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DEVELOPMENT OF SMART M3D MEDIA (SIMULATED MEDIA AUGMENTED REALITY TECHNOLOGY MATHEMATICS 3 DIMENSIONS) TO IMPROVE CREATIVE THINKING IN ELEMENTARY SCHOOLS

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Abstract. Creative thinking skills are essential for students because they can help them find innovative solutions in facing various challenges and problems that arise due to technological advances and their readiness in 21st century skills. This study aims to develop SMART M3D learning media to improve students' creative thinking skills in the fifth grade elementary school spatial structure material. The development model used is Lee & Owens. The validity test results show that the media meets the very valid category, with scores: media experts 90%, material experts 93%, and learning experts 94.6%. Thus, SMART M3D media is declared suitable for use in learning activities. This AR-based learning media is also considered very practical to use in the learning process. This is evidenced by the results of the teacher response questionnaire with a score of 98% and the student response questionnaire which obtained a score of 95%, both of which are included in the very practical category. Analysis of the results of the pre-test and post-test of creative thinking skills in the experimental class shows an increase in each indicator of creative thinking. The average pre-test score was 52.25 (quite creative category), increasing in the post-test to 69.25 (creative category).

Keywords: Creative Thinking, Augmented Reality, Learning Media

I. INTRODUCTION

In an era of increasingly rapid technological development, creative thinking skills are essential for every student. Creative thinking skills are essential for students because they can help them find innovative solutions to various challenges and problems arising from technological advances, and encourage them to think beyond conventional boundaries, which will increase their competitiveness and readiness for 21st-century skills. This is supported by research by Siswono (2016), which explains that creative thinking skills are important for students because they not only help students solve problems innovatively but also enable students to adapt to the challenges of changing times. In addition, creative thinking can also influence preparation to compete as superior human resources (Abidin et al., 2018). Thus, improving creative thinking skills is an important aspect of modern education that must be considered by educators and educational institutions. Teachers' efforts to face the challenges of changes in 21st-century skills include being able to design interactive learning that can encourage the development of students' creative thinking skills (Nugraha et al., 2023). Mathematics learning that encourages creative thinking skills must be supported by innovative media. Supporting components such as media, methods, and learning models must also be adapted. According to Lestari (2018), appropriately utilized learning media in the learning process will be more effective and efficient in achieving learning objectives. Therefore, a balance between creative thinking and the use of technology, such as media, is key to creating better learning in the future.

Based on the results of pre-research conducted at SDN 1 Kesatrian Malang, it was found that students' creative thinking skills are still very low. In mathematics learning, most students experience difficulties when asked to solve math problems that require open thinking, in-depth analysis, especially abstract material. Some students have difficulty understanding material that is only presented in the form of still or two-dimensional images because it is difficult to illustrate. This is due to a lack of interaction between students and teachers, less varied learning methods, low learning interest and a lack of media during learning. In addition, students are only able to solve problems if the form is exactly like the exercises that have been given without exploring other ways to solve the problem. This is reinforced by the results obtained after conducting trial activities with students of SDN Kesatrian 1 Malang, which showed that many students have difficulty in expressing new and innovative ideas.

Based on the problems identified by the researchers, media are needed to enhance creative thinking in learning. Media such as Augmented Reality (AR) supported by the Assemblr EDU application can be used to create interactive learning and stimulate students' creative thinking because this

media can apply learning methods that facilitate students in solving learning problems.

II. RESEARCH METHODS

This research falls under the category of research and development (R&D). It is classified as research and development because it aims to design and produce new, effective learning products or innovations that can enhance students' creative thinking skills in learning.

This research and development uses the Lee & Owens development model. The Lee & Owens development model is a development model for creating a learning prototype that uses multimedia. Lee & Owens (2000) stated that Lee & Owens' development research is a development model used in technology-based learning design. This research uses the Lee & Owens model because this model is one of the research and development models used in creating digital or technology-based learning media, such as those that researchers will develop using Augmented Reality technology.

The product developed in this research is an Augmented Reality learning media using the Assemblr EDU application. The target users of this learning media are fifth grade students of SDN Kesatrian 1 Malang. In the process of developing this product, the Lee & Owens development model is used which has systematic stages. The five stages proposed by Lee & Owens are (1) Analysis Stage which is divided into two, namely needs analysis and initial-final analysis, (2) Design Stage, (3) Development Stage, (4) Implementation Stage, (5) Evaluation Stage Lee & Owens (2000). These stages are described in the following diagram:

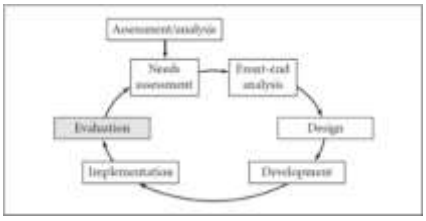

Figure 3. 1 Lee & Owen's Model of Development
Source: Lee & Owen (2004)

III.RESULT AND DISCUSSION

This research produces a product in the form of Augmented Reality-based learning media using the Assemblr Edu application to improve the creative thinking skills of class V SDN Kesatrian 1 Malang City.

1. Results of the Analysis Stage

In the analysis stage, researchers collect information that can be used in the development of Augmented Reality-based learning media. At this stage, researchers carry out several activities including needs analysis (need assessment and front-end analysis). In the needs analysis, researchers conducted interviews with mathematics teachers and observations at SDN Kesatrian 1 Malang to analyze the problems found in the mathematics learning process. Based on the results of observations and interviews with mathematics teachers in grade V of SDN Kesatrian 1 Malang, there are several problems that researchers identified, namely that in the learning process, digital learning media has not been utilized optimally. The ongoing learning process is still not able to improve creative thinking skills, because the learning carried out still tends to be teacher-centered or one-way. The following table shows the results of the needs analysis based on the researcher's findings through observations and interviews. Front-End Analysis activities consist of: (1) student analysis which aims to determine the background, characteristics, and skills of students, (2) technology analysis, namely identifying the availability of technological facilities, (3) situation analysis, namely identifying matters related to the learning environment, (4) analysis of questions and assignments, namely determining learning objectives, (5) problem analysis, namely aiming to identify and understand in depth the basic problems that need to be resolved, (6) objective analysis (7) media analysis, namely identifying the availability of existing media, (8) data analysis, namely identifying the availability of learning resources, (9) cost analysis

2. Design Stage Results

The next stage carried out by the researcher was designing the learning media. This stage aims to create a general plan of the content contained in the learning media in the form of a storyboard and a design of learning activities. This plan analyzes Learning Outcomes then creates indicators and learning objectives. After carrying out the process of compiling learning objectives, then planning learning strategies and models for fifth grade students of SDN Kesatrian 1 Malang. The learning used is that students can directly operate augmented reality-based learning media. The selection of learning activities is adjusted to the characteristics of students and the provisions of learning outcomes that lead to improving students' creative thinking skills.

3. Results of the Development Phase (Develop)

The development of SMART M3D learning media products based on Augmented Reality uses the Assemblr Edu application to create QR barcodes that will be scanned by students to display 3-dimensional images of geometric shapes, the Canva application for background design and writing on materials formed such as books and question cards so that in its use it has practical value that utilizes technology in independent learning activities. This learning media contains a cover page, application usage instructions, learning materials, and there are question cards based on indicators of creative thinking skills. After the product is made with the Assemblr Edu application, the product is validated by a validator and reviews and improvements are carried out. Validation is carried out with material experts, media experts, and learning experts.

The following is a summary table of validation data from the expert:

No.	Validator	Score(%)	Category
1	Material Validation	93%	Very Valid
2	Media Validation	90%	Very Valid
3	Learning Validation	94,6%	Very Valid
Rate-rate		***92,5%***	***Very Valid***

The table above shows the validation results for the material validation with a score of 93%, categorized as very

valid, the media validation with a score of 90%, and the learning validation with a score of 94.6%, categorized as very valid. The overall average validation result was 92.5%, categorized as very valid and suitable for field trials.

4. Results of the Implementation Phase

After the product development process is complete, the next step is to conduct a trial on fifth-grade students and conduct a practical test on teachers and fifth-grade students. At this implementation stage, learning activities are carried out according to the previously designed learning module. The purpose of this trial is to obtain data on responses and assess the level of product effectiveness. At this stage, researchers provide an explanation to students about how to use Augmented Reality-based learning media, then students are given tasks in the form of solving problems with creative thinking indicators.

After the learning activities using Augmented Reality-based media were completed, the researchers distributed questionnaires to assess the practicality of the media. The practicality data in this study were obtained from the results of the questionnaire data for the fifth-grade teachers of SDN Kesatrian 1, Malang City, small group tests, and large group tests. Based on the determination of the questionnaire criteria for the practicality of the learning media filled out by the teacher, the value obtained was calculated, obtaining a practicality percentage of 98%. It can be concluded that the SMART M3D learning media is included in the very practical category. Based on the determination of the questionnaire criteria for the practicality of the learning media filled out by the students, the value obtained is a practicality percentage of 95%. It can be concluded that the SMART M3D learning media is included in the very practical category.

5. Evaluation Phase Results

The SMART M3D learning media, which had gone through the trial phase, was then evaluated by researchers. At this stage, researchers conducted two types of evaluations: formative and summative. Formative evaluation aimed to examine the effectiveness of the learning media in improving students' creative thinking skills in the spatial geometry topic. Meanwhile, summative evaluation could not be conducted because the scope of the material used in this study was still limited to that topic.

1. Learning Media Feasibility Study

The developed learning media then undergoes a validation process by competent experts. The validation stage plays a crucial role in development research, as explained (Mufidah & Putra, 2021), where validation testing aims to produce a valid and usable product. Validation also aims to identify any remaining deficiencies in the product so that the final product meets the standards of suitability for use by students. The validation process for this learning media encompasses three aspects: material validation, media validation, and learning validation..

The results of the validation test conducted by the material expert showed a percentage score of 93%, which is included in the very valid or very feasible category. Based on the validator's assessment, the content of the material presented is in accordance with the learning needs of students, the media can be used for independent learning activities, the indicators for each material are more operationalized and the material is easy to understand by students. Based on these results, the developed SMART M3D learning media is declared very feasible to use. This shows that the assessment aspects, such as the suitability of the material and the harmony of the material have met the feasibility criteria according to the assessment of the material validator. The results of the media validation test conducted showed a percentage score of 90%, which is included in the very feasible category. Based on the assessment of the validator, this learning media product is suitable for use in learning. Based on the assessment indicators that have been given through the questionnaire, the media display is considered interesting, because it combines various learning content, such as text, 3-dimensional images so that not only makes students see abstract material through 2 dimensions but can see with 3-dimensional images that seem real. The media validation sheet shows that the media assessment aspects have met the feasibility criteria and the media can be tested on a large scale. The results of the learning validation test using the creative thinking indicator showed a score of 94.6%, categorized as very feasible. The results indicate that the learning media developed using the creative thinking indicator has met the criteria, making it a learning medium for stimulating creative thinking skills worthy of being tested.

Thus, the developed media product can be used in the learning process. Based on the results of material validation, media validation, and learning validation, the validity was achieved with an overall average final score of 92.5%, categorized as very feasible or very valid.

2. Study on the Practicality of Learning Media

The practicality test of the SMART M3D learning media was conducted by teachers as learning practitioners and fifth-grade students at SDN Kesatrian 1 Malang. The purpose of this practicality test was to determine the level of ease of use of the media in the learning process. Learning media is said to be of quality if it meets three main criteria: feasible, practical, and effective. Learning media can be said to be practical based on respondents' responses, which can be seen from the results of the teacher and student assessment questionnaire regarding the ease of use of the media in the learning process. The practicality test was conducted by mathematics teachers and 20 students who were the subjects of the research at SDN Kesatrian 1 Malang. The assessment of the media's practicality was carried out by filling out a questionnaire that covered several aspects, such as ease of use, attractiveness of the media display, and clarity of the media product presentation. The practicality test conducted by the teacher learning practitioners obtained a score of 98%, categorized as very feasible. Thus, the media product that has been developed can facilitate teachers in learning activities.

Based on student assessments during the field trial, the SMART M3D learning media obtained a total score of 1137, with a percentage of 95%, which is classified as very practical. This indicates that the developed learning media is appropriate to student needs and easy to operate. According to (Hafidz & Masriyah, 2020) in their research, a developed product is said to be practical if learning practitioners say the developed product can be used and the level of product implementation is included in the good category. From this statement, the practicality of a learning media can be

determined through the results of respondents' assessments. Media is said to be practical if, when applied in the learning process, its use is easy to understand and use by both teachers and students. The practicality of using this media will influence students' willingness to learn. This is in line with the statement (Fitra & Maksum, 2021) that learning media that is attractive both in terms of material and ease of use can increase students' interest in learning the content presented therein.

3. Study of the Effectiveness of Learning Media

The use of SMART M3D learning media has been proven to help students understand the material presented. Its implementation during the learning process also contributes to improving students' creative thinking skills. Furthermore, this learning media provides a more engaging and enjoyable learning experience for students, making it easier to understand.

This study aims to see the effectiveness of learning media on creative thinking skills by providing a pre-test (before being given treatment) and post-test (after being given treatment) to students in the experimental class. The pre-test results in the control class obtained a score of 51.25% and the post-test of the control class obtained an average of 55%. While the pre-test results in the experimental class obtained an average of 52.25% and the post-test in the experimental class obtained an average result of 69.25% with a creative category. Although the control class also showed an increase in creative thinking, the increase in results in the experimental class appeared more significant and fell into the creative category. Based on the testing criteria of the paired sample t test p and the results of the analysis using SPSS obtained a significant value of <0.001 which means significant <0.05. This shows that there is a significant difference in creative thinking skills before and after using SMART M3D learning media based on Augmented Reality. Judging from the N-Gain test on the pre-test and post-test, the creative thinking of the control class obtained a score of 20.36%, which can be interpreted that the effectiveness of learning in the control class using only conventional learning is still in the low category. The results in the experimental class showed a score of 65.88, which can be interpreted that the effectiveness of learning using SMART M3D media is quite effective in learning. Figure 4.5 shows the differences obtained by students, which are assessed through several aspects used. The aspects used are fluency, flexibility, originality, and elaboration. The increase in creative thinking skills in each aspect in the experimental class was also significantly greater than in the control class.

Based on the analysis in Figure 4.5, the percentage of creative thinking was obtained that in the pre-test each indicator in the experimental class was 52.25 with a fairly creative category, while the post-test each indicator had an average value of 69.25 with a creative category. From these two results, it can be said that the results of the pre-test and post-test of students' creative thinking experienced an increase in creative thinking abilities after using the SMART M3D learning media. These results are also in line with the results of research (Wulandari et al., 2020) that when students interact with digital learning media, they can immediately see the results of their actions or decisions, which can trigger creative thinking.

IV. CONCLUSIONS

Based on the results of research on the development of Augmented Reality-based learning media products for spatial geometry material for fifth grade students at SDN Kesatrian 1 Malang, the conclusions of the research results are as follows: This research produced a learning media called SMART M3D, adapted to the material, namely spatial geometry. This media was designed for use by fifth-grade students at SDN Kesatrian 1 Malang. Product development was carried out using the Lee & Owens model, which includes five stages, namely the analysis stage (needs analysis and initial-final analysis), the design stage, the development stage, the implementation stage, and the evaluation stage. The results of the learning media validity test that had been assessed by the media expert validator obtained a score of 90%, the results of the material validity test conducted by the material expert obtained a score of 93%, and the results of the learning validity test obtained a score of 94.6%. The validation results of the SMART M3D learning media obtained were categorized as very valid and suitable for use during learning.. This Augmented Reality-based learning media is declared very practical for use in the learning process. This is reinforced by the teacher response questionnaire score, which scored 98%, categorized as very practical, and the overall student response questionnaire score, which scored 95%, categorized as very practical for use in learning. The results of the study showed a difference in effectiveness between the two classes tested. The experimental class that utilized SMART M3D media in the learning process obtained an average effectiveness score of 65.88%, thus categorized as “quite effective.” However, the control class that utilized conventional learning only achieved an average score of 20.36, which was categorized as “less effective.” Thus, the comparison of these average scores indicates that the application of SMART M3D learning media is proven to be more effective than conventional learning alone in improving creative thinking skills. Based on the results of the creative thinking analysis, the percentage of creative thinking for each indicator of creative thinking ability (fluency, flexibility, originality, elaboration) was obtained that in the pre-test in the experimental class it was 52.25 with a fairly creative category, while the post-test with an average value of 69.25 with a creative category. From these two results, it can be said that the results of the pre-test and post-test of students' creative thinking experienced an increase in creative thinking abilities after using SMART M3D learning media.

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