

# Development of Game Education Basic Virtual Augmented Reality in Geometry Learning

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# Development of Game Education Basic Virtual Augmented Reality in Geometry Learning

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## Abstract:

The condition of the educational game now is so rapid development, one of the indicators is that students are busy playing games in between lectures, so that it raises concern as teachers to add value to the benefits of games in lectures adapted to the current millennial era. The purpose of this study is to determine the design of making educational games based on VAR (Virtual Augmented Reality) in learning geometry that is valid (feasible) at tertiary institutions. The research method uses the ADDIE R&D model (Analysis, Design, Development, Implementation, Evaluation). we can first make changes to ADDIE analysis model, consist of design, development, dissemination, in the analysis steps of the analysis of the needs analysis with the teacher and children of kindergarten PGRI 73 Semarang added (1) choosing material according to the thematic, (2) the use of media play in class, (3 ) adjusted the way of thinking of children according to the theory of brunettes that is enactive, econic and symbolic performance learning, (4) educational games must be packaged in the form of pictures and voice commands only kindergarten children can not read, this is as a basis in making media design games education, the next step is to design an educational game media with the following design steps: (1) determining the material / material that you want to be included in the game (2) arrange the Game Play (story line / the player's journey while in the game), (3) create 3D assets such as trees, rocks, clouds, land and related objects using 3D software using Blender Software, (4) Making games (here use Unity Game Engine) arranging all assets according to the gameplay gameplay that has been compiled, (5) Activating the Vuforia Plugin which provides a library that is used to create VR displays, (6) Programming game controls using Bluetooth Game Pad so that users can control the game, (7) Build applications, (8) Test the Bug, after the design of the educational game, then proceed with the validation of material experts with an average rating of 85% and media experts with an average value of 82.69% means that the media is appropriate to use. then a limited test has been conducted with the results of the average value of the experimental class  $x_1 = 82,85$  and the average control class  $x_2 = 70,03$  and  $t_{count} > t_{table}$  is  $0,2001 > 0,1647$  then there are differences in student achievement between control class and experimental class.

**Keywords:** Educational Game, Virtual Augmented Reality, Geometry

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## I. INTRODUCTION

The development of Information and Communication Technology is currently developing very rapidly. These developments cause changes in people's behavior and activities in daily life. One technology that is developing very fast now is

information and communication technology. One of them is VAR (Virtual Augmented Reality) based game that is able to display interesting virtual objects and reality. Billingham, M. (2002) states that Augmented Reality technology needs to be explored in the world of education because it offers unlimited interaction between the real and the virtual

world and is applied in the school environment. Meanwhile, according to Buchori (2017), mobile augmented reality can motivate student learning so that it affects student cognitive learning outcomes.

Mobile technology is currently not only used as a communication tool, but also as a tool to facilitate users in their daily lives. This can happen because in mobile technology there are many facilities, including: internet access, e-mail, organizer, music, games and can be used anywhere, anytime faster and easier. According to Sunandar, W. K., Achmad, B., & Dini, R. N. (2017) learning mathematics using mobilemath will provide better learning outcomes. Learners can be more interested in learning mathematics online with the game features provided. This is supported by Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J.L., & Fernández-Manjón, B. (2008) who state that the use of educational games in the learning environment is an increasingly trend relevant. Implementation of the game on learning will facilitate students in understanding a particular concept. Games are computer games created with animation techniques and methods. This finally becomes its own challenge to make an educational game that is both fun and has benefits. In this case, i.e. making a geometry learning game in college on an android device. It is hoped that this game will also provide learning benefits and play a role in the development of mobile games in Indonesia.

Siswanto (2012) discusses the making of an educational game for the study of Natural Sciences (IPA) in grade VI elementary school students. This research is based on Java Mobile Edition (J2ME) as a medium used to build applications. Then Yulianti (2012), conducted a study that discussed basic learning games for kindergarten children. Where in this game there is no game level, but if the player succeeds in completing the game according to the instructions given, there will be an animation or sound that indicates that the player has successfully completed the game.

Based on the results of research conducted by Huizenga, J., Admiraal, W., Akkerman, S., & Dam,

G. T. (2009) concluded that learning strategies based on mobile games are very effective when compared to learning without using game applications. This is because students find something more fun when learning. Whereas Ebner, M., & Holzinger, A. (2007) conducted research on the use of online games for learning in higher education with the aim of making complex theoretical knowledge easier to understand. So that the results of his research are learning outcomes of students who use online game application assistance is better than the results of student students who use conventional learning.

Based on the background above, the purpose of this study is to determine the design of making educational games based on VAR (Virtual Augmented Reality) in learning geometry that is valid (feasible) at tertiary institutions. In this case, according to media experts and material experts to be used in learning geometry in tertiary institutions.

## II. LITERATURE REVIEW

### A. Android Smartphone

In following the latest learning, students are expected to use their smartphones for learning, one of which is Android. Android is an operating system for Linux-based mobile devices that includes an operating system, middleware and applications. (Developers, A.: 2011). Kirthika B. et al (2015: 260) in the journal Android Operating System: A Review says "Android is a software platform and operating system for mobile devices, based on the Linux kernel, and developed by Google and later the Open Handset Alliance (OHA)". According to Meier, R. (2012), OHA includes a consortium of 34 hardware, software and telecommunications companies including Google, HTC, Intel, Motorola, Qualcomm, T-Mobile and Nvidia.

Android in learning becomes an operating system for the first Linux-based mobile devices that provides an OPENSOURCE (open) platform. This makes it easy for developers to create their applications. Many applications can be made for Android, one of which can be used as a learning

medium. Therefore, researchers want to utilize Android as effective learning media.

According to Ibrahim, N., & Ishartiwi, I. (2017). the strengths of Android are 1) Complete (complete platform), developers can take a comprehensive approach when developing the Android platform. Android is a safe operating system and provides many tools for building software and making opportunities for application developers. 2) Android is open (open source platform), Linux-based Android which is open source or open-source, so it can be easily developed by anyone. 3) Free Platform, Android is a free platform for developers. There are no fees for paying licenses or royalty fees. Android software as a complete, open, free platform and other information can be downloaded for free by visiting the website <http://developer.android.com>. 4) The popular operating system, Android phones are certainly different from the iPhone Operating System (IOS) which is limited to gadgets from Apple, so Android has many manufacturers, with their mainstay gadgets at quite affordable prices.

While Android Weaknesses are 1) Android is always connected to the internet. This Android system smartphone requires an active internet connection. 2) The number of advertisements displayed above or below the application. Although there is no effect on the application being used, this ad is very annoying. 3) Does not save battery power.

The application of Augmented Reality technology is now quite extensive, including in the world of education. Billingham (2002) argues that the use of augmented reality technology in the world of education is still being developed until now because it is not like computing technology in general. The augmented reality interface can integrate users, virtual objects and real environments and in its application to the school environment, there needs to be a collaboration between teachers or tutors and researchers in the field to know the compatibility of the application of augmented reality media with the curriculum in the school.

## B. Game Education

Educational Game Educational game is a special learning game specifically for students created based on Virtual Augmented reality, which is able to display virtually and is able to display augmented reality that is of interest to students. This opinion is in line with the conclusion of Kaufman (2000) that as advances in the development of pedagogical concepts, applications, technology and hardware cost reduction, the use of small-scale augmented reality technology for educational institutions has become very possible in this decade (assuming a careful level of sustainable development). However, the potential of this technology requires careful attention in order to really be utilized to improve educational success.

Azuma (1997) also revealed the reasons for the use of augmented reality technology in the world of education, namely: (1) supporting interaction between real and virtual environments, (2) the use of interfaces that seem real for object manipulation, (3) learning outcomes for smooth transition between environments real and virtual objects. The relevant studies related to the research that researchers will conduct are: Research Achmad Buchori, et al. (2017). Mobile Augmented Reality Media Design with Waterfall Models for Learning Geometry in College shows that PGRI Semarang University students are very interested in using mobile augmented reality in studying geometry course material. So Azuma Research, Ronald T. (1997). A Survey of Augmented Reality. Hughes Research Laboratories. Malibu explains that augmented reality can improve students' spatial ability with added reality. So Research conducted by Permadi, Dendi and Ahmad Rafi. (2015). Developing a Conceptual Model of User Engagement for Mobile-based Augmented Reality Games. So Zheng, R., Zhang, D. and Yang, G. (2015). Seam the Real with the Virtual: a Review of Augmented Reality. Shows that by combining virtual and augmented reality makes learning as if seeing the real world in a fun way.



### III. METHOD

This research method was research and development. It is a research method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2010: 407). The research model used the ADDIE learning design model. This model, as the name implies consists of five main phases or stages, namely (A) analysis, (D) design, (D) e-development, (I) implementation, and (E) valuation. The five phases or stages in the ADDIE model, need to be done systematically and systematically (Sugiyono, 2010: 125). In this study only carried out until the third stage, namely as follows.

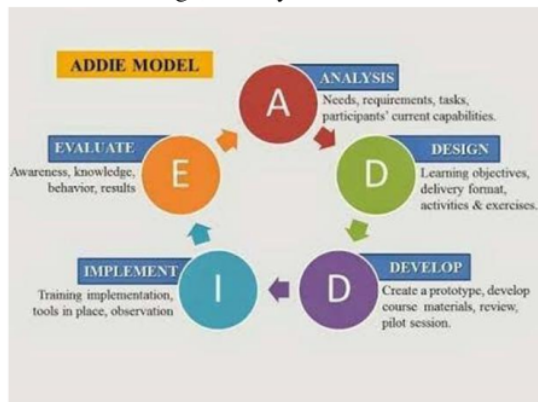


Figure 1. ADDIE learning design model

### IV. RESULTS AND DISCUSSION

Based on the learning system design procedures using the ADDIE development model, the stages of the implementation of this study are as follows:

#### 1. Analysis

The analysis step consists of two stages, namely performance analysis or performance analysis and needs analysis or needs analysis. In this session interviews of several lecturer courses in the mathematics education study program at the University of PGRI Semarang and UNISSULA Semarang. From the results of the interviews produced the fact that 95% of students of mathematics education study programs still use media games or simple games, there are no additional updated technologies such as augmented

reality, virtual reality, and other applications. For this reason, it is necessary to develop learning media that can accommodate these thoughts. Based on observations made by researchers in 3 first semester classes 2019-2020 academic year Semarang shows the learning process of geometry material that is less active and less interesting, this shows that there is no learning media used by game-based instructors which makes students look fast. Teaching and learning interactions in the classroom are inseparable from the media used by lecturers in delivering teaching material. The existence of smartphone-specific technology that is further developed must be developed wisely. One of the benefits that can be taken from this technology is using effective, creative and educative learning media. Free educational media applications can continue to be developed, one of which is the technology of Augmented Reality (AR) and Virtual Reality (VR).

#### 2. Design

At this stage the researcher designs the product to be developed based on the results of the analysis that has been done. From this study produced an educational game learning media using Virtual Augmented Reality (VAR) called an educational game based on virtual augmented reality. The material contained in this media is the geometry material of semester 1 in the UPGRIS mathematics education study program which includes material to build flat and build space. In making this educational game media it takes several applications to support maximum products, namely corel draw, blender software, vuforia development and 3D unity software, in making this educational game product systematic steps are needed as follows: 1) material design is made that is attractive in accordance KKNi curriculum, using corel draw software, 2) making markers using vuforia development, 3) making animation with 3D unity software, 4) then VR glasses to display interesting educational game products for students. 5) install the apk on android so that reality comes out on student smartphones, 6) students point the VR glasses in the direction the

game is made. The VAR-based educational game display can be seen in Figure 1 below:



Figure 2. Practice Using Educational Game based on Virtual Augmented Reality

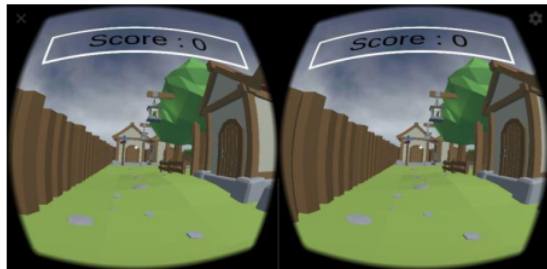


Figure 3. The initial menu in the Educational Game based on Virtual Augmented Reality

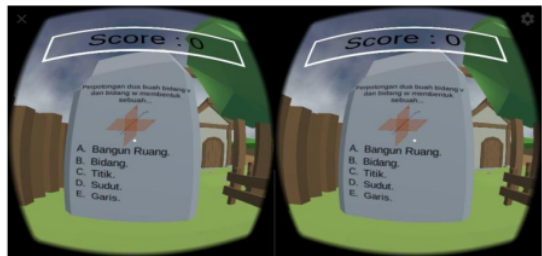


Figure 4. Quiz Menu on Educational Games based on Virtual Augmented Reality

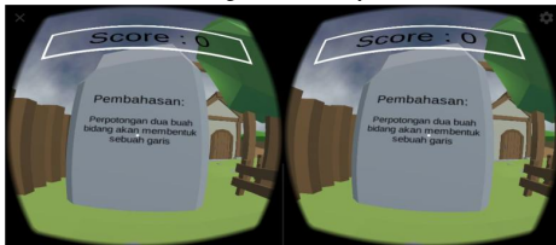


Figure 5. Discussion Menu in Educational Games based on Virtual Augmented Reality

### 3. Development

At the stage of developing android-based learning media using Virtual Augmented Reality (AR) will be made in accordance with the material, after the android-based media using Virtual Augmented Reality (AR) is finished, it will be validated by media experts and material experts by the validator to get input and evaluate accordingly input provided by the validator. The results of the validation will be described below.

#### a. Material Validation

Validation by the material expert is done so that the media that will be tested is truly feasible to be used in research. Development products evaluated by material experts are Virtual Augmented Reality (VAR) based Educational Games using a questionnaire that must be filled out by material experts. The questionnaire filled out by material experts has four scales with the following criteria. The validation assessment criteria have 4 aspects, namely the Material Extent Aspect, Material Update, Language Usage and Evaluation Questions. The results of the validation and assessment of the learning material experts for each aspect are presented in the following table.

Table 1. Assessment by material experts

No.	Aspect of Scoring	Expected Score	Evaluation Score	appropriateness
1.	Extent of Material	24	20	83,34%
2.	Update of Material	16	12	75,00%
3.	Use of Language	4	3	75%
4.	Evaluation Questions	8	7	87,5%

The next stage the researcher analyzes the overall results of the assessment by material experts.

$$\sum \frac{(\text{answer} \times \text{weights per choice})}{n} = 20$$

$$\text{Highest weight} = 4$$

Then the data above is calculated using the following formula:

$$\text{Percentage} = \frac{\sum(\text{answer} \times \text{weight of each choice})}{n \times \text{highest weight}} \times 100\%$$

$$\text{Percentage} = \frac{68}{20 \times 4} \times 100\%$$

$$\text{Percentage} = 85\%$$

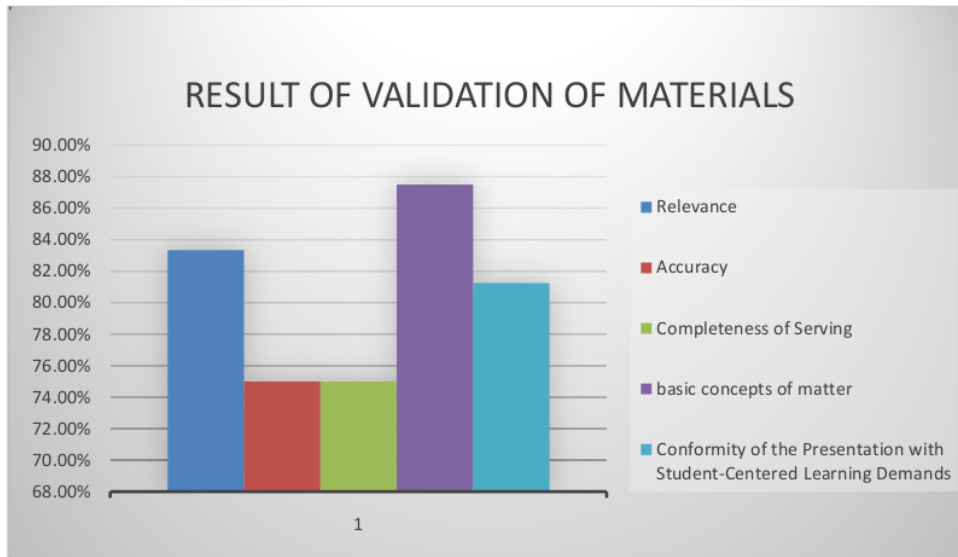


Figure 6. Result of validation of materials

From the above calculation, the percentage of eligibility for Educational Games based on Virtual Augmented Reality (VAR) of 85% by material experts. After being converted to a scale conversion table, the Virtual Augmented Reality (VAR) based Educational Game media is in the range of 81% - 100%. So placing the position on the criteria is very good.

Expert comments on learning materials (validation of expert assessment of materials) in general, namely the material presented is more adapted to daily life and adjusted the level of thinking of students. Comments and suggestions from learning material experts are taken into consideration for improving the design of educational game media based on Virtual Augmented Reality (AR), following up on comments and suggestions from the validator of learning material experts, it is necessary to make revisions to the educational game media based on Virtual Augmented Reality (VAR). The revision is to provide a contextual problem that is suitable with

the daily life of students because students need more challenging games.

#### b. Media Validation

Validation by media experts is done so that the media that will be tested is really feasible to be used in research. Development products evaluated by media experts Lecturer of Information Technology at Universitas PGRI Semarang, which is an Virtual Augmented Reality (VAR) based Game Education using a questionnaire that must be filled out by media experts.

The results of the validation and assessment by media experts for each aspect are presented in the following table.

Table 2. Result of Media Validation

No	Assessment Aspect	Expected Score	Evaluation Score	Feasibility
1.	General Display	24	20	83,34%

2.	Special Display	12	9	75,00%
3.	Media Presentation	16	14	87,50%

The next stage the researcher analyzes the overall results of the assessment by media experts.

$$\sum (\text{answer} \times \text{score each choice}) = 43$$

$$n = 13$$

$$\text{highest score} = 4$$

Then the data above is calculated using the following formula:

$$\text{Percentage} = \frac{\sum (\text{answer} \times \text{score each choice})}{n \times \text{highest score}} \times 100\%$$

$$\text{Percentage} = \frac{43}{13 \times 4} \times 100\%$$

$$\text{Percentage} = 82,69\%$$

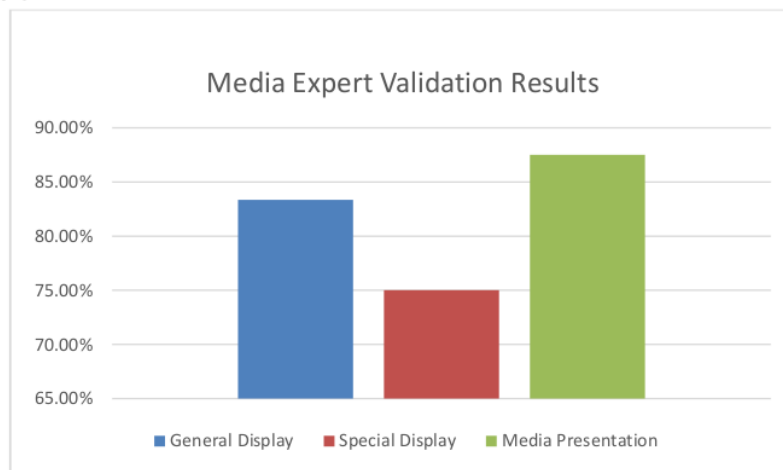


Figure 7. Result of Media Validation

From the above calculation, the percentage of eligibility for Virtual Augmented Reality (AR) based Game education is 82.69% by media experts. After being converted to a scale conversion table, Virtual Augmented Reality (VAR) based Game Education media is in the range of 81% - 100%. So placing the position on the criteria is very good.

c. effectiveness product

The effectiveness of the Geometry Educational Game based on Virtual Augmented Reality (VAR) media was tested using an experimental design namely the Post Test Only Control Design. In this design there are two groups, namely the experimental group and the control group. The experimental design was used to compare student achievement between the experimental group and the control group with the expectation that the

experimental group's performance was better than the control group.

To find out which learning is better, then use the t-test (right hand) by using the following formula.

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{s \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

While the results of the right-side t test indicate that it was obtained  $t_{obs} = 16.47$ . With the value  $\nu$  using the formula above obtained  $\nu = 58.54 \approx 59$  with

$\alpha = 5\%$ , obtained  $t_{(0.05;59)} = 2.001$ ,

where  $DK = \{t | t > 2.001\}$  and  $t_{obs} = 16.47 \in DK$ , so  $H_0$  rejected.



Based on the above calculation, because  $H_0$  is rejected, it can be concluded that the results of learning mathematics using the Virtual Augmented Reality (VAR) Geometry Educational Game media are better than conventional learning models. This proves there are differences in learning achievement because the lecturer uses two different treatments between the control class and the experimental class with the average value of the experimental class  $x_1 = 82,85$  and the average control class  $x_2 = 70,03$ . This result is confirmed by research Saputro, R. E., & Saputra, D. I. S. (2015). Which shows that the Development of Learning Media Recognizing Human Digestive Organs Using Augmented Reality Technology is able to make students more understanding of the material delivered by the teacher, then strengthened by Annetta, L. A. (2008). About Video games in education: Why they should be used and how they are being used. With the existence of game-based videos, it makes students more interested in learning.

#### V. CONCLUSION

The conclusions of this study are (1) Produced android-based learning media products using Virtual Augmented Reality (VAR) called game education based on virtual augmented reality in which discussing kindergarten material, (2) Development of Virtual Augmented Reality Based Game education Media is valid and suitable for use by students. This can be seen from the assessment of material experts, media experts, and student responses where the results are in very good criteria. (3) the results of learning mathematics using the Virtual Augmented Reality (VAR) Geometry Educational Game media are better than conventional learning models.

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