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Augmented Reality in the Application of 3 Dimensional Objects as Laboratory Equipment

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Abstract: In today's developing era, quite a few schools still have limitations or lack of learning media. So technology is needed to support the learning process so that it is easier for students to learn both online and offline. This research aims to create and add Augmented Reality-based learning media at SMA Negeri 1 Plampang. The learning media created is a chemistry practical learning application using the Android platform which will be implemented in the chemistry textbook for class X-MIPA students at SMA Negeri 1 Plampang. Augmented Reality technology makes it possible to combine the virtual world and the real world in real time. So it will be able to provide a real learning experience. By applying Augmented Reality to the Chemistry textbook, students will be able to get to know the chemistry practical tools displayed through the application without needing to look directly into the chemistry laboratory.
The research method used is the ADDIE method which consists of analysis, design, development, implementation and evaluation stages. This method will produce output in the form of an Android-based application that uses Augmented Reality technology to display 3D objects for chemistry practical tools. Based on the results of the questionnaire or questionnaire that was given to respondents, the result was that the application that had been created was feasible and could be used as a learning medium that would be used at SMA Negeri 1 Plampang in the Chemistry subject class X-IPA CHAPTER 1.

Keywords: Augmented Reality, Educational mathematics, 3-dimensional objects, Unity

Introduction

Plampang 1 Public High School is one of the senior high schools on the island of Sumbawa, which is precisely in Plampang District, Sumbawa Regency, NTB Province. SMA Negeri 1 Plampang has several majors or competencies, namely Mathematics and Natural Sciences, Social Sciences and

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Languages. The Mathematics and Natural Sciences department itself has several subjects that differentiate it from other majors, such as Chemistry, Physics and Biology. Chemistry is one of the main subjects at senior secondary education level. Chemistry lessons aim to equip students with logical, analytical, systematic, critical and creative thinking skills. The learning media used at SMA Negeri 1 Plampang to study chemistry subjects is in the form of textbooks. The chemistry textbook for class X SMA Negeri 1 Plampang in CHAPTER 1 studies practical tools. From the use of commonly used learning media in the form of books which only display information in the form of static text and images. The lack of explanation regarding the function and use of the practical tools listed in the Chemistry book, encouraged the author to create an application that would be able to display and present material that was not contained in the textbook. Limited access for students to see the practical equipment in real life is because the practical equipment is in the laboratory and cannot be seen at any time.

In this case the author will apply Augmented Reality technology to the Chemistry subject book in CHAPTER 1 for class straight into the chemistry laboratory. So the introduction of practical tools is more realistic, which can not only be seen in the form of static images but can also display more dynamic information. So there is a need for learning media that is capable of displaying dynamic information from the images contained in the books being studied. So that the application of Augmented Reality to Chemistry books will be able to display dynamic information.

Augmented Reality technology makes it possible to incorporate virtual objects into a real environment and superimpose appropriate information into the surrounding environment. By using Augmented Reality technology, the fields of education and entertainment can be combined, thereby creating new methods to support learning and teaching in formal and informal environments.

Fun learning activities are greatly influenced by various factors, one of which is that the choice of learning media used must be interesting for students to learn, interactive when used, but not reduce the essence of the material being presented.

If the original object is difficult to bring to class or the class does not allow it to be exposed directly to the place where the object is, then the imitation object can also function as an effective learning medium.

Learning media that uses Augmented Reality technology can easily increase student understanding because 3D objects, text, images, video, audio can be displayed to students in real time. Students can be involved interactively, which causes Augmented Reality to become a learning medium that can provide feedback to students so that students feel comfortable in using this media. inches, height 11.69 inches. Layout: header 0.5 inch, footer 0.5 inch. The text does not need to be page numbered.

Method

Method of collecting data

Literature review

The first stage of data collection that the author carried out was data collection based on literature study. The main theoretical source of this research is the book entitled MULTIMEDIA Concepts & Applications in Education, the third edition of which is the work of Prof. Dr. Munir, M.IT published by Alfabeta in December 2015. Then the second book that the author uses as a supporting reference in Chemistry Education material is the Chemistry package book used by Plampang 1 Public High School students during the learning process.

Interview

The interview stage carried out by the author aims to obtain data from the parties concerned, related to the creation of learning media applications at SMA Negeri 1 Plampang. These parties are in the form of Mrs./Mr. Teachers who teach chemistry subjects and the principal. The conclusion of the interview was found to be the need for additional learning media that can support the learning process online or offline.

Observation

The author made direct observations at the research location, namely SMA Negeri 1 Plampang, to find out and see how the learning process was taking place. From the observations that have been made, the results show that the use of textbooks is the main learning medium in the classroom. The difficulty of entering the laboratory room and the limited practical equipment are also information obtained during observations carried out by the author at SMA Negeri 1 Plampang.

Interpretation of Learning Multimedia Qualifications

Interpretation of the feasibility of multimedia learning is carried out through descriptive statistical calculations. Answer scores in the range 1 – 5 are tabulated and the average score is calculated. The level of feasibility is differentiated into four groups, with the ideal mean (2.50) as the feasibility limit score. Therefore, a mean score less than the ideal mean is interpreted in the "not feasible" category, while the mean score in the "decent" category is differentiated into three levels, namely "less than feasible", "decent" and "very feasible", as stated in the following Interpretation Table [14].

Development Methods

The development model that the author uses in developing this learning media is the ADDIE development model. This development model consists of five stages which include analysis, design, development, implementation and evaluation. The ADDIE development model was developed by Dick and Carry in 1996 to design learning systems.

Figure 1. Method ADDIE

Analysis

Objective

The aim of creating this Augmented Reality-based learning media application is:

a. As additional learning media at SMA Negeri 1 Plampang,
b. Implementing new learning media based on Augmented Reality (AR) which will help the teaching and learning process at SMA Negeri 1 Plampang.
c. Introducing new technology that can be an alternative in the teaching and learning process for other subjects.

User

The users of the AR-based chemistry learning media application are students of SMA Negeri 1 Plampang, Sumbawa Besar Regency.

Functional Requirements Analysis

Functional requirements analysis is carried out with the aim of determining the level of system requirements for users, in the form of what material requirements are needed in the system. The material requirements are taken from the material that has been collected first at the data collection stage.

Device Requirements Analysis

Hardware

The hardware used and its specifications are:

1) Processor Intel Core i5 7th Gen
2) VGA Nvidia Geforce
3) Memory Ram 4gb
4) 1000GB HDD
5) 14" HD LED LCD
6) Mouse
7) Keyboard

Software (Software)

The software used in making this learning media application is:

1) Windows 10 Pro 64-bit
2) Unity 3D Engine
3) Vuforia SDK for AR Unity
4) Android Software Development Kit (SDK)
5) Java Development Kit (JDK)
6) Adobe Illustrator CS6
7) Blender version 2.71
8) Minimum Android Version 4.1

Design Planning

Navigation Structure

The following navigation structure will be implemented in the application created:

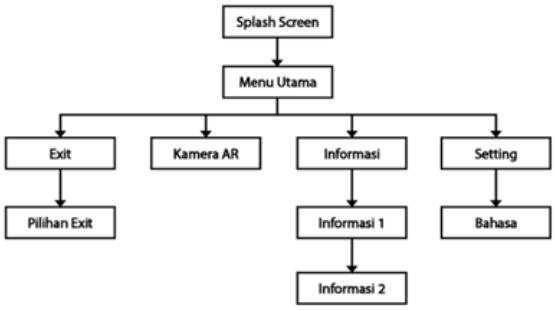

Figure 2. Navigation Structure

Interface Design

The interface design of this application is as follows:

a. Splash Screen
b. The main menu
c. Menu Exit
d. Camera Menu

It is. Information Menu

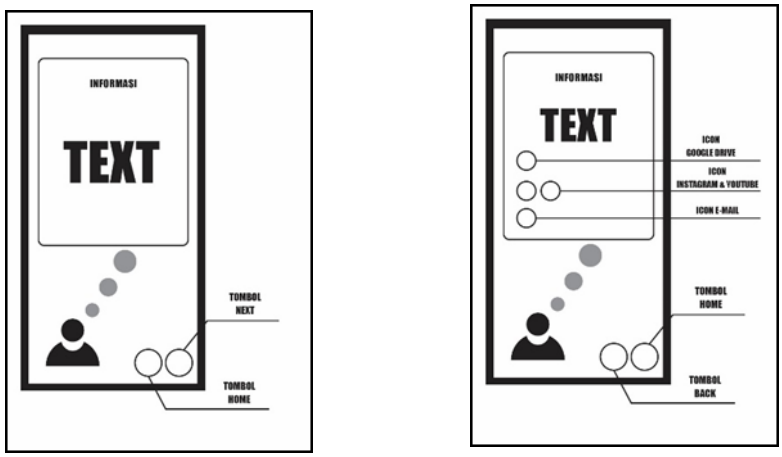

Figure 3. Information Menu

Marker Design

The author made 19 markers representing 19 objects with each marker representing an object that is different from one another. The following are the markers used:

Figure 4. Object Marker 1

Objek 3D

The 3D object components that have been created are then entered into the Unity application and place each object on a different marker.

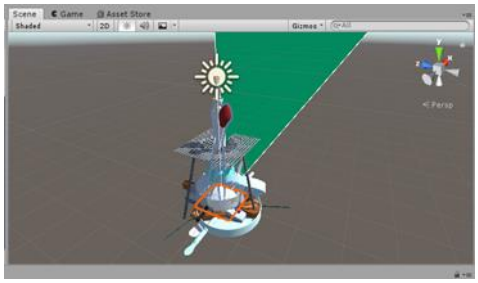

Figure 5. Import Objects into Unity

Development (Development)

Creating scenes or menus that will be displayed by the Kimia AR application. The scenes created are Main Menu, AR Camera Menu, Information Menu, Settings Menu and Exit Menu.

Figure 6. Creation of Scenes

a. Implementation
   This stage is carried out by installing the application on the smartphone of the student who is the respondent, then after the application is installed, a demo of the application is carried out. After the application demo is carried out, the application is then handed over for use by students. After the application is used by students, it will enter the evaluation stage.
b. Evaluation (Evaluation)
   This is a stage carried out to evaluate products that have been developed. From the process of applying the application to students, the results of the trial are obtained. Trial data was obtained from questionnaires given to users when they were and had finished using the application. The questionnaire provided contains statements that have points and a range of values that will be used to determine the feasibility of the application that has been created and tested.

Result And Discussion

Implementation

The following displays the application of the Chemistry AR application when used by users in Indonesian and English:
Splash Screen

Figure 7. Splash Screen Display

The main menu

Figure 8. Main Menu Display

Settings/Language menu

Figure 9. Display Settings/Language Menu

Menu Camera AR

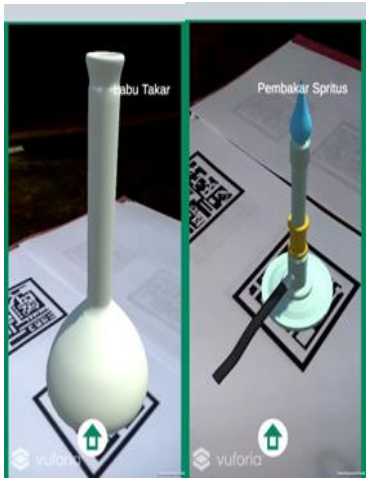

Figure 10. AR Camera Menu Display

Information Menu

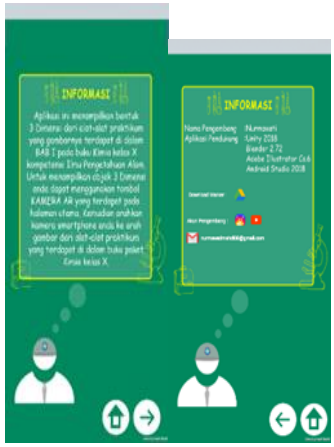

Figure 11. Information Menu Display

Exit menu

Figure 12. Exit Menu Display

Evaluation (Evaluation)

The evaluation stage was carried out using a questionnaire given to 10 homogeneous students. The questionnaire is given after the application is installed on the student's Smartphone and used by the student. The following are the results of the questionnaire that was given:

No.	Validator	P1	P2	P3	P4	P5	P6	P7	P8	P9	Jumlah
1	Siswa 1	4	4	4	3	3	4	3	3	4	32
2	Siswa 2	4	4	3	3	4	3	4	4	4	33
3	Siswa 3	4	3	4	4	4	4	3	3	4	33
4	Siswa 4	4	3	3	3	3	4	4	4	4	32
5	Siswa 5	4	4	4	4	4	4	4	3	4	35
6	Siswa 6	4	3	4	4	3	4	4	4	4	34
7	Siswa 7	4	4	4	4	4	4	3	4	3	34
8	Siswa 8	4	3	4	4	3	4	4	4	4	34
9	Siswa 9	4	3	3	3	4	4	4	4	4	33
10	Siswa 10	4	4	3	4	3	4	4	3	4	33

Dari tabel di atas terdapat kolom-kolom yang berisikan data-data hasil angket, dengan P = Point Kuisioner. Sehingga dari total point yang diperoleh penulis mengkalkulasikan menggunakan rumus yang telah dicantumkan pada bab sebelumnya. Kalkulasi point kuisioner dilakukan dengan tujuan untuk melihat seberapa tingkat kelayakan aplikasi yang telah diuji. Berikut penjelasan dari proses kalkulasi hasil kuisioner:

$$Xt = \frac{\Sigma xi}{n}$$

Keterangan : Xt = rata-rata skor, Σxi = total skor, n = jumlah data.

- $\Sigma xi = 32 + 33 + 33 + 32 + 35 + 34 + 34 + 34 + 33 + 33 = 333$
- $n = 10\ (siswa) x\ 9\ (point\ kuisioner) = 90$

$$Xt = \frac{333}{90} = 3{,}7$$

Figure 13. Interpretation Results

From the calculation process above, a feasibility interpretation result of 3.7 was obtained from the trials on the AR Chemistry application that had been carried out. Pay attention to the table below:

No.	Interval Mean Skor	Interpretasi
1	1,00 – 2,49	tidak layak
2	2,50 – 3,32	kurang layak
3	3,33 – 4,16	layak
4	4,17 – 5,00	sangat layak

Figure 14. Eligibility Interpretation Table

From the table above, it is known that the test results are in the value range 3.33 – 4.16 or are in the third Mean Score Interval with the Interpretation statement "Decent". So that after evaluating the total scores from the trials that have been carried out, the evaluation process has been completed.

Conclusion

Based on the description of each chapter and the results of the discussion, it can be concluded that the creation of augmented reality-based chemistry learning media using the ADDIE development method using marker based tracking at SMA Negeri 1 Plampang is as follows:

1. The 3D objects displayed in the Application match the original shape of the practical tools and can be recognized as practical tools used in the real world.
2. The AR Chemistry application with the Marker Based Tracking method can only be used and operated by usersSmartphone with the Android operating system which provides camera facilities.
3. The method used is Marker Based Tracking with a development method using the ADDIE method. Based on the results of the questionnaire that has been given to students with resultsinterpretation feasibility of 3.7 is in the mean score interval in the "Feasible" category so that the AR Chemistry Application is declared suitable for use as a learning medium and can be applied in chemistry textbooks for class X-Science.

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