students. The teacher noticed that, when they applied the Kinect application in the classroom, the students' behavior is impressive. They become more attentive in class, willing to speak up during lessons and getting the homework done. Most of them get more focused while lesson been taught. This has been proved by one particular student in the class that has difficulties focusing while learning in class. However, right after the Kinect was brought in to the class, she shows improvement by being so engaged throughout the lesson and tried her best in finish-up the assignments.

Gareth Ritter and Ray Chambers in their project Kinect Orchestra, illustrated in Figure 1 discussed about the idea on how applications could be modified for other lessons [9], [10]. They developed Kinect spelling test and Kinect Quiz which then modified to include different instruments sounds. The interface in the Kinect Orchestra enables the student to hover over the correct answer according to picture and the labels given. They conclude that students were really engaged into this application. Edutainment applications explain the idea of game based learning and conjunction with the Kinect is believed able to create an effective and best implementation for 21st century and future classroom. Positive impact of Kinect Technology in education also has been discussed and able to improve the education system especially in aided the student in doing revision. Positively by using Kinect, the educational game would be engaging, fun and most important thing is informative [13], [14]. Most of the applications discussed above were develop in western countries. To the author's knowledge, there is no other such application in Malaysia has been developed and tested yet. Thus, this study attempt to develop a pilot study of Kinect-based edutainment system that can assists teachers in teaching Primary One students specifically in Malaysia. It combines virtual reality technology and Kinect gesture sensors on motion and skeletal tracking in one educational game application that provide active-physically fun learning environment.

3.0 DESIGN AND IMPLEMENTATION

In this proposed pilot system, motion sensor and skeleton tracking will be applied to three games: The Kinect e-Book and The Mix & Match game. Kinect e-Book tells information about animal, how they lived, their food, their type and so on. The main idea of creating this e-book is to enable students to not only read information on the screen but also can listen to the sound of the animal. The Mix and Match game asks the student to choose the correct answers by actively moving left or right or jumping around. The sensor will capture and detect the movement of the student in the virtual environment and interpret the action.

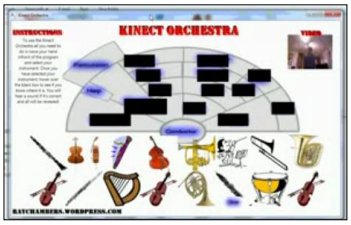
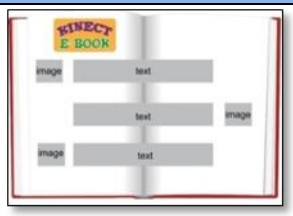


Figure 1 Kinect orchestra

3.1 Storyboard Design

3.1.1 Interface Design for Kinect E-Book

Story Board	Description
	-When the user hover over an image, a related sound will be produced and a description will be shown in the text box

3.1.2 Interface Design for Mix & Match Game

Story Board	Description
	-User needs to hover over the correct answer and user can check the answer by hovering over the check answer button in the middle. If the answer is correct, the triangle will change colour and if the answer wrong, user needs to choose correct answer again.

3.2 Navigation Design

One of the important things in designing an interface is the consistency for example consistency in designing the interface buttons, their color, the position of the buttons or the type of font used for the button. Consistency in the user interface enables users to build an accurate mental model of the way the system works that lead to lower training and support system cost. Thus, Figure 2 shows the design for Kinect e-Book. The arrow shape button will navigate user for previous or next page of the book.

Figure 3 shows the design for the Mix and Match game. This game requires user to identify the correct pair based on the image shows and the description stated to the normal behavior for each animal. User needs to hover over the triangle on the left and right hand side and check the answer by hovering on the check answer button. The navigational design for this game is easy to understand and makes the user feel comfortable to use it.

Apart from consistency, user control and freedom in navigability also plays it role. It is important to make the user to feel in control of their experience while navigating the site they visit. A chaotic interface could lead to frustration and could possibly make the user not to visit the site again.

It is a must to make sure the user feels comfortable while navigating the site where the interface able to provide an easy avenue of exit at all points in their experience. A good interface should make the user recognize rather than recall. They should not have to remember information from one part of the dialogue to another but this information should be easily retrievable by them whenever appropriate. Therefore, in this application, users will first get the experience to use with the navigational system and how the button works in Kinect e-Book. After developing their own mental model on how the interface works, there will be no hassle for them to play the other games.

In this application, Sans-Serif font has been chosen as the main font style since it is easier to read and suitable for educational program. Most of the graphics that are used are bitmap graphics and mostly cartoon animal graphics. For the audio .wav format is used. Wav is standard for storing an audio bit streams in personal computers. In addition, the Microsoft Visual C# 2010 Express also supports the wav sound format. This is because certain audio format likes mp3 was not able to be read either by the Kinect program and the Microsoft Visual C#.

While for the Kinect E-book part, the used of audio are mostly in the Kilobyte size. Kids at age seven usually they have a small frame, thus it will be hard for them to play with the application if the application is small and hard to be read. The size of the window is set as follow: height = '700' and width = '1168' to give comfort to the eyes and makes it look less crowded.

Figure 2 Navigational design for Kinect e-Book

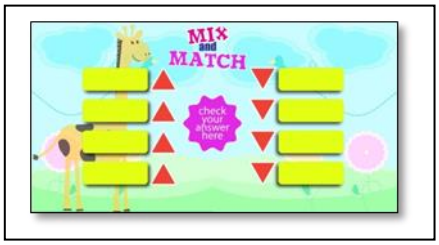


Figure 3 Navigational design for mix and match game

The final interfaces design for Kinect e-Book and Mix & Match game are illustrated in Figure 4.

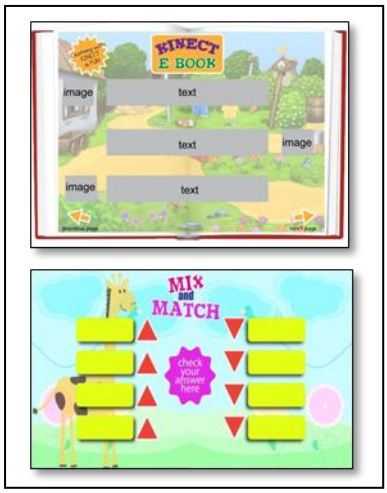


Figure 4 Design Implementation for Kinect e-Book and mix & match game

4.0 EXPERIMENT

Experiments have been done to two groups: The students and the teachers. For student, they are divided into two groups and only one group will use the Kinect. Here, the main goal is to justify how the students perceived the use of technology in their learning environment. There are several assumptions before the test is being carried out, whether the students will find the application and the technology use is interesting and fun for their learning or otherwise. While for the teachers, they will review the project that has been designed and need to give their feedback on the project developed by answering a few questions.

The main reason for conducting the survey is because to get their feedback on the product. The teachers' thoughts and comments are important in refining the product in the future. The experiments were carried out in Sekolah Kebangsaan Taman Tasik, Ampang, Selangor. Nowadays classroom has been provided with the projector and screen. Thus, it was easy to conduct the test. The large screen projector helped the student perceived the whole new concept of learning via Kinect.

Table 1 show that four of the students like the module, Kinect e-Book. They are able to follow the movement of their body that were sense by the Kinect sensor and comprehend the module that was given. While only one could not follow the Kinect application.

Table 1 Student feedbacks toward Kinect e-Book

	Like	Dislike
Num. of student	4	1

Table 2 shows the result of from the game segment. Based from the observation that has been done, all the students can easily understand the game process. In this game they need to mix and match the animal according to their characteristics. In addition, this application will give response if their answer is right or wrong. The student's acceptance towards the learning with Kinect was amazing.

Table 2 Students feedbacks toward mix & match game

	Able to comprehend	Difficult to comprehend
Num. of student	5	0

After the session with the test group has been done, both groups were combined. Here the aim was to figure out the user acceptance towards Kinect. Beside that's the testing also was intended to observe whether the control group capable to join the test group in playing with the applications. The result after the observation was conducted was definitely magnificent. Both group shows a huge interest in the application and were really excited to explore the Kinect. Table 3 shows the result from both groups.

Based from the overall observations, the activities connect the students and teacher together. The activity promotes a good bonding which they able to shares the joy among them. Based from their expressions, it clearly shows that they were enjoyed exploring the Kinect technology.

Table 3 Results from both group

Type of Group	Modules	Result after observation
Test group	Kinect e-Book	The students eager to learn more with Kinect. They were excited with Kinect capabilities in sensing their body movement without the need of controller. The student excited with the hover over button that produced sound.
	Mix & Match	They were thrilled with the game. Even though they facing difficulty in reading, they managed to tackled the game method.
Control Group (CG) and Test Group (TG)	Kinect e-Book Mix & Match Drag & Drop	Both groups were enthusiastic to try the application. CG and TG shows cooperation in solving the problem. All the students involved and participated. They were happy and eager to try another modules

While for the teachers, they were given with a set of questionnaires that have Part A and B. The aims of the questionnaires were to find out their acceptance toward the Kinect technology and the teachers opinion in regard to the introduction of Kinect into the Malaysian education at early schools grades. The teachers responds towards the product is one of the essential feedbacks towards the products. Table 4 and Table 5 show the results of the survey.

Table 4 Teachers' survey: Part A

	Strongly Agree	Agree	Disagree	Strongly Disagree
Ques. 1	5	0	0	0
Ques. 2	5	0	0	0
Ques. 3	1	4	0	0
Ques. 4	5	0	0	0
Ques. 5	5	0	0	0
Ques. 6	3	2	0	0
Ques. 7	2	3	0	0
Ques. 8	5	0	0	0

Below are the descriptions about the details of the result for Part A.

Ques. 1	Kinect technology suitable for teaching process.
Ques. 2	Technology and education able to educate the students.
Ques. 3	The teachers and students capable to adapt with the application.
Ques. 4	New learning experience for the students.
Ques. 5	Kinect technology triggers the students' motivation and encourages teamwork.
Ques. 6	The application fosters an exciting learning and enjoyable activity.
Ques. 7	An eye-catching interface.
Ques. 8	Satisfying application.

Table 5 Teacher's survey: Part B

	Yes	No
Ques. 1	5	0
Ques. 2	5	0
Ques. 3	0	5
Ques. 4	5	0

Below are the descriptions about the details of the result for Part B.

Ques. 1	Kinect technology and the education able to work well.
Ques. 2	The introduction of the Kinect application program meets the teachers' expectation on the image of 21st century schools
Ques. 3	The teachers still favoured traditional teaching method.
Ques. 4	The ability of the Kinect to the students and teachers.
Ques. 5	Kinect capable in creating a new learning environment in schools.

We have received an encouraging feedback from one of the teacher as quoted below:
"Students at 21st century schools is exposed to an open source of information. Teacher should be one step further than the students. Traditional teaching method involving chalk and talks are no longer relevant with the students".

Based from the answer, it can conclude that it is true that traditional teaching method could be served better if we can enhance the method by implementing the Kinect technology. It can engage student's more than traditional teaching and increase enjoyment in learning.

5.0 CONCLUSION

Based from the experiments done, the edutainment prototype has received tremendous responds that leads to the application strengths and potential. Looking back to the product goals, the first objective is to investigate what is Kinect device is and the capabilities of Kinect to be introduced to the Malaysian Education atmosphere. As mentioned in the earlier chapter as in the www.microsoft.com site that discussed about Kinect stated that the introduction of Kinect in education did bring lesson to life [15]. The idea of gesture-based learning really attracts the students to give full attention toward the learning program. Kinect gives the students an instant fun that most students nowadays need. This is because in this 21st century students, they are now able to cope up with high technology invention. In fact, Kinect technology is easy to be learned and it is easy to be used. Thus by using Kinect in class, the student able to have an interactive gesture based learning which no other device can offer.

It is believes that the proposed educational game application that combines VR and Kinect technology able to offer an exciting way of learning among the students. Apart from that, the combination of technology and education will create a good bond among the students themselves and with their teacher. From the experiments, the participation of the student in class is magnificent. All of them were excited to try the application and throughout this testing we are able to witness the student's cooperation to help their friends solving the questions. It is an achievement to a developer if the product they develop received good feedbacks from the users. This shows that the acceptance of user on the product is successful. By referring to the last objective of this product, the acceptance of the students towards the introduction of Kinect in their learning programs is ultimately welcoming. The students were excited with the technology and able to learn on how to use the application minutes after some demonstration is shown to them. This situation really proved that, education and technology are a good combination that capable in educate the student.

There are numbers of factors that make the Kinect technology and the introduction to the education is extraordinary. The contribution of Kinect toward the product is that it able to energize the student physically. The free movement that the student able to explore with Kinect application does not make the student feels bored in class. In fact it allows social interaction among the students and teacher for instance they will helping each other in solving the problems. Kinect bridges the gap between technology and education. Before this, there are some groups of people thinks that game-based learning and edutainment learning environment is not suitable especially to student. They were more preferred to the traditional way of teaching just by using the chalks, blackboard and textbooks. This group of people thought that this is how the student should be taught in class with just a typical classroom activity. However the introducing of Kinect to the world of education really bridging the gaps and demolished the old times thoughts. Now, not just the student enjoyed the learning but also the teachers.

The idea of introducing Kinect with education really supports the aim of Malaysian Education to surround the student with technology. Kinect and education is a good pair of team that able to create wonderful impact to the world. Despite the limitation that the products encounter, the applications still able to fosters a physically active fun learning to everyone. Hopefully in the future, the product will experience further improvement and the idea to implement the use of Kinect in the classroom will be adopted.

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