Augmented Reality as The Learning Media of Fundamental Chemistry on An Android Smartphone

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Abstract. Smartphone technology can be used as an innovative and promising learning media that is believed to be able to keep up with the times. Static learning media can be transformed into more dynamic learning media and can display object visualizations. One technology that can be utilized is Augmented Reality technology. Augmented reality technology is a visual technology that combines virtual world objects into real world view. The method used is ADDIE model of R&D (Research and Development) for the five stages of a waterfall model. Application used is unity 3D and Blender as supporting software. Testing of product uses validation, practicality, and effectiveness tests. The product produced is an application with an extension (.apk). The results of validation, practicality and effectiveness of the products were 0.68 with valid criteria, 78.6 with practical criteria and 0.72 with high effectiveness criteria, respectively.

Keywords. component, formatting, style, styling, insert (key words)

1. Introduction

Education is one way to produce quality next generation of the nation in the future. As a result of the rapid development of science and technology at this time requires education to participate in the use of technology as a form of renewal in learning. One of the technologies developed at this time is cellular phone or commonly known as smart phone. Smartphone is the term mobile phone that has the ability to stand out more like a computer in use and multimedia functions compared to other cell phones in general. This is due to the existence of the operating system and supporting applications that are far more interesting in a smartphone device. Currently, smartphones have various platforms such as Symbian, Blackberry, Windows, iOS, and Android. In addition, in this operating system the user can add the desired application. Based on survey data and current trends, the average mobile user comes from millennials including teenagers such as students using this mobile device.

Technology can be used as an innovative and promising learning media that is believed to be able to keep up with the times. Sakat et al [1] said that learning using technology media had a significant influence on learning outcomes. One strategy for increasing the achievement of learning objectives is
the integration of technology in learning, because technology is no longer considered a new device in learning. Now, the use of smartphones is very close to student life which functions as a communication, chat and game tool. In addition, smartphones have a great opportunity to be developed into learning media that are beneficial for students. One smartphone technology that can be utilized in making interesting learning media is technology based on Augmented Reality (AR). Augmented Reality (AR) is an application that combines the real and virtual world in the form of two dimensions and three dimensions that are projected in a real environment at the same time. Augmented Reality is often referred to as augmented reality [2]. Augmented Reality technology on smartphones based on Android can be combined with printed books. Objects can be visualized through a three-dimensional virtual model that is similar to the original object and various features such as video are directly above the printed book. One of the courses that can utilize Augmented Reality technology in the form of instructional media is Fundamental Chemistry. Chemistry is a scientific discipline that was originally obtained and developed experimentally (inductively) but subsequent developments in chemistry are also obtained and developed in theory (deductive). Chemistry is the science that seeks answers to various questions of what, why and how natural phenomena are related to composition, structure and properties as well as changes, dynamics and energetics of substances that involve skills and reasoning.

2. Methodology
2.1 Research Method
The design of this Basic Chemistry learning media uses the Research and Development (R&D) method, which is a research method aimed at producing products. The resulting product is an application on an Android smartphone with the extension (.apk). This basic chemistry learning media uses technology based on Augmented Reality on an android smartphone. The target users of this application are Lecturers and students of the Mathematics Education Department of IAIN Bukittinggi [3]. The R&D development model used in this study is the ADDIE (Analysis-Design-Development-Implement-Evaluate) model which is integrated according to the research steps recommended by Reiser and Mollenda with the consideration that the model is suitable for developing targeted instructional / learning product models, effective and dynamic and very helpful in the development of learning. The development model used is the Luther Sutopo multimedia development model which is a system summarized from MDLC (Multimedia Devolution Life Cycle) with the concept, design, material collecting, assembly, testing, and distribution stages.

2.2 Stages of Research

![Figure 1. The stages of ADDIE and Luther Sutopo model](image)
2.3 Product Testing
After the product is made, a validation test is carried out by experts, a practicality test is carried out by a Chemistry lecturer and an effectiveness test is carried out by students.

2.3.1 Validity test
The validity test conducted refers to the Aiken’s V statistical formula as follows.

\[ V = \frac{e}{n(c-1)} \]......Aiken’s V

Azwar, S [4] says that determining the validity of the "V" number is based on a range between 0.00 and 1.00. The category of determining validity according to the Aiken formula which says that the product will be valid if it has a range of Aiken's V values between 0.60 - 1.00 and is invalid if the Aiken's V value is smaller than 0.60 [5].

2.3.2 Practicality test
Practicality Test is a test that can be done to users through filling out questionnaires that show the media that are built provide convenience for users and are appropriate to use [6]. The practicality test data were analyzed with the percentage using the formula:

\[ N = \frac{BP}{BM} \times 100\% \]

The criteria of \( 0 \leq N \leq 20 \) are impractical, \( 21 \leq N \leq 40 \) are less practical, \( 41 \leq N \leq 60 \) are sufficiently practical, \( 61 \leq N \leq 80 \) are practical, \( 81 \leq N \leq 100 \) are very practical.

2.3.3 Effectiveness test
The effectiveness aspect in learning media can be seen from the potential effects in the form of quality of learning outcomes, attitudes and student motivation. Nieveen set the level of effectiveness rather than the level of student appreciation in learning the media and the desire to continue using the program.

The effectiveness test is calculated by referring to the Richard R. Hake statistical formula of gain score (G) as follows [7]:

\[ G = \frac{(s_f - s_i)}{(100\% - s_i)} \]

The criteria of \( G \leq 0.3 \) are low effectiveness, \( 0.3 < N \leq 0.7 \) are medium effectiveness, and \( 0.7 < N \) are high effectiveness.

3 Results and Discussion
The learning media of fundamental chemistry based on Augmented Reality for students in the mathematics education department of IAIN Bukittinggi, produces an application with extensions (.apk) that can be run on an Android phone. Supporting software used in the form of 3D Blender, Unity 3D, Adobe Photoshop. This learning media based on Augmented Reality is designed to support the learning process of fundamental chemistry in the mathematics education department of IAIN Bukittinggi. This Learning Media is designed by presenting six main menus, namely information menu, SKKD, material, training, and periodic table. The material presented in this media is chemical bonding material and is equipped with a marker book which can be scanned using an AR camera scan to see the results of animated chemical bonding material in 3D.

Based on the questionnaire given to the validator for the validity test, the students for the practicality test obtained a validity value of 0.68 with valid criteria, a practicality value of 78.6 with practical criteria and an effectiveness value of 0.72 with high effectiveness criteria for learning media on Chemical Bonding material based on Augmented Reality.
4. Conclusion
1. The design of learning media for Chemistry Bond material based on Augmented Reality produces a product in the form of an application with extensions (.apk) that can be run on an Android smartphone.
2. The six main menus in this design are the information menu, SKKD, material, training and periodic table.
3. The product developed has been tested for validity, practicality and effectiveness by experts with valid, practical and effectiveness criteria.

Acknowledgement
would like to express my gratitude and appreciation to all those who have given me the opportunity to complete this paper. Special thanks from me to the leadership of IAIN Bukittinggi for providing support for the publication of this paper.

References
[1] A. A. Sakat, M. Z. M. Zin, R. Muhamad, A. Anzaruddin, N. A. Ahmad, and M. A. Kasmo, “Educational technology media method in teaching and learning progress,” Adv. Nat. Appl. Sci., 2012.
[2] E. Ardhianto, “Augmented Reality Objek 3 Dimensi dengan Perangkat Artoolkit dan Blender,” Din. Teknol. ..., 2012.
[3] Sugiyono, “Quantitative, qualitative and R & D research methods,” Alfabeta. 2012.
[4] S. Azwar, “Reliabilitas Dan Validitas,” Yogyakarta: Pustaka Pelajar, 2011.
[5] L. R. Aiken, “Three coefficients for analyzing the reliability and validity of ratings,” Educ. Psychol. Meas., 1985.
[6] M. Haviz, “Research and development: Penelitian di bidang kependidikan yang inovatif, produktif dan bermakna,” Ta ’ dib, 2013.
[7] R. R. Hake, “Analyzing change/gain scores,” Unpubl. URL http://www. physics. indiana. edu/∼sdi/AnalyzingChange-Gain. pdf, 1999.