Developing Transformation Geometry Learning Media Integrated with The Architecture of Menara Kudus Mosque through an Articulate Storyline

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Abstract

The objectives of this research are: 1) developing transformation geometry learning media integrated with the architecture of menara Kudus mosque through articulate storyline; 2) knowing the feasibility of transformation geometry learning media integrated with the architecture of menara kudus mosque through articulate storyline. The research method used is the Research and Development (R & D) method with the ADDIE model stands for Analysis, Design, Development, Implementation, Evaluation (evaluation/feedback). The results of this study were obtained, including: 1) the process of developing this learning media utilize several stages: a) analysis, conducting analysis of the mathematical lesson plan (in Indonesia called Rencana Pembelajaran Semester/ RPS), student needs, and characteristics; b) designing, planning mathematical topics structure, making flowcharts, preparing and evaluating mathematical topics, preparing a grid of media feasibility assessment instruments, media selection, media display planning stages; c) development, making applications in accordance with flowchat, media display plans and feasibility assessments to expert of learning media and mathematical content; d) implementation, conducting feasibility assessments to users (students). e) evaluation, revising the results of user assessment. 2) the results of the feasibility assessment of learning applications by expert of mathematical content obtained a percentage of 83% with eligibility criteria. The results of the assessment by expert of learning media were obtained 79.5% with feasible criteria. The results of the assessment by users (students) in the small group obtained 79.2% in the feasible category and in the large group obtained 76.83% in the feasible category.

Keywords: Articulate Storyline; Learning Media; Mathematics Education; The Architecture of Menara Kudus Mosque; Transformation Geometry

Abstrak

Tujuan dilakukannya penelitian ini yaitu: 1) mengembangkan aplikasi pembelajaran geometri transformasi terintegrasi arsitektur Masjid Menara Kudus berbantuan *articulate storyline* bagi mahasiswa tadris matematika; 2) mengetahui kelayakan

aplikasi pembelajaran gemetri transformasi terintegrasi arsitektur Masjid Menara Kudus berbantuan *articulate storyline* bagi mahasiswa tadris matematika. Metode penelitian yang digunakan yaitu metode *Research and Development* (R&D) dengan model ADDIE singkatan dari *Analysis* (analisis), *Design* (desain/perancangan), *Development* (pengembangan), *Implementation* (implementasi/eksekusi), *Evaluation* (evaluasi/umpan balik). Diperoleh hasil penelitian dan pengembangan yaitu: 1) proses pengembangan aplikasi pembelajaran geometri transformasi terintegrasi arsitektur Masjid Menara Kudus berbantuan *articulate storyline* dikembangkan dengan tahapan: a) analisis, melakukan analisis mencakup pemahaman materi, RPS, kebutuhan dan karakteristik mahasiswa; b) perancangan, melakukan perencanaan struktur materi, pembuatan *flowchart*, penyusunan dan evaluasi materi, penyusunan kisi-kisi instrumen penilaian kelayakan media, pemilihan media, tahap perencanaan tampilan media; c) pengembangan, membuat aplikasi sesuai dengan flowchat, rencana tampilan media dan penilaian kelayakan kepada ahli media, materi; d) implementasi, melakukan penilaian kelayakan kepada *user* (mahasiswa). e) evaluasi, melakukan revisi dari hasil penilaian *user.* 2) hasil penilaian kelayakan aplikasi pembelajaran oleh ahli materi diperoleh persentase sebesar 83% dengan kriteria layak. Hasil penilaian oleh ahli media diperoleh 79,5% dengan kriteria layak. Hasil penilaian oleh *user* (mahasiswa) pada kelompok kecil diperoleh 79,2% dengan kategori layak dan pada kelompok besar didapatkan 76,83% dalam kategori layak.

Kata Kunci: Arsitektur Masjid Menara Kudus; *Articulate Storyline*; Media Pembelajaran; Pendidikan Matematika; Transformasi Geometri;

Introduction

Transformation geometry is an important topic in mathematics learning that requires a deep understanding. Geogebra software applications in transformation geometry learning have succeeded in increasing students' understanding (Khafid, Suyitno, and Prabawanto, 2019). However, none research in learning media that integrate transformation geometry with mosque architecture.

The development of transformation geometry learning media also fits with a constructivist learning approach that focuses on student experience. The use of teaching materials based on the experience of prospective teacher students can improve understanding of concepts (Ristianto, 2018). By integrating the architecture of the Menara Kudus Mosque which is abundant in history and aesthetics as part of learning, it is expected to motivate and inspire mathematics education students in understanding the concepts of transformation geometry.

The application of constructivist learning approaches can also be improved by utilizing Indonesian local wisdom. Integrating local wisdom in transformation geometry learning can give meaningful learning experience to students relate mathematical concepts to their culture (Fauzan et al., 2021). Through learning

media that are integrated with the architecture of Menara Kudus Mosque, expectanly the students understanding the relevance of mathematical concepts to Indonesian culture.

In developing learning media, Articulate Storyline Software is considered an effective tool. The use of GeoGebra in teaching transformation geometry has improved students' understanding (Rudianto and Anggriani, 2017). Similarly, motion graphic-based learning media can increase students' interest and understanding in transformation geometry (Ardi & Rachmawati, 2020). Therefore, the use of Articulate Storyline in developing transformation geometry learning media has the potential to be the right choice.

Not only providing benefits to mathematics education students, the development of this learning application can also contribute to public understanding of the architecture of Menara Kudus Mosque. Through interactive and interesting media, transformation geometry learning can be presented in a more interesting and relevant way for students (Fauzan et al., 2021). Consequently, this research has the potential to have a positive impact on understanding and appreciation of the beauty of mosque architecture which has high historical value.

In addition, the development of multimedia transformation geometry can also support distance learning which is increasingly popular in this digital era. By utilizing an online platform, the multimedia developed can be accessed by Mathematics Education students from various locations, reducing geographical limitations in learning. This inclusive learning approach is important to accommodate student diversity and increase accessibility to learning materials (Khafid et al., 2019).

Expectanly, this study can be a reference and inspiration for the development of multimedia learning geometry transformation with other local Indonesian cultural contexts. Utilizing the uniqueness and architectural robust of Indonesia's historical buildings as part of mathematics learning will provide added value to education and enrich students' understanding of traditional architectural works. This is in line with efforts to maintain and introduce local wisdom to the younger generation (Fauzan et al., 2021).

Several previous studies have examined the use of multimedia and technology in the context of mathematics learning. For example, the use of interactive multimedia can improve the understanding of mathematical concepts (Yaghoub Mousavi et al., 1995). Another opinion says that multimedia learning can improve academic achievement and understanding of physics concepts (Hake, 1998).

However, in more specialized studies related to transformation geometry, there are some gaps in the literature. Thus far, there have not been many studies that specifically integrate transformation geometry with the architecture of the Menara Kudus Mosque in the form of interactive multimedia learning media, especially as learning aids for Mathematics Education students. This research will be a new contribution in filling the research gap related to the use of Indonesian cultural architecture as a context for learning transformation geometry.

In addition, although there have been several studies discussing the use of software such as GeoGebra and Articulate Storyline in mathematics learning, it does not explore deeper the learning media about transformation geometry integrated with the architecture of the Menara Kudus Mosque. This research will filliing the gap by developing learning applications specific to the topic and applying constructivistic learning approaches and integrating Indonesian local wisdom.

In addition, previous research that has focused more on the use of learning technology in a mathematical context may not have considered many local cultural and architectural contexts as part of teaching. Seeing the architectural potential of the Menara Kudus Mosque as a medium for learning transformation geometry provides an opportunity to integrate the Indonesian cultural and historical resources in the mathematics learning.

By filling this research gap, it is hoped that the results of this research can provide practical guidance for the development of transformation geometry learning media that can be easily adopted by mathematics educators, especially for prospective mathematics teachers. In addition, this research also expected to provide wider benefits in enriching the way mathematics is learned by integrating Indonesian local wisdom and motivating students to learn through their own cultural context. This prompted researchers to conduct development research entitled "*Developing Transformation Geometry Learning Media Integrated with The Architecture of Menara Kudus Mosque through an Articulate Storyline*". The objectives of the research are: 1) developing an integrated transformation geometry learning application for the architecture of the Menara Kudus Mosque assisted by articulate storyline for mathematics education students; 2) knowing the feasibility of learning applications transformation geometry integrated architecture of the Menara Kudus Mosque assisted articulate storyline for mathematics education students.

Method

The research method used is the Research and Development (R & D) method with the ADDIE model stands for Analysis, Design, Development, Implementation, Evaluation (Zulfikri et al., 2024).
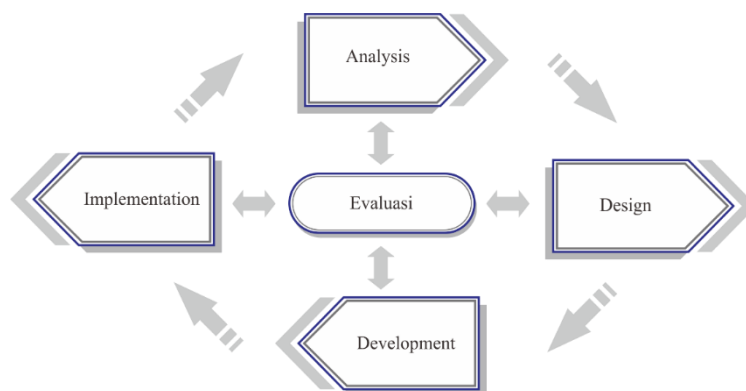

Figure 1. ADDIE Model R&D Steps

The design of this media is still conceptual and will support the development process in the next step. The ADDIE model development stage contains the realization of learning media activities that have been previously designed into products that are ready to be implemented. This step consists of two stages, that is the creation of learning media and the assessment of media experts and material experts. The multimedia, assessed by experts and deemed suitable for use, is implemented in the learning process at the Mathematics Education Department at Institut Agama Islam Negeri Kudus (IAIN Kudus). Students use the learning applications geometry transformation integrated architecture of the Menara Kudus Mosque in their learning. The researcher collects feedback from the students to identify the strengths and weaknesses of this multimedia. Evaluation or feedback is the final step in implementing the ADDIE model. The improvement of learning applications geometry transformation integrated architecture of the Menara Kudus Mosque was carried out based on student responses at the time of implementation. The essence of this evaluation is to ensure that the learning applications geometry transformation integrated architecture of the Menara Kudus Mosque developed falls into a relatively perfect category when used in actual learning situations.

Researchers analyzed the data with two techniques, That is qualitative descriptive data analysis and percentage descriptive data analysis. The qualitative descriptive data analysis that researchers use involves the process of collecting, deciphering, and interpreting data. Whereas percentage descriptive data analysis involves converting numerical data to percentage-based descriptive data.

The qualitative data obtained will be analyzed through the stages of preparation, data reduction and conclusions. This qualitative data is used as a basis for evaluating and assessing the feasibility of the developed product. On the other hand, quantitative data that has been collected by researchers will be analyzed using Likert scale. The use of Likert Scale aims to measure the attitudes, opinions, and perceptions of individuals or groups towards a particular phenomenon.

Calculate the score of each aspect of the assessment from experts and respondents to determine the level of feasibility of learning media. Researchers use the percentage formula as follows (Auliya, 2018:1):

$$P = \frac{S}{S_m} \times 100\%$$

Information:

P = Media qualification level %

S = Total number of scores obtained

S_m = Maximum total score count

After calculations using the formula above, the eligibility criteria for learning media are obtained as contained in Table 3.7 below:

Table 1 Learning Media Eligibility Criteria

No.	Percentage Range	Category
1.	$P > 84\%$	Very Feasible
2.	$68\% < P \leq 84\%$	Feasible
3.	$52\% < P \leq 68\%$	Pretty Feasible
4.	$36\% < P \leq 52\%$	Less Feasible
5.	$20\% < P \leq 36\%$	Very Less Feasible
6.	$P \leq 20\%$	Not Feasible

Results

The results of research and development were obtained, namely the process of developing an integrated transformation geometry The results of research and development were obtained, namely the process of developing an integrated transformation geometry learning application for the architecture of the Menara Kudus Mosque assisted by articulate storyline developed Research and Development (R &D) methods with the ADDIE model. The first stage is analysis. At this stage, researchers found that students still had difficulty understanding transformation geometry topic. One of the reasons is the lack of references. Students

also objected to references to books sold in the market because they were expensive. Even if there is a reference to the transformation geometry book, it is not in accordance with the semester lecture plan, the needs, and characteristics of students. In the design stage, researchers plan material structure, make flowcharts, prepare and evaluate materials, prepare a grid of media feasibility assessment instruments, selecting media, planning stage of media display. At the development stage, the researcher makes the application according to the flowchat, media display plan and feasibility assessment to media experts, material. The material offered is about translation, reflection, rotation, dilation. The material displayed is in the form of theorems and concepts in the Menara Kudus Mosque. The flowchart can be seen in Figure 2.
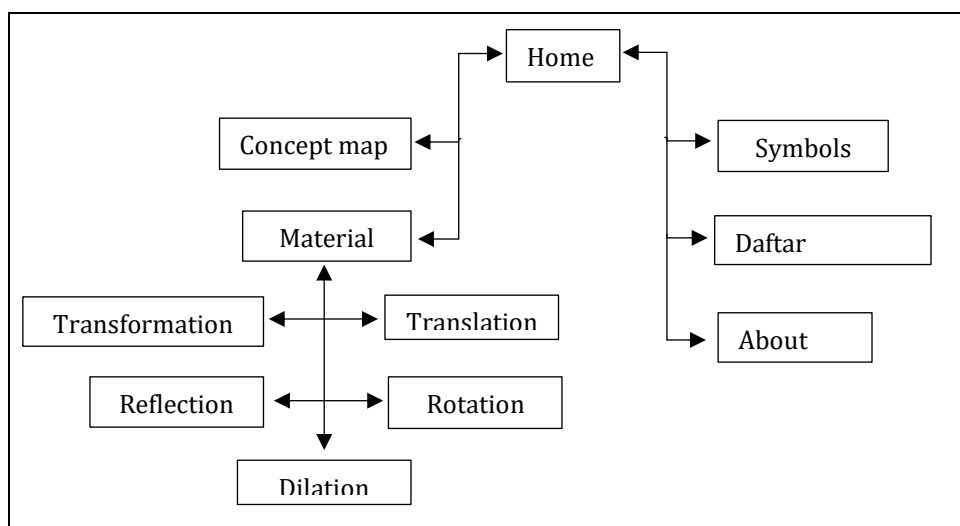

Figure 2. Flowchart Media

At this stage of development, researchers began to create mathematics learning media based on the ethnomathematics of Menara Kudus in accordance with flowchat and media display plans. At this stage also the researcher must choose the color, image, type and size of the letters, and the content of the consten so that the resulting media can attract users. Here are some views of the transformation geometry learning application that integrates the architecture of the Menara Kudus Mosque.
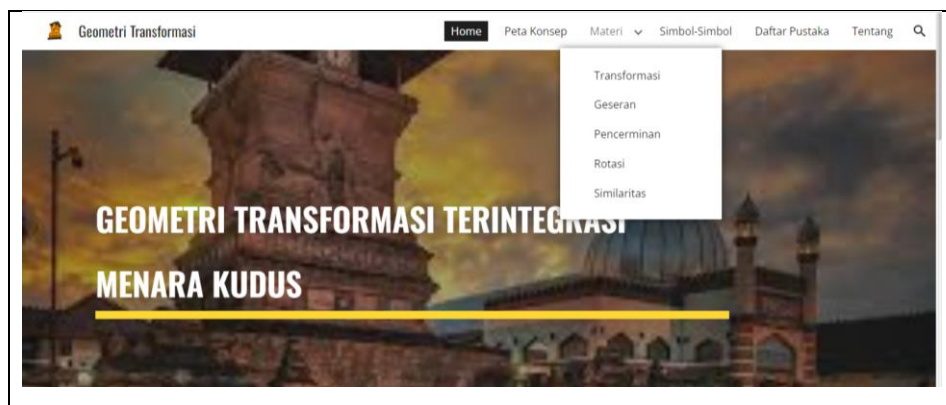
Figure 3. Display of Home
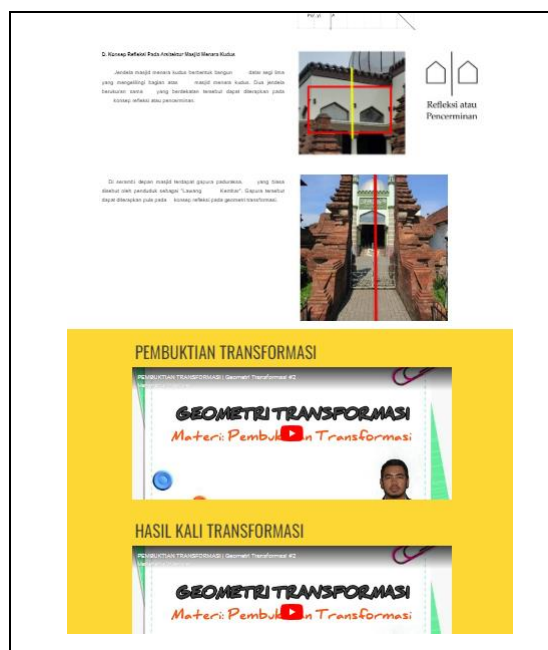

Figure 4. Material Menu Options
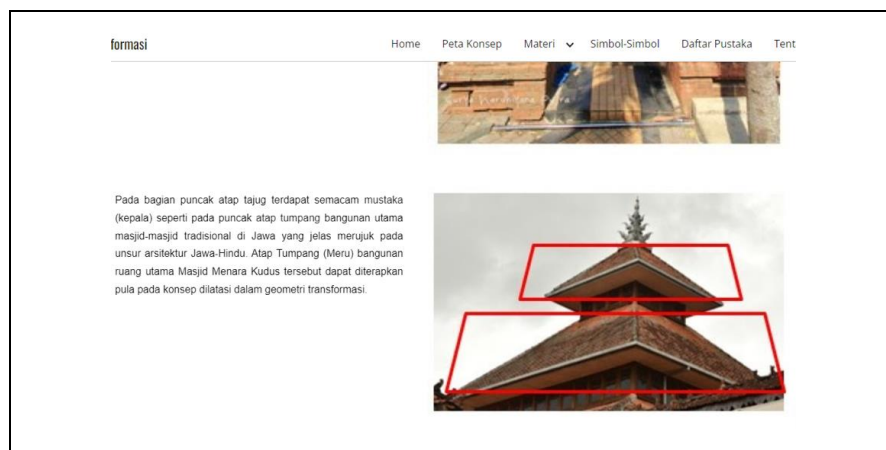
Figure 5. Mirroring Material Display

Figure 6. Display of Dilated Material

The results of expert testing by ahi material can be seen in the Table 2 below.

Table 2. Matery Member Qualification Test Results

Aspects	Validator		Total Score	Percentage	Criterion
	1	2			
Completeness of Material	42	36	78	78%	Feasible
Material Accuracy	44	44	88	88%	Very Feasible
Total	82	80	166	83%	Feasible

Based on Table 2. it can be seen that the learning application of transformation geometry integrated architecture of the Menara Kudus Mosque assisted by articulate storyline from material experts is said to be "feasible" with a total score of 166 and a percentage of 83% score.

Here are the results of the media member's qualification test:

Table 3. Media Member Qualification Test Results

Aspects	Validator		Total Score	Percentage	Criterion
	1	2			
Media Display	35	39	74	74%	Feasible
Progamation	42	43	85	85%	Feasible
Total	77	82	159	79,5%	Feasible

Based on Table 3. It can be seen that the learning application of Transformation geometry integrated architecture of the Menara Kudus Mosque assisted by articulate storyline from media experts is said to be "feasible" with a total score of 159 and a percentage of scores of 79.5%.

Furthermore, at the Implementation stage, researchers conduct feasibility assessments for users (students). Small group trials were conducted on 5 students of mathematics education department IAIN Kudus. The step passed is that students use research products, namely the transformation geometry learning application integrated with the architecture of the Menara Kudus Mosque assisted by articulate storyline and then students need to fill out the respondent questionnaire distributed. The results of small group trials can be observed in Table 4.

Table 4. Results of Respondent Questionnaire Media Trial in Small Group

Aspects	Total Score	Score Maximum	Percentage	Criterion
Facilities	98	125	78,4%	Feasible
Understanding	69	75	92%	Very Feasible
Motivation	59	75	81,9%	Feasible
Benefits	120	150	80%	Feasible
Highlights	50	75	66,7%	Well Feasible
Total	396	500	79,20%	Feasible

Based on Table 4. The information obtained was related to the results of student assessments in small group trials, namely getting the "feasible" criteria with a total score of 396 out of a maximum score of 500 with a percentage of 79.2%. After being tested on the silhouette group and no problems were found, the respondent questionnaire was then given to a large group. The results of the large group trial are in Table 5.

Table 5. Results of Respondent Questionnaire Media Trials in Large Groups

Aspects	Total Score	Score Maximum	Percentage	Criterion
Facilities	590	750	78,7%	Feasible
Understanding	365	450	81,1%	Feasible
Motivation	324	450	72%	Feasible
Benefits	711	900	79%	Feasible
Highlights	315	450	70%	Feasible
Total	2305	3000	76,83%	Feasible

Based on Table 5. In a large group trial with 30 student respondents, the "feasible" criterion was obtained in every aspect of the respondent questionnaire. Thus, the overall achievement in the respondent questionnaire also received the "feasible" criteria with a total score of 2305 and a percentage score of 76.83%.

Based on these scores, it can be said that the learning application of transformation geometry integrated mosque architecture Menara Kudus assisted by articulate storyline is feasible and received a good response from students. With explanations, they showed a sense of pleasure and enthusiasm during the trial process, it was shown by those who actively explored the content presented through the developed learning media. While using learning media, students try to achieve a deep understanding of the mathematical material presented.

In the last stage, namely the evaluation stage, the results of various evaluations of each stage reveal that students need innovation and renewal of learning media in the learning process, for that researchers have developed mathematics learning media based on the ethnomathematics of Menara Kudus. The development of ethnomathematics-based mathematics learning media Menara Kudus that was developed was declared feasible to be applied in learning.

Discussion

This study intends to provide information on how the development process, as well as the feasibility results of the products produced by researchers, that is the application of learning transformation geometry integrated mosque architecture Menara Kudus assisted by articulate storyline. The interactive multimedia research and development process is carried out by researchers with the ADDIE model. The development of ADDIE has 5 stages, that is: analysis, design, development, implementation and evaluation. In the initial stage, namely the analysis stage,

several activities are carried out, including initial final analysis, student needs analysis, task analysis, concept analysis, and specification of specific instructional objectives. Research activities and data collection are carried out at mathematics education department of IAIN Kudus. At the design stage, several activities are carried out including media selection, format, and making the initial design of interactive multimedia products to be developed.

After obtaining the results of the initial design, the next step is the development stage (develop). At this stage of product development, feasibility tests of learning media developed by one expert of mathematical content and one expert of learning media, were carried out and revisions were carried out before trials were carried out on students as users to obtain input and responses directly (Winarni, 2018). The integrated transformation geometry learning application of mosque architecture Menara Kudus assisted by articulate storyline for mathematics tadris students received feasibility testing results by experts with a percentage of feasibility from material experts of 83% with feasible criteria, and from media experts of 79.5% with feasible criteria also. A good percentage of ratings by both expert groups indicates that this media meets the standards of eligibility for use. Furthermore, the media trial was carried out in two stages, namely a trial in a small group with 5 students and a large group trial with 30 students using a respondent questionnaire sheet, which obtained the eligibility percentage results of 79.2% and 76.83%, respectively, with both included in the feasible criteria. If the feasibility test score obtained exceeds 60%, the product is successfully declared feasible so that it can be declared valid and can be tested (Putri et al., 2021).

The results of this research are in line with the results of research that has been carried out by several previous researchers, including entitled "Development of Mathematics Learning Media Based on Articulate Storyline on Class VIII Flat Side Space Building Material", which has the same as developing learning media using Articulate Storyline as a medium to improve students' understanding of mathematical concepts (Komariah et al., 2022). Furthermore, the results of this study try to answer the shortcomings of the previous research by integrating the material with the ethnomathematics of the architecture of the mosque Menara Kudus so that students can understand and construct mathematical concepts through culture which contains mathematical elements.

Based on research that has been done, the product from the development of this learning application has a number of advantages, including: 1) Able to present transformation geometry learning material by displaying videos about the material studied so as to make it easier for students to understand the lesson; 2) Have a good visual design and look attractive; 3) Have been equipped with interactive evaluation

questions to measure the level of student understanding independently; and 4) Media is easy to use both with PC or Android phones because it is an HTML5-based application so that it can be opened via cellphone or PC. This learning application also has shortcomings that still need to be revised. The drawback of this development product is that there is no database system to store data that has been entered by users into the application.

This learning media content includes structured material text, illustrative images that help visualize concepts, and animation as a visualization of the subject matter of transformation geometry material. The content is used to help students' understanding in learning, according to the results at the analysis stage. This is in line with research that has been conducted that the average mastery of students' concepts by using interactive multimedia in learning is higher than learning that does not use interactive multimedia (Gunawan et al., 2016). Multimedia referred to by Gunawan, et al is multimedia whose components include text, images, animation, video, and audio used as learning aids in the classroom by teachers and students.

The creation of the transformation geometry learning application product integrated with the architecture of Menara Kudus Mosque assisted by articulate storyline is designed to reflect the concept of digital-based learning. One of the goals of developers doing this is to prepare users and educators to keep up with rapid technological developments, this statement is also in line with the statement that digital skills which include the ability to use to create digital content must be learned and mastered, because these contents are then used in the learning process (Wibowo Mukti, 2022). This product is presented in the format WEB which is HTML5 format. Learning media in HTML5 format and HTML5 links can be categorized as digital-based learning media, where HTML5 is a markup language used to use interactive content in digital form. Digital format in the context of learning media refers to various types of content that can be accessed and used through electronic devices, such as digital text, images and graphics, audio, video, animation, interactive multimedia, simulations, online learning platforms, quizzes and online exercises (Sitepu, 2021).

The good response of students in using the learning application developed shows that the transformation geometry learning application integrated with the architecture of the Menara Kudus Mosque assisted by articulate storyline has succeeded in creating an interactive and fun learning environment for students. User interest and enthusiasm for mathematics learning can be said to increase with conditions where users not only understand mathematical material, but also enjoy the learning process, so this can illustrate the feasibility of learning applications transformation geometry integrated architecture of the Menara Kudus Mosque

assisted by articulate storyline in motivating students to learn mathematics happily and meaningfully.

The proposed research on developing transformation geometry learning media integrated with the architecture of Menara Kudus Mosque through an articulate storyline for mathematics education students can make several important contributions: that is; 1) development of contextual learning materials, this research will produce learning applications that are contextual and relevant to Indonesian culture, especially by integrating mosque architecture Menara Kudus. Through the use of real cultural contexts, athematics education students will more easily relate transformation geometry concepts to real life and traditional Indonesian architecture; 2) increase learning interest and motivation, interactive and interesting learning media, especially based on articulate storyline, can increase student interest and motivation to learn. By presenting learning materials in the form of interesting multimedia, it is hoped that mathematics education students will be more enthusiastic in learning transformation geometry; 3) enriching mathematics learning, the development of this learning application will enrich the way of learning mathematics, especially in understanding transformation geometry. By integrating Indonesian local wisdom, mathematics education department students will have the opportunity to learn with a different and more in-depth approach; 4) supporting distance learning, given the increasingly popular trend of distance learning, the developed learning applications can be accessed online, thus enabling more flexible and accessible learning from various locations; 5) contributing cultural and historical information, this research will contribute information about the architecture of the Menara Kudus Mosque, which is one of Indonesia's historical cultural heritage. Through learning applications, knowledge about culture and history can be disseminated and appreciated by mathematics education students.

Thus, this research has the potential to have a positive impact on mathematics education students in developing contextual mathematics learning, increasing understanding of transformation geometry concepts, and enriching appreciation of the robust of Indonesian culture and architecture.

Based on the results of research, discussion and studies on research in making an integrated transformation geometry application for the architecture of the Menara Kudus Mosque assisted by articulate storyline, the researcher provides suggestions for the continuation of this research, which are as follows: 1) the material developed in this study is limited to the transformation geometry course. The researcher gave suggestions to add material to the learning application transformation geometry integrated architecture of the Menara Kudus Mosque.

Therefore, for similar research, the material should be developed and more creative in presenting the material; 2) the implementation carried out in this research is solely to determine the feasibility of the application developed. Therefore, further research is needed to examine the use of products in learning activities and to determine the effectiveness of using products in learning activities. The application developed is expected to be used in lectures in universities with the same problem characteristics.

Conclusion

Based on the results of research and discussion, the following research conclusions were obtained, the learning application development process transformation geometry integrated architecture of the Menara Kudus Mosque assisted by articulate storyline was developed with the ADDIE model development procedure. The development of ADDIE has 5 stages, that is: analysis, design, development, implementation and evaluation. The analysis phase researchers conduct various analyses that include an understanding of the material, the Semester Learning Plan (RPS), and the needs and characteristics of students. In the design stage, researchers plan material structure, make flowcharts, prepare, and evaluate materials, prepare a grid of media feasibility assessment instruments, select media, plan stage media display. Development Phase researchers began to create an integrated transformation geometry learning application of the architecture of the Menara Kudus Mosque assisted by articulate storyline in accordance with the flowchat, media display plan and conduct feasibility assessments to media experts, materials and. In the implementation stage, researchers conduct feasibility assessments to users (students). In the evaluation stage, researchers revise the results of the assessment of the user. The results of the feasibility assessment of interactive learning media by expert of mathematical content obtained a percentage of 83% with feasible criteria. The results of the assessment by expert of learning media obtained a percentage of 79.5% with feasible criteria. The results of the assessment conducted by users or students in this study were obtained in a small group obtained a percentage of 79.2% with the feasible category and in the large group a percentage of 76.83% was obtained with the feasible category.

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