

# Math poster with augment reality to increase learning outcome of students' high school

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## ABSTRACT

Augmented Reality-based mathematics poster is one of the media for learning mathematics with the use of technology. The rapid development of technology requires education to innovate learning devices with technology, this learning media is made as a form of developing technology-based learning tools that are in accordance with educational needs. This study aims to determine the feasibility and effectiveness of mathematical posters on building materials using Augmented Reality (AR). The subjects of this study were students of Class X SMA. This type of research ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The results of this study show that the Mathematics Poster for Building Spaces with Augmented Reality is "Very Appropriate" with a value given by Design and Technology experts in the "Good" category with a feasibility presentation of 89% in the "Eligible" category. The results of the validation of mathematicians in the "Very Good" category and a feasibility presentation rate of 93% in the "Very Eligible" category. The results of the teacher assessment are in the "Very Good" category and the feasibility presentation rate is 94% with the "Very Eligible" category. And based on the results of the pretest and posttest, it was found that there was an increase in student learning outcomes in the material of building space.

**Keywords:** Augment Reality; Mathematics; Technology-Based Learning Media; Learning Outcome of Students

## 1. INTRODUCTION

The development of information and communication technology brings changes in various aspects of human life, including in the field of education (Idris, 2015: 175). In education, an educator influences students to be able to adapt to their environment, while educational goals are a set of educational outcomes achieved by students after holding educational activities, and through education students are directed and encouraged to achieve the goals they aspire to (Hamalik, 2012: 3). Budiman (2017: 64) found that technology can improve students' understanding in the learning process. This is supported by the emergence of various technological products that can be used as media and learning resources which are the right alternative for developing the implementation of the learning process (Idris, 2015: 175). Learning media is a tool that can help the learning process and serves to clarify the content conveyed so that it can achieve learning objectives better and more perfectly (Kustandi and Sutjipto, 2011: 8). Along with the development of technology, mobile phones have innovated into smart phones or commonly called smartphones.

Smartphone is one of the communication media that has advanced features in various ways and has effective and efficient functions to be used anytime and anywhere (Resti, 2015: 2). Utilization of smartphones can be used in various fields, one of which is the field of education, namely as a learning medium. Smartphone-based learning media has now been widely developed. According to Calimag, et al., (2014) stated that the use of mobile devices can benefit teachers and can increase student motivation and mobile devices can facilitate human interaction and access information resources anytime and anywhere. In his research, Sugiyanto, et al., (2018: 15) stated that learning using m-learning applications can help high school students, in learning students do not have to use books but students can study via smartphones to obtain learning materials anywhere and anytime. Along with the development of smartphone devices, new technology is also developing, namely Augmented Reality.

In recent years Augmented Reality (AR) technology has become an important field of research because this technology provides great opportunities in science and engineering because these sciences emphasize practical training (Nurcahyo, 2015: 193). Utilization of educational media using Augmented Reality can stimulate students' mindsets in critical thinking about existing problems and events, because the nature of educational media is to help the learning process with the presence or absence of educators in the educational process, so that the use and utilization of learning media can occur in wherever and whenever students want to carry out the learning process (Mustaqim, 2016: 174). Augmented Reality has been applied in mobile devices (Mahendra, 2016: 2). The development of smartphones and Augmented Reality technology has created many new applications to support learning. According to Wardani (2015: 402), there are still many teachers -

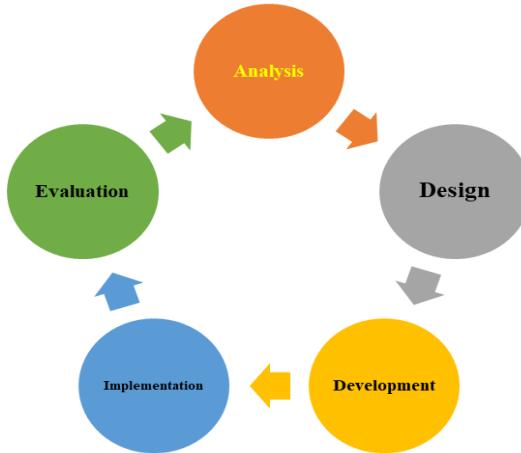
who have not changed and innovated by utilizing technology in learning, because teachers have difficulty making IT-based learning media. In line with the research of Nugroho, et al., (2015: 20), although technology continues to develop today, there are still many conventional forms of spatial learning where the school and teaching staff have difficulty procuring teaching aids for building learning media and at the high school level students. Various forms of spatial structure are introduced, but still in learning the teacher often encounters students who still do not understand the building material because this material requires students' imaginative abilities in imagining shapes, besides that many students are bored with the teacher's method of teaching. that is, the teacher only conveys the material without teaching aids.

Based on the observation report that has been carried out by researchers in November 2021 with Class X teachers at X SMA 12 Bandar Lampung regarding the learning process and learning media, it was found that there were problems in Class X students who had difficulties in understanding ge-ometrical material in mathematics, while for learning media in building materials in schools are still limited using books and media made of cardboard that are easily damaged in limited quantities and the available media are only cubes and blocks for other building media, and students cannot use these media to study at home. In the learning process, the teacher uses the blackboard to write the material and for-mulas and the students copy it on the notebook which makes students not play an active role in the learning process so that students cannot understand the material optimally. Learning in this way makes it easy for students to forget and less interested in the learning delivered by the teacher.

Augmented Reality technology is growing rapidly so that it can be applied in all fields including education, one of which is learning mathematics (Harrison, 2017). According to Izzanusika states that the Augmented Reality-based 3D spatial model which is used as a learning medium is able to create a new, more interactive atmosphere in mathematics learning which usually seems boring for high school students (Izzatunnisa, dkk, 2018; Abah, 2018). Based on this explanation, it is deemed necessary to make a learning media application for mathematics subjects in building materials for Class X SMA Negeri 12 Bandar Lampung by utilizing Augmented Reality technology in poster learning media with building materials, which are expected to be used as learning media to increase knowledge, students' understanding and interest in learning about the material of building space.

## 2. RESEARCH METHOD

This study is a type of Research and Development (R&D). Sugiyono (2017: 297) said "the research and development method or in English Research and Development is a research method used to produce certain products, and test the effectiveness of certain products" (Sugiyono, 2017). This study aims to develop learning media for mathematics posters with Augmented Reality in the material for building space for class X mathematics. The development research model used is the ADDIE development model. The selection of the ADDIE model in this study was based on a simple research model flow that was easy to apply by re-searchers. The stages and steps of the ADDIE development model include: 1) Analysis stage, 2) Design stage, 3) Development stage, 4) Implementation stage and 5) Evaluation. The subject of the research on the development of learning media with Augmented reality in this spatial structure learning is the students of Class X SMA 12 Bandar Lampung with 26 students, 14 male students and 15 female students. The research location for this development is at SMA Negeri 12 Bandar Lampung.



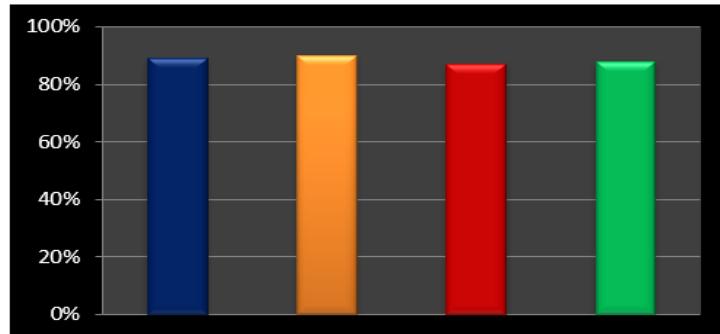
**Figure 1.** ADDIE research concept map

The instruments in this study are divided into Learning Out-comes Test (THB), Expert Validation Instruments, Interview Sheets, and Observation Sheets. The data analyzed in the development of this poster are poster feasibility analysis and student learning outcomes test analysis. To calculate the poster assessment with a questionnaire, it can be analyzed by determining the answer criteria from the validation instrument using a Likert Scale. Before analyzing student learning outcomes, the learning outcomes test instrument that will be used is tested to determine the validity and reliability of the questions to be used. And the reliability test using the Kuder Richardson formula.

### 3. RESULTS AND DISCUSSION

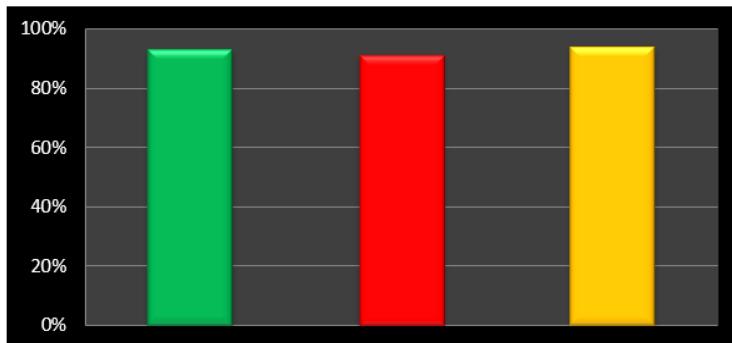
The learning media development process that is being developed uses the ADDIE development model which has five stages, namely, analysis, design, development, implementation, and evaluation. In this case, the trial phase was carried out online to Class X students because the research was carried out during the COVID-19 pandemic. The data analysis stage (Analysis) is the first stage to be carried out in this research. The analysis carried out by the first researcher is performance analysis and needs analysis. Performance analysis is carried out to find out and classify the problems that are being faced by schools during learning activities taking place in the classroom related to learning media. The second is a needs analysis, after finding the problems faced by students in Class X, namely regarding the understanding of building materials that are difficult for students to do, the researchers provide a solution, namely a learning media that is suitable for use in online learning today on building materials in the form of learning media Posters Mathematics with the help of Augmented Reality on the material of building space.

Design stage, after the data analysis stage is carried out, the next is the learning media design stage. The design stage begins by taking the type of media to be developed, the media to be developed is in the form of a Mathematics Poster with the help of Augmented Reality on the material of building space. At the design stage there are also several process stages to achieve a design that will be developed, namely, among others, the first stage is the process of collecting data and materials. The collection of data and materials includes pictures and building materials (cubes, blocks, triangular prisms, tubes, rectangular pyramids, cones, and spheres) which will be presented in learning media. The second stage is making a media design, in this stage of making a media design the researcher uses the Canva application. This Canva application is a tool for graphic design to make it easier for users to design or design a job, in the Canva application there are various templates available to design various types of creative designs such as invitation cards, posters, logos, wallpapers and so on. Then the researcher started the poster design according to the students' needs which was obtained through the analysis phase. The development stage this stage will carry out the development process of the design that has been prepared by the researcher, then realized in the form of a product that has been prepared previously and then made in the form of an embodiment of learning media. At the stage of media development there are several stages that researchers need to do. Such as conducting media validation to mathematicians and technology-based poster design experts (See [Figure 2](#)).



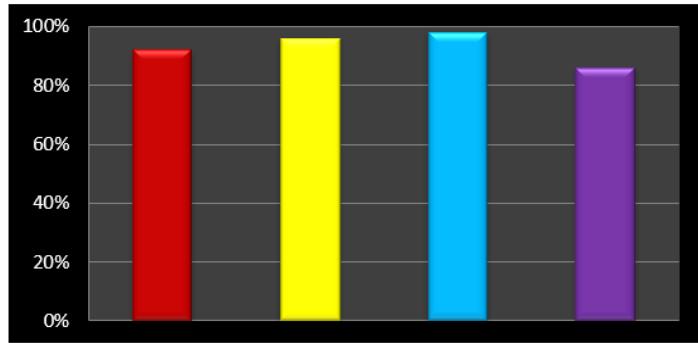
**Figure 2.** Diagram of Design Expert Validation Results

Based on the results of the feasibility assessment of the Mathematics Poster with the help of Augmented Reality on the building material by media display design experts based on the feasibility aspect, it can be categorized as feasible, with details of the display aspect with an average of 4.4 or 89% meet the appropriate criteria, the practicality aspect of use with an average of 4.5 or 90% meets the very feasible criteria, the color aspect with an average of 4.3 or 87% meets the appropriate criteria, and the technology utilization aspect with an average of 4.5 or 90% who meet the criteria are very feasible. So that the overall average result of the learning media design assessment is 4.35 or 88% which is included in the very feasible category. The results of material expert validation can be seen in the [Figure 3](#).



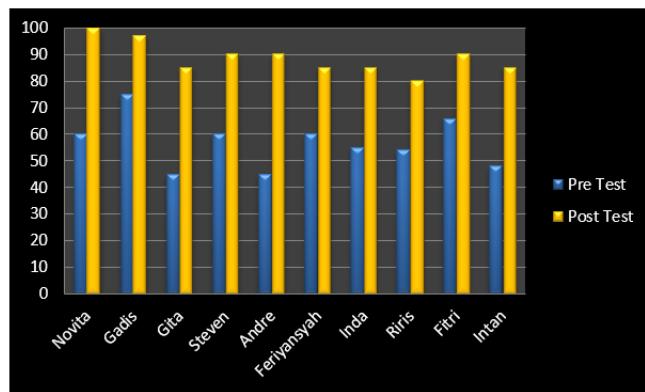
**Figure 3.** Diagram of the Validation Results of Mathematical Material Experts

Through the diagram above, it can be seen that the results of the feasibility assessment of the Mathematics Poster with the help of Augmented Reality on the spatial material by material experts based on the feasibility aspect can be categorized as very feasible, with details of the material or content aspects with an average of 4.6 or 93% meeting the very feasible criteria, the presentation component aspect with an average of 4.6 or 93% met the very decent criteria and the language aspect with an average of 4.5 or 91% met the very feasible criteria. The average number of material experts is 4.7 or 94% who meet the very feasible criteria. And this product has also been assessed by a Class X teacher SMA 12 Bandar Lampung here are the results of the teacher's assessment (See **Figure 4**).



**Figure 4.** Teacher Assessment Results

Diagram of the teacher's assessment results based on the content and appearance of this mathematics poster learning media can be categorized as very feasible, with details of material aspects with an average of 4.6 or 92% meeting the very decent criteria, the display aspect with an average of 4.8 or 96% meeting the very decent criteria, the presentation component aspect with an average of 4.9 or 98% meeting the very decent criteria, and the Language criteria with an average of 4.5 or 90% which meet the very decent criteria. So that the overall average result of the teacher's assessment of this learning media is 4.7 or 94% which is included in the very feasible category. Phase Implementation the validation and revision of the learning media in the form of a mathematics poster with augmented reality in X SMA 12 Bandar Lampung the researchers carried out a limited trial in Class X SMA 12 Bandar Lampung With the number of students 26 people. Stage Evaluation evaluation, stage is carried out after a limited trial, the evaluation stage aims to measure the level of effectiveness of LKPD development products based on Higher Order Thinking Skills (HOTS) in mathematics lessons assisted by Live Worksheets and student learning outcomes by comparing the results of post-test and pretest students on the fraction material.



**Figure 5.** Learning Outcome Evaluation Diagram

Diagram above shows that the average pre-test is 56.8 and the post-test average is 89. From this average, there is an increase in learning outcomes, namely the post-test better than the pretest. In the diagram, it can be seen that the difference in the learning outcomes of each student is increasing after carrying out learning using smart poster learning media on building materials using technology in the form of Augmented Reality (AR).

#### 4. CONCLUSION

Through this research and development, it can be seen that the learning media for mathematics posters on building materials in Class X with the Augmented Reality can improve student learning outcomes with a significant increase in the average student learning outcomes seen from the results of the pre-test and post-test to 26 Class X SMA 12 Bandar Lampung students. The average pre-test -test average post is 89. Furthermore, this media is said to be feasible by validators of material experts and media and technology design experts, as well as assessments from teachers. With validation results by Design and Technology experts in the "Good" category with a feasibility presentation of 89% in the "Eligible" category. The results of the validation of mathematicians in the "Very Good" category and a feasibility presentation rate of 93% in

the "Very Eligible" category. The results of the teacher assessment are in the "Very Good" category and the feasibility presentation rate is 94% with the "Very Eligible" category. So, it can be concluded that this learning media is very feasible and effective to improve student learning outcomes, especially in learning mathematics.

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## AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

## CONFLICT OF INTEREST

There are no conflicts of interest declared by the author.

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