

Augmented Reality-Based Learning Medium for Autistic Children

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Abstract: *One thing to which attention should be paid in the educational world is the fact that it is difficult for the autistic children to understand the surrounding world. The fact that there are so many less innovative learning media is greatly responsible for the development of children especially the autistic ones. Therefore, the writer tried to design the Augmented Reality-Based Learning Medium for Autistic Children, which is expected to be applied as a learning medium. Apart from that, the writer also measured the level of the Usability and Acceptance of the Augmented Reality-based Learning Medium for the Autistic Children. The material prepared was adjusted to the curriculum applied by YayasanPeduliAutisme Bali. The method used to create the system was the Classic Life Cycle or the Waterfall Model. The usability of the Augmented Reality-Based Learning Medium for the Autistic Children was tested using questionnaire distributed to 10 members of the teaching staff employed by YayasanPeduliAutisme Bali. The result showed that the perceived usefulness of the Augmented Reality-Based Learning Medium was good. In other words, it was accepted as the learning medium by the teachers of YayasanPeduliAutisme Bali. Therefore, it can be concluded that the Augmented Reality-Based Learning Medium significantly supported the respondents in the learning process involving the autistic children.*

Keywords: Autistic, Augmented Reality, Usability, Technology Acceptance Model, Marker, Android

1. Introduction

God entrusts children, as His precious creations, to us. Each child has weaknesses and strengths. Their weaknesses, strengths and external factors contribute to their characters, attitudes and behaviors.

Autism refers to a mental condition which disturbs the growth of a child and contributes to several aspects of how he/she views the world and learns from his/her experience [1]. In general, an autistic child feels less social contact. He/she tends to be alone and avoids making contact with another.

Social interaction refers to a relationship between two or more persons in which the character of one individual affects, changes or improves that of another, and vice versa [2].

The fact that it is difficult for an autistic child to socially interact and the fact that this can contribute to his/her learning ability inspired the writer to design the Augmented Reality-Based Learning Medium for the Autistic Children.

2. Augmented Reality

a) Review of Literature and Concepts

The studies on Augmented Reality have been conducted by many researchers. The study conducted by Perez-Sanagustín et al. (2014) is entitled Augmenting Reality and Formality of Informal and Non-formal Settings to Enhance Blended Learning. The study carried out by María-Blanca Ibáñez et al. entitled Augmented Reality-Based Simulators as Discovery Learning Tools: An Empirical Study is an empirical one, which was designed as the finding-based learning. In 2014 a study was also conducted by Mau-Tsuen entitled Computer-Assisted Culture Learning in an Online Augmented Reality Environment Based on Free-Hand Gesture Interaction. The study entitled Learning Optimized Local Difference Binaries for Scalable Augmented Reality on Mobile Devices was conducted by Xin Yang in 2014. In

2014 Marianтони conducted a study entitled the Augmented Reality Book Introducing a Set of the Balinese Gamelan Instruments. In 2014 Jayadi conducted a study entitled the Augmented Reality Book Introducing the Layout of the LuhurUluwatu Temple and Its Natural Landscape. In 2014 Prawira conducted a study entitled the Augmented Reality Book Introducing the Layout of the Pulaki Temple and Melanting Temple. In 2014 Sari carried out a study entitled the Augmented Reality Book Introducing the Building of Ganesha University. The study conducted by Saputro in 2014 is entitled the Learning Medium for Introducing the Human Digestive Organ Using Technology. It is a learning medium for the students with specific needs. The study conducted by Oktari in 2014 is entitled the Development of the Augmented Reality Book Introducing the Layout of the Building of the Goa Lawah Temple and the Building of the Goa Gajah Temple. The last study conducted in 2014 is entitled the Development of the Application of the Augmented Reality Book Introducing the Taman Ujung Soekasada and Taman Air TirtaGangga in Karangasem Regency. It was conducted by Sudyatmika.

b) Augmented Reality

Augmented Reality refers to the combination of the real world and virtual world in one medium. From the real time point of view, the medium is interactive in nature and is in the form of the 3D animation [3].

c) Vuforia

Vuforia refers to the software library used for the Augmented Reality; it is consistent source of the computer vision focusing on the image recognition.

d) Marker

Marker refers to the picture with a specific focus already recognized on the Template Memory. It is printed using a printer directly directed to the camera to make it easily read and recognized by the camera. Then it is adjusted to the template saved in the vuforia. After it is found, the camera presents the 3D object on the Marker.

e) 3D Unity

The 3D Unity is an integrated tool for creating the form of the three dimensional object on the video games or for the other interactive context such as architectural visualization or the real-time 3D animation.

f) Blender

Blender refers to the software used for creating the unpaid three-dimensional animation. The programming languages C, C++ and python are those used in the Blender. The main language used is the programming language python.

g) Autism

The term autism is used to show a psychosis phenomenon on the unique children. Psychosis is a medical term which refers to a mental condition disturbed by dilution or hallucination. Dilution refers to misunderstanding or a wrong insight into something, and hallucination refers to a strong perception of an event heard or seen which is not in existence.

h) Usability

Usability refers to a process of optimizing interactive interactions between users using a system; as a result, they obtain accurate information or complete an activity in that application better [4]. Usability is measured based on the following components [5]:

- Learnability refers to how fast a smart user can use the system or how fast he/she can use the system in one function or how fast he/she can obtain what he/she wants.
- Efficiency refers to a resource used to achieve the speed and completeness of the goal.
- Memorability refers to the ability of the user to maintain what he knows after a particular period of time; memorability can be obtained from the menu which is set to be always ready.
- Errors refer to how many and what mistakes are made by the user; the mistakes made by the user include the fact that what is thought about by the user is not in accordance with what is actually presented by the system.
- Satisfaction refers to being free from discomfort and the positive attitude towards the use of the product or the subjective measurement as what the user feels as to the use of the system.
- Technology Acceptance Model (TAM)
- The Technology Acceptance Model, which is developed from the theory of psychology, explains the user's behavior towards the system based on the user's belief, attitude, intention and behavior relationship). This model is intended to explain the acceptance of TI with its particular dimensions causing it to be accepted by the user. The model classifies the attitude of each user into two variables. They are:
 1. Ease of use
 2. Usefulness

3. The Design of the Learning Medium

The Augmented Reality-based learning medium is designed using the "Classic Life Cycle" or the Waterfall Model,

which is the model mostly used in the Software Engineering (SE).

A. The General Picture of the System**1) Information Engineering and Modeling/System**

Modeling started by directly surveying YayasanPeduliAutisme Bali to search out what was needed based on the curriculum used.

2) Software Requirements Analysis

The hardware and software needed were analyzed in order to be able to support the performance of the Augmented Reality-based learning medium for the autistic children.

3) Design

The Augmented Reality-based learning medium for the autistic children were made to be more colorful. The reason was that the autistic children are more interested in more colorful things and sounds.

4) Coding

The 3D Software Unity was used for coding basically using the programming language C++ and C#. Blender was used for creating the 3 dimensional object.

5) Testing/Verification

Acceptance was tested using questionnaire distributed to 10 teachers teaching the children with specific needs.

6) Maintenance

The change in the curriculum used by YayasanPeduliAutisme Bali determined the development made.

B. The Learning Medium Design**1) Analysis and definition of requirements****a) The Need for Software**

- Blender is the software needed to create the 3D object
- Vuforia is the library software used to develop the Augmented Reality
- Marker

b) The Functional Need

- The functional need was based on the analysis of the functional need for the application of the Augmented Reality-based Learning Medium for Autistic Children, that is, the system which could cause the 3D object to appear.

2) The system and software planning

- The theories used were collected and needs were defined
- The application and Book Design were designed
- The user directed the marker already prepared in the book to the android smartphone camera
- The camera detected the picture in the real world and sent it to the computer and the software (Vuforia) searched out the marker available.
- Once the marker was found, the Vuforia processed and adjusted it to the template memory
- If it was appropriate, the 3D object would be presented; however, if it was inappropriate the marker would be sought out again from what had been taken by the android smartphone camera.

3) The integration and trial of the system

The trial process focused on the extent to which the marker was appropriate to the 3D object presented and

on the performance based on the application of the Augmented Realty.

The trial was done in two stages; they are:

a) The Usability Testing

[5] The initial step taken in the usability testing was that a number of tasks prepared before for the user when interacting with the system were tested. The tasks were given to 10 respondents who were the teaching and administrative staff and had already been familiar with the android application to make them find no difficulties when doing the tasks.

Table 1: Task Usability Testing [6]

No	Task
1	The learnability to open the software
2	The learnability to search out the marker
3	The speed of reading the marker
4	The speed of presenting the 3D object after reading the marker
5	The learnability to close the software

Each task in the table above can be explained as follows:

Task 1. Touch the software icon to open the Augmented Reality program.

Task 2. Direct the smartphone camera or tablet to the marker.

Task 3. Wait until the camera read the marker.

Task 4. The length of time needed to read the marker before the 3D object appeared.

Task 5. Close the application by touching or pressing the home knob.

b) The TAM Testing

The data were collected using questionnaire containing several questions based on the variables in the technology acceptance model; they were the variable of learnability, the variable of usability and the variable of acceptance. Several questions were attached to every variable to be answered by the respondents by crossing out the option chosen based on the Likert scale weighting.

1 = Strongly disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly agree

This scale gave options to the respondents as to how to respond to the questions attached to every variable.

4. Results and Discussion

a) The Learning Medium

The results of the learning medium test were as follows:



b) Descriptive Analysis

The result of the descriptive analysis of the perceived ease of use score is presented in Table 5 as follows.

Table 5: The Perceived ease of use Score is Presented

No	Question	Score	Min	Max	Mean
1	The learning medium causes me to teach easily	10	4	5	4.6
2	This learning medium is highly easily accessible from all android handphones	10	4	5	4.4
3	The marker can be easily read	10	4	5	4.5
4	This learning medium is highly easily applied	10	4	5	4.3
5	The medium presented is clearly understood and learned	10	4	5	4.3
6	The display can be easily viewed and known	10	4	5	4.3

Table 5 shows that, as far as the perceived ease of use of the Augmented Reality-based Learning Medium is concerned,

the mean of the score of the answer to from item 1 to item 6 is 4.4 in which the total valid N is 10. Therefore, it can be

stated that the perceived ease of use of the Augmented Reality-based Learning Medium is good, meaning that the respondents perceived that the Augmented Reality-based Learning Medium for the autistic children is easily used.

2. The User's Perception of the Usefulness of the Learning Medium

The result of the descriptive analysis of the score of the Perceived Usefulness is presented in Table 6 as follows:

Table 6: The Score of the Perceived Usefulness

No	Statement	N	Min	Max	Mean
1	The use of the learning medium contributes to the fast understanding of the learners	10	4	5	4.6
2	The use of the learning medium lightens my task	10	4	5	4.4
3	The use of the learning medium causes my task to be easier	10	4	5	4.5
4	The use of the learning medium the data needed can be easily accessed	10	4	5	4.3
5	In my opinion, the learning medium is useful to my job	10	4	5	4.3

Table 6 shows that, as far as the user's perception of the usefulness of the Augmented Reality-based Learning Medium for the Autistic Children (perceived usefulness) is concerned, the mean of the answers to all the statements is 4.42 in which the total Valid N is 10, showing that, as a whole, the perception of the user of the usefulness of the Augmented Reality-based Learning Medium for the Autistic Children used by the teaching staff of YayasanPeduliAutisme Bali is good. Therefore, it can be concluded that the respondents perceived the usefulness of the Augmented Reality-based Learning Medium for the Autistic Children.

5. Conclusion

Based on the results of the analysis of the data in the form of the information given by 10 respondents in Yayasan Peduli Autisme Bali on the application of the Augmented Reality-based Learning Medium for the Autistic Children in Bali, several conclusions can be drawn as follows.

- 1) The Augmented Reality-based Learning Medium for the Autistic Children already made has the usability values, meaning that the values of its learnability, efficiency, memorability, errors and satisfaction are very good, as indicated by the following usability values.
 - a) The score of the attribute "the learning medium is easily known" is 4.1, showing that the Android has the Learnability value.
 - b) The score of the attribute "the learning medium is easily operated" is 3.99, showing that the Android is easily operated and that the Android has the Efficiency value.
 - c) The score of the attribute "the menu and display on the learning medium are easily memorized" is 4.38, showing that the learning medium has the Memorability value.
 - d) The score of the attribute "the learning medium available is easily read" is 4.9, showing that the learning media has the Memorability value.
 - e) The means of all the attributes higher than 3 show that the learning medium has very good satisfaction value.
 - f) The user's perceived usefulness of the Augmented Reality-based Learning Medium for the Autistic Children applied by the teaching staff of YayasanPeduliAutisme Bali is good, meaning that they accept the medium. Therefore, it can be concluded that the Augmented Reality-based

Learning Medium for the Autistic Children is useful to them.

6. Recommendation

Based on the result of the study, it is suggested to those who would like to conduct research with a topic related to the Augmented Reality-based Learning Medium for the Autistic Children in the future that:

- 1) They should pay more attention to the object of the study to make the study achieve its target and not redundant.
- 2) They should develop the Augmented Reality-based Learning Medium for the Autistic Children to make them more interested in it.

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