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Development of Learning Media with Mathematical Understanding in Geometric Sequences and Series within Malay Islamic Context

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Abstract

This research aims to develop mathematical learning materials for understanding geometric sequences and series within the context of Malay Islamic culture, which can provide a valid and practical connection to mathematics and enhance mathematical comprehension skills. The research follows the Tessmer 1993 research procedure, encompassing two stages: introduction and prototyping, with a formative evaluation process. The research findings indicate that the learning materials are suitable for implementation, as demonstrated by assessments. The validity of the materials, as assessed by experts, is 93%, signifying their high suitability. The practicality of the learning materials, based on student feedback, is 79%, indicating their practical utility. As for their potential to enhance mathematical abilities, the results show an 82% positive impact on mathematical understanding abilities, as determined from student practice. Furthermore, the mathematical understanding ability of students using these learning materials was rated at 75%, indicating a high level of comprehension of geometric sequence and series content. Consequently, the developed learning materials are suitable for use in the educational process.

Keywords: Geometric Sequences and Series, Malay Islam, Learning Media

Abstrak

Penelitian ini bertujuan untuk menghasilkan media pembelajaran matematika barisan dan deret geometri dengan hasil akulturasi Islam Melayu yang dapat dikaitkan dengan matematika sebagai konteks yang valid, praktis dan berpotensi mempengaruhi kemampuan pemahaman matematis. Penelitian ini menggunakan prosedur penelitian Tessmer 1993 dengan dua tahap yaitu pendahuluan dan pembuatan prototipe dengan alur evaluasi formatif. Hasil penelitian menunjukkan bahwa media pembelajaran layak digunakan berdasarkan penilaian. Validitas media diperoleh dari penilaian para ahli sebesar 93% artinya media sangat layak digunakan. Kepraktisan media pembelajaran yang diperoleh dari hasil penggunaan siswa sebesar 79% artinya media praktis digunakan. Mengenai potensi pengaruh terhadap kemampuan matematika pada media diperoleh hasil sebesar 82% artinya media pembelajaran berpotensi mempengaruhi kemampuan pemahaman matematis yang diperoleh dari hasil latihan siswa. Hasil kemampuan pemahaman matematis sebesar 75% yang berarti kemampuan siswa dalam memahami materi barisan dan deret geometri menggunakan media pembelajaran yang dihasilkan adalah baik. Dengan cara ini media pembelajaran yang dihasilkan dapat digunakan dalam proses pembelajaran.

Kata kunci: Barisan dan Deret Geometri, Islam Melayu, Media Pembelajaran

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INTRODUCTION

The ability to understand mathematics is important in mathematics learning. As noted by Khairani et al. (2021), a lack of mathematical comprehension among students can severely limit their ability to tackle mathematical problems effectively. To facilitate effective comprehension, it is

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advisable to incorporate illustrative examples within the teaching materials. The significance of mathematical comprehension is explicitly outlined in the mathematics learning objectives of the curriculum (KTSP 2006 and K-2013). The acquisition of mathematical understanding by students can be regarded as the cornerstone for their development in mathematics, as emphasized by Hikmah (2017). Furthermore, it is supported by the notion that learning with understanding not only facilitates subsequent learning but also makes mathematics more meaningful and memorable. When students connect new knowledge to their existing knowledge in meaningful ways, they are more likely to grasp and apply mathematical concepts effectively (NCTM, 2000).

Geometry sequences and series are materials that must be studied in mathematics the obstacle to studying this material is that students must understand the concept of geometric sequence patterns which leads to understanding the use of the Un and Sn formulas. Wijayanto and Munandar (2021) revealed that students' mistakes in solving sequence and series material problems were analytical errors in determining the formula to be used, such as determining the nth term (Un) and the number of the nth term (Sn). Based on the field results and previous research, it can be concluded that the main factor is the student's lack of understanding of geometric series and sequences. Research conducted by Vina Permata Sari in 2019 revealed that students often struggle to grasp the concepts presented through traditional teaching methods. However, when an experiment was conducted using learning media, students achieved significantly improved learning outcomes in the category of sequence and series materials following the implementation of these tools.

In the media context, the Malay Islamic context is used. The use of this context is expected to make it easier for students to create an understanding of geometric sequences and series material because students are familiar with the Malay Islamic culture. This context serves as a bridge for students to grasp geometric patterns, connecting them to challenges stemming from the exploration of Malay Islamic acculturation, which has implications for the material. This form of acculturation comes from the development of Islam in the Malay region (Mahdini, 2003). With the development of Islam in the Malay region, Malay became the center of Islamic culture in the region. In this way, Malay culture blends with Islamic culture (Bakri, 2020). To be able to see students' understanding of the material, indicators of mathematical understanding will be used in learning media.

An application that fulfills the requirements of researchers is Adobe Animate software. Adobe Animate is an advancement of the Adobe Flash Professional application, with the addition of enhanced features and improved security (Prastyo & Hartono, 2020). This versatile application finds utility in educational settings, enabling the creation of engaging and interactive learning materials. Adobe Animate offers extensive customization options, including workspaces, tools, properties, and more, allowing the program to adapt to the artist's capabilities (Brooks, 2016). This adaptability simplifies the development of desired learning materials for researchers.

Notably, a research project conducted by Saniriati, Dafik, and Murtikusuma (2021) titled "Development of Schoology-Assisted Adobe Animate CC Learning Media on Material Sequences and

Arithmetic Series" employs the Thiagarajan development model, a modified 4D model for research and development. Based on the responses of students classified as "good", effective and practical results are obtained. A student's test results achieving the specified KKM score of 85% or more also supported this view. The findings of this research clearly show that the use of learning media can result in good educational outcomes. Therefore, the objective of this research is to leverage Adobe Animate for the development of learning materials concerning geometric sequences and series within the Malay Islamic context. These materials are designed to be valid, practical, and capable of enhancing mathematical comprehension, aiding users in understanding the content with the aid of the developed learning media.

METHODS

In this study, the researchers employed formative evaluation, which is known for its fundamental contribution in enhancing the quality of the intervention under development. The key quality criteria encompass validity, practicality, and effectiveness (Akker et al., 1999). The potential effects in this study pertain to the impacts attributed to the product in development. Researchers use this process to develop and validate new products or make improvements to existing ones, all aimed at enhancing educational outcomes (Meredith D. Gall, Joyce P. Gall, 2003). To create high-quality learning materials, the researchers followed Tessmer's (1993) procedure, which consists of two stages: the preliminary stage and the prototyping stage, employing a formative evaluation framework.

The preliminary stage is the first stage in developmental studies and is done in two phases: (1) Preparatory phase begins with gathering mathematical comprehension skills, backgrounds in Malay Islam, sequence and series material, and some references on previous development studies. At this point, the location and subjects were also selected. That is Tamansiswa Palembang high school in Class XI MIPA. Next, curriculum analysis was conducted to identify the basic competencies, indicators, and learning objectives to be implemented in learning media based on the analysis results of the media content materials to be developed. (2) The design phase was conducted by researchers, consisting of designing the flow of learning media and designing the media interface that displays the results of the product.

The prototyping phase comprises four stages. In the first stage, a self-evaluation is conducted to assess the media created and developed in the previous stages, with a focus on identifying evident errors in the media. This design outcome is referred to as Prototype I. The second stage involves expert review and one-to-one evaluation. The expert review phase engages validators with expertise, particularly in the areas of media and materials (mathematics and context). These experts evaluate the design, content, and techniques. Their feedback and suggestions are integral for revising and gauging the learning media's effectiveness. In the one-to-one evaluation phase, researchers select three groups of students, categorized by their proficiency levels-low, medium, and high. Their usage patterns and

evaluation results inform assessments of the media's comprehensibility in terms of design and materials, as well as its overall appeal. These findings are used to enhance Prototype I and yield Prototype II. In the small group stage, researchers form small groups of students with differing abilities to assess effectiveness, attractiveness, and practicality when working with the learning media. The results from this stage contribute to the refinement of Prototype II, leading to the development of Prototype III. The final stage, the field test phase, examines the continuity, applicability, attractiveness, acceptability, and overall effectiveness of the learning media across all subjects in the research course. Data collected in this phase validates previous improvements and informs the final revision. Figure 1 illustrates the data collection technique employed in this study.

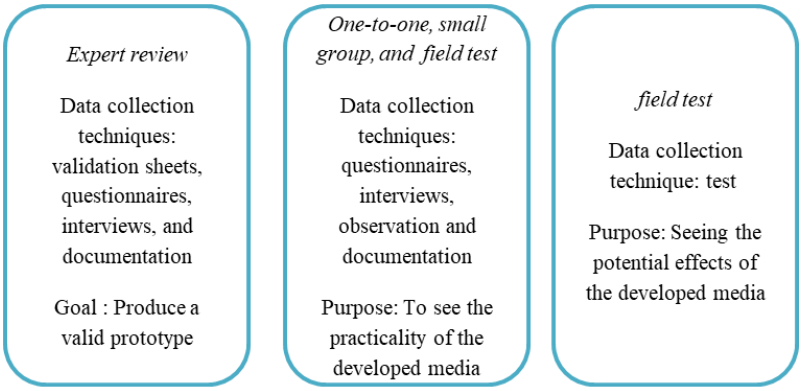


Figure 1. Data collection techniques

As Figure 1 shows, the data obtained at each step of the research procedure were analyzed from quantitative to qualitative data using Likert scales that measure the opinions and perceptions of individuals or groups of individuals (Sugiyono, 2020). Qualitative data are still displayed in Qualitative data. A way to transform quantitative data into qualitative data form is to calculate the average respondent response using the following formula: Score Percentage = (Total Rating Score: Maximum Total Score) × 100%. The percentage score results from the formula obtained are then used to determine the validity, practicality, and potential effects of learning media. The following is a method to analyze the validity and practicality used in this study.

Validation Sheet Analysis

The validation sheet is used to see whether the product is valid or not and to measure the validity of the product. Validation sheets were descriptively analyzed using mean formulas to analyze the results provided by the researchers. Comments from the Validation Sheet are used as one of the inputs to revise the product during the expert review phase. Percentage values can be used to ascertain the level of validity associated with the modified validity assessment category from Saniriati et al. (2021) which is shown in Table 1.

Table 1. Media validity criteria

Percentage (%)	Category Rating
< 21 %	Very Ineligible
21 % – 40 %	Inadequate
41 %– 60 %	Fairly Good
61 % – 80 %	Decent
81 % – 100 %	Very decent.

Table 1 presents the level of the level of effectiveness of the learning media developed based on the evaluations of the experts involved. If the media score falls below 41%, the media has been informed that it is unusable. So, the media must be checked and re-fixed for unusable parts, and the media will also be moved to the next phase. If the media is 41% or higher, it can be used in the next phase, depending on revision if desired.

Questionnaire Analysis

Questionnaire was employed to collect quantitative data from the respondents. The data was then translated into qualitative data. This data is used to see the practicality of learning media based on the use of media as a medium of studying the material of geometric sequences and series. The media practicality criteria were modified from Saniriati et al. (2021) which can be seen in Table 2.

Table 2. Media practicality criteria

Percentage (%)	Category Rating
< 21 %	Very impractical
21 – 40 %	Not practical
41 – 60 %	Quite practical
61 – 80 %	Practical
81 – 100 %	Very practical

As Table 2 shows, if the percentage obtained from the user questionnaire ratings is less than 56%, the media is considered impractical. Therefore, it is necessary to review the causative aspects. This analysis is used not only to determine whether the media is practical, but also to measure the level of utility. If the media is 56% or higher, it can be used in the next step, depending on revision if desired. The higher the determined percentage, the more practical the use of the media.

Interview Analysis

Qualitative data from the interviews show results that cannot be disclosed in the expert review stage validation sheet. This interview method was then also used to determine the students' mathematical understanding of geometric sequences and series after using the developed learning

media. The results of this interview analysis were used for additional modification of learning media development not apparent from the questionnaires, validation sheets, and observations.

Observation Sheet Analysis

Media usage observations transform quantitative data into qualitative data and present them in the form of short descriptions. For the assessment of observational conclusions, Table 3 provides criteria for student media engagement, and Table 4 presents student performance and direct response in the media.

Table 3. Criteria for student interest in media use

Percentage (%)	Category
< 21 %	Very Disinterested
21 – 40 %	Not interested
41 – 60 %	Pretty Interested
61 – 80 %	Interested
81 – 100 %	Very Disinterested

Table 4. Criteria for student learning outcomes using media

Percentage (%)	Category
< 21 %	Very Not Good
21 – 40 %	Not good
41 – 60 %	Pretty good
61 – 80 %	Good
81 – 100 %	Very good

Categories in Table 3 and Table 4 are used to make it easier for the researchers to conclude the condition of the observations fairly. The purpose of this activity is to obtain information about media results that are not disclosed in the interviews or questionnaire with the respondents. If her rating in Table 3 is below 41%, the student is not likely to be interested in using media in the learning process. This data can be used by the researchers to help improve areas of the media that need improvement. Similarly, if Table 4 is less than 41%, the student is having trouble processing and understanding material using media. This data can be used as a correction material for the parts that need to be improved in the media.

Test Analysis

The test obtained at the field test stage is used to determine whether or not there is a potential effect of learning media on mathematical understanding abilities. The minimum completeness for class XI in mathematics at the research setting is 63. Learning media is said to have a potential effect on mathematical understanding abilities if the percentage of student achievement test results meets the assessment of 65%≤ x <85%. To find the percentage of completeness of student test results, the

researchers use the following formula: Percentage of Completeness = (Number of Students Who Complete: Number of Students) × 100%

The criteria for assessing the ability to understand mathematics in each item and indicator are based on Arikunto's adaptation (Khairani et al., 2021) which are presented in Table 5.

Table 5. Qualification percentage of mathematical understanding per item

Percentage (%)	Category
81% - 100%	Very high
70% - 80,99%	High
41% - 60,99%	Medium
21% - 40,99%	Low
0% - 20,99%	Very low

If a data rate of 70% is achieved, it can be stated that the student's understanding of the item is high.

RESULTS AND DISCUSSION

Preliminary Stage

At the preparation and design stage, activities were carried out to analyze the mathematics material, curriculum, and student characteristics. The results of the preparation show that the curriculum used is K-13 and the mathematics material used is about geometric sequences and series which includes the concept of geometric sequences, elements of n-term geometric sequences, and formulas for n-term geometric sequences. Each material is designed to determine students' mathematical understanding of the material so that material on geometric sequences and series will be presented in stages during each delivery of material on learning media. The use of learning media as a learning tool that contains teaching materials appropriate to the conditions can stimulate students to learn (Kompri, 2017). Based on the interview results, it is apparent that students encounter difficulties when learning geometric sequence material due to their conceptual understanding of sequences. They comprehend the concept of a sequence but struggle to grasp it fully, as revealed through the analysis. This incomplete comprehension is a significant factor contributing to the challenges students face in studying geometric sequences. In particular, students encounter difficulties in comprehending the concept of geometric sequence shapes. In the design stage, the researcher developed the learning medium with careful consideration of its content, aligning it with the learning objectives, and addressing technical aspects like background, sound, text, and other visual elements. An illustration of the interface design developed for the learning medium is depicted in Figure 2.

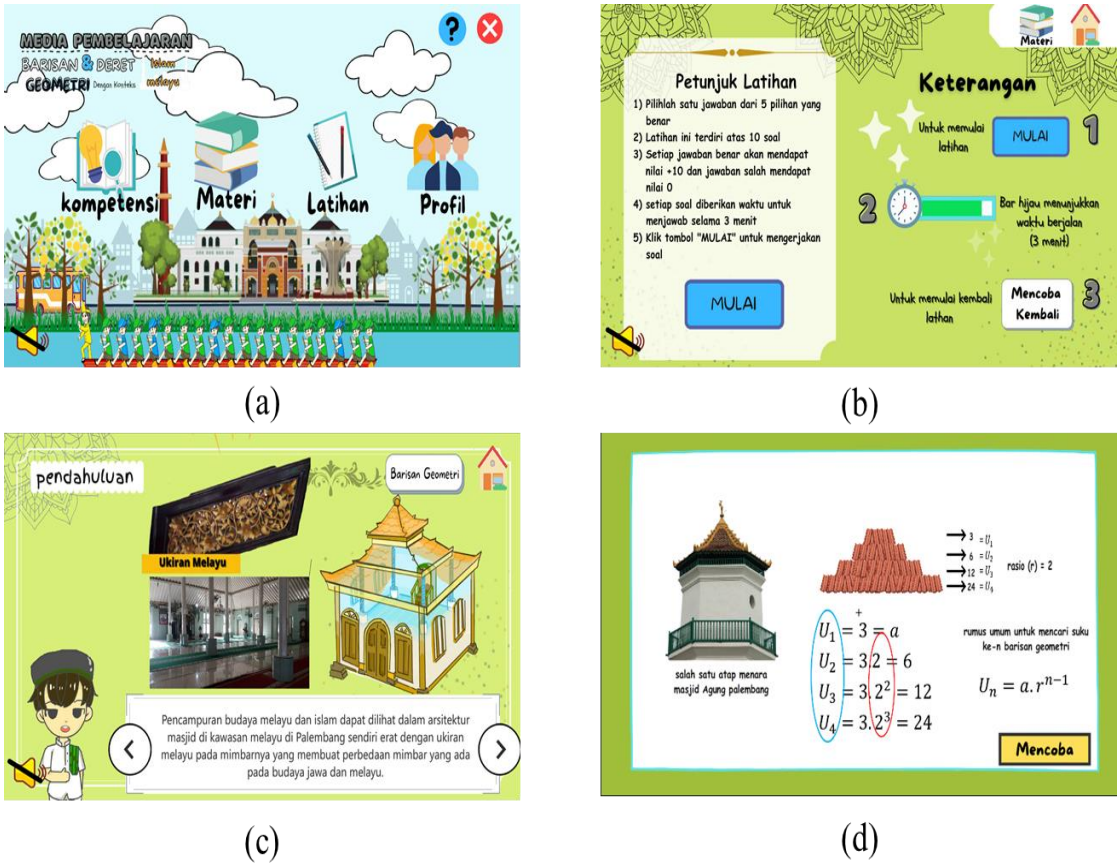


Figure 2. Learning media interface design

Figure 2 depicts the learning media interface design that was specifically developed to evoke an Islamic ambiance. Additionally, the main menu display (Figure 2a) is designed to be visually appealing, featuring an animated background with several contextual objects integrated into the learning media. For the material introduction page (Figure 2b), the researcher has included general information about the Malay-Islamic context incorporated into the learning media. In the Teaching Material Concepts section (Figure 2c), the media is crafted to enhance comprehension by employing a relatively slow animation speed for teaching through motion animation explanations without audio. The first exercise display (Figure 2d) illustrates problem-solving procedures and provides descriptions of the icons and buttons used in the learning media exercises. Notably, all icons, backgrounds, and button designs were created directly within the Adobe Animate application, utilizing the Canva app.

Self-Evaluation

In the self-evaluation stage, the researchers evaluated the results of previously designed media. The purpose of self-evaluation is to review errors in learning media that are developed to achieve the desired media evaluation. One of them is by providing a "support function" for delivering learning material and animated movements in learning media.

Expert Reviews and One-to-One

In the expert reviews stage, an examination of the product was conducted by an expert. In the one-to-one evaluation stage, the researchers tested it on small groups of students. The results from this stage are used to improve the previous prototype. In the expert reviews stage, the researcher validated the learning media involving experts in their fields. There are 3 fields, namely media (programs) and material (Malay Islamic context and mathematics material). Table 6 shows the validation results.

Table 6. Results of expert review analysis

Name	Aspect	Percentage	Representation
V1 V2	Material	90%	Very decent
V3 V4	Context	97%	Very decent
V5	Media	93%	Very decent
Conclusion		93%	Very decent

Based on the expert evaluation results obtained during the expert review stage, as presented in Table 6, it is evident that the learning media has been categorized correctly based on the evaluation of three critical aspects: material, context, and media. This score is derived from averaging the responses provided by the evaluators and converting it into a percentage format, which signifies the extent of media validity. Following this assessment, the researcher incorporated feedback and recommendations obtained from verification sheets and interviews as input for revising the prototype. The prototype was subsequently refined based on the evaluation results and the input from experts, resulting in the creation of Prototype II. The outcomes of the expert review for the revised Prototype I are detailed in Table 7.

Table 7. Comments from expert reviews

Validator	Comment	Revision
Material	The animated display of material is slowed down for students to finish reading	Reduced material animation playback speed
	Adjust the questions given according to the ability of students and according to the size of the work time given.	Questions are made according to ability based on stages and question indicators based on difficulty level from easy to difficult.
Context	Add verses from the Koran/Hadith of Rasulullah SAW which can reduce learning motivation, and add references in the context of the Malay Islamic civilization approach.	Changes in the words of learning motivation, to learning motivation taken from Islamic values and reference sources used at the beginning of the material "introduction" slide

Validator	Comment	Revision
Media	The display is made more attractive and depicts the theme of the media of mathematics with Malay Islam.	Changes in appearance by displaying images that contain elements of mathematics and Islam on the base background of the media and the front view of the media

Table 7 presents the comments and revisions made in the expert review stage. The parts that need to be revised based on the feedback from the 5 experts include the appropriateness of the questions and the duration of the delivery of the material, the emphasis on the Malay Islamic context, and the appearance of media design.

During the one-to-one evaluation stage, the researcher conducted a trial of the learning media with six students representing different proficiency levels: low, medium, and high. The Learning Media Experiment Results from this one-to-one evaluation stage were subsequently compared to the answer analysis results obtained from the learning media user questionnaire. These results were categorized as practical use. From the observations and interviews, valuable insights were gathered, indicating that some students did not have a complete grasp of the material concerning geometric sequences. This was particularly evident in students' responses related to the formation of geometric sequences. However, students did exhibit an understanding of the process of deriving a geometric series by adding up all the terms. The student responses, coupled with further research findings from the one-to-one evaluation phase, served as the basis for revising Prototype I, resulting in the creation of Prototype II. The outcomes of the revised Prototype I are presented in Table 8.

Table 8. Results of the revised one-to-one evaluation stage

(Before Revision) Prototype I	(After Revision) Prototype II
The duration of working time on each practice question is 3 minutes.	The duration of working time on each practice question is 4.5 minutes.
There is no button/program to go to the introduction (Malay Islamic discourse) on the "trying" slide.	Given a button/program to go to the introduction (Malay Islamic discourse) on the "trying" slide.
There is no explanation of the definition of sequences in animation regarding forming geometric sequence patterns in animated material	An initial explanation of sequences is given, before entering the form of geometric sequence patterns

Table 8 indicates the revision that was carried out in the one-to-one evaluation stage. The revised part is the material and technical part of the media. More details can be read in the revision description in Table 8. After making revisions based on expert and student findings during the expert review and one-to-one evaluation stages, the learning media is ready for the small group phase.

Small Groups

The activities at this stage were developed for assessing the effectiveness, attractiveness, and practicality of the learning media under development. A total of 15 students were involved in this stage, grouped into three categories based on their proficiency levels: low, medium, and high. The results obtained in this phase indicate an overall practicality rating of 80%. Following interviews and observations within the small group setting, it became evident that the majority of students demonstrated an ability to comprehend the material on geometric sequences, albeit not in its entirety. This was notably reflected in the students' responses across various proficiency levels, especially regarding their understanding of geometric sequences and the sequential mention of terms and elements. Additionally, it was observed that while some students grasped the process of finding geometric series, their comprehension of the material related to geometric series remained somewhat incomplete. The responses from students and other research findings from the small group stage served as valuable input for the refinement of Prototype II, resulting in the development of Prototype III. The revised outcomes of Prototype II are presented in Table 9.

Table 9. The small group stage revision results

(Before Revision) Prototype II	(After Revision) Prototype III
There is no button/program to go to the material animation page back in the help slide	Provides a button to go to the material animation in the help slide

Table 9 presents the revision made in the small group stage. The revised part is the technical part of the media, namely giving a button back to the previous page after going to the help page. More details can be read in the revision description in Table 9.

Field Tests

In the field test phase, the researchers observed the use of learning media that was developed with a focus on its continuity, applicability, attractiveness, and acceptance in terms of practicality. This assessment was made by examining student responses while using the media and by analyzing the potential impact on mathematical understanding abilities, as reflected in the students' test results after engaging with the learning media. A total of 22 students were involved in this stage. The outcomes of the learning media trials during the field test stage revealed that the student response questionnaire yielded an 82% satisfaction rate, categorizing these results as practical in terms of use. Additionally, at this stage, the researcher administered a test to evaluate students' comprehension of the material pertaining to geometric sequences and series after their exposure to the developed learning media. The Minimum Completeness Criteria (KKM) for class XI mathematics at the research school is 63. Learning media is considered to have a potential effect on mathematical understanding abilities if the percentage of student achievement in the test meets or exceeds the 65% threshold. The completeness of student test results is assessed based on the adaptation of Widoyoko (2009), with the

following categories: 0% - 20.99% (Very Low), 21% - 40.99% (Low), 41% - 60.99% (Enough), 61% - 80.99% (Good), and 81% - 100% (Very Good). The results of these tests are visualized in Figure 3.

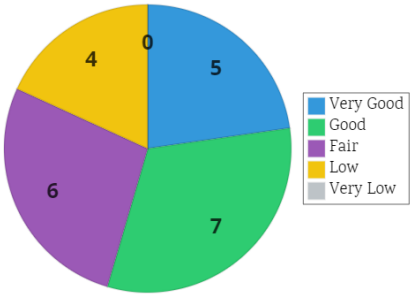


Figure 3. Student test results

Analyzing the data presented in Figure 3, it is evident that 18 students successfully met the Minimum Completeness Criteria (KKM). Among these students, 5 achieved a very high level of completeness in their test results, 7 attained complete KKM information, and 6 achieved sufficient KKM information. The overall percentage of students' mathematical understanding ability test completeness stands at 82%, indicating that the learning media can be used to improve mathematical comprehension.

The developed learning media was considered valid based on expert evaluation results obtained during the evaluation phase. This validation process focused on assessing the contextual conveyance of information and the accuracy of the information, particularly concerning how the relationship between mathematical material and the context presented in the learning media was conveyed. Furthermore, the content was evaluated by mathematics material experts and teachers directly involved in instructing the research subjects. Lastly, the media (program) was appraised for its appearance as a learning medium and the structure of the media as a means for disseminating information. Following the results of the expert evaluation during the expert review stage, the learning media is declared suitable and valid for use as a learning tool for geometric sequences and series material within the context of Malay Islam, after undergoing necessary revisions before field testing.

Based on the data collected at each stage, it can be concluded that the learning media can be regarded as practical and effective as a learning aid for understanding geometric sequences and series. This conclusion is drawn from the trials conducted during the one-to-one evaluation, small group, and field test stages. When examining the findings from each stage, it becomes apparent that students with low proficiency levels in the study of geometric sequences and series tend to benefit more from the use of this learning media compared to traditional teaching methods. On the other hand, students with medium proficiency levels may find the learning media less effective. Several factors may contribute to this, including the fact that some students have a better understanding of mathematics through conventional teaching methods. Additionally, the learning media may not be as appealing to students, and they might encounter challenges in using it. These difficulties could stem from a lack of

familiarity with the learning media, highlighting the need to consider the nature, range of abilities, and usage techniques (Sundayana, 2015). Conversely, students with high proficiency levels were able to utilize the learning media effectively in their studies. The choice of the medium used in the research significantly influences its practicality. Researchers observed that students had reservations about using learning media on computers, while they exhibited no such hesitation when using smartphones. This could be attributed to the students' comfort in using devices familiar to their daily lives. This observation aligns with the role of learning media as a medium for introducing information to recipients (Sutirman, 2013). Therefore, careful consideration of the choice of tools and supporting facilities in electronic learning media is necessary. Not all tools, facilities, and media are equally suitable for supporting the learning process, with user convenience being a key factor. Additional details can be found in Table 10, which presents the results of tool usage in the research.

Table 10. The practicality of learning media

Stage Total	Subject	Tool	Practicality	Category
One to one	6 Students	Laptop	74%	Practical
Small group	15 Students	PC	80%	Practical
Field test	22 Students	Smartphone	82%	Practical

Table 10 shows the results of the practicality of each stage and the practicality of the research. It is known that at different stages of acquiring practicality. This information was obtained based on observations of students' interest in media use and direct interviews with students. Therefore researchers obtained information that the tools used need to be considered in developing electronic learning media.

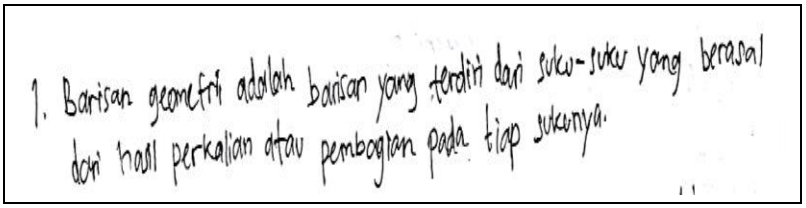
Table 10 provides an overview of the practicality observed at each stage and the overall practicality of the research. It is evident that practicality varied across different stages. This information was derived from the observations of students' engagement with the media and direct interviews with students. Consequently, researchers recognized the need to consider the tools employed in the development of electronic learning media. Upon evaluating the students, it was determined that the potential effect reached a percentage of 82%, signifying that the developed learning media held promise for enhancing students' mathematical comprehension. According to Hendriana et al. (2017), specific indicators of mathematical understanding abilities were employed in the research, including the ability to: (1) restate a concept both verbally and in writing, (2) identify connections with the concepts being studied, (3) provide examples and non-examples, and (4) present concepts in various forms of mathematical representation. These indicators were translated into a test consisting of eight items, with two questions, specifically questions 1 and 2, deemed invalid. Despite their invalidity, these questions were retained to help estimate the students' ability to understand the mathematical indicator related to "Restating a concept both verbally and in writing" in the context of

geometric sequences and series. For the item instrument's reliability, the result was 0.51, indicating a moderate level of reliability. It's worth noting that, based on analysis, an alpha value exceeding 0.90 signifies perfect reliability, while an alpha between 0.70 and 0.90 suggests high reliability. An alpha ranging from 0.50 to 0.70 is considered moderate reliability, and an alpha below 0.50 indicates low reliability (Sundayana, 2018). The results of students' mathematical understanding abilities after using the learning media are detailed in Table 11.

Table 11. Results of students' mathematical understanding of each question item

Question number	Aspects measured	Material	Percentage	Category
1	• Estate is a concept both verbally and in writing.	Geometric Sequence	85%	Very Good
2		Geometric Series	80%	Good
3	• Identify linkages with the concepts being studied. • Identify/mention examples and non-examples	Geometric Sequence	84%	Very Good
4	• Identify linkages with the concepts being studied	Geometric Sequence	53%	Enough
7	• Presenting concepts in various forms of mathematical representation	Geometric Series	74%	Good
5		Geometric Sequence	72%	Good
6	• Identify linkages with the concepts being studied	Geometric Series	82%	Very Good
8		Geometric Series	83%	Very Good

Table 11 shows the students' mathematics comprehension based on the measured items. Based on an analysis of the students' mathematical understanding of the material, the result of 75% was obtained which could be categorized as good in understanding geometric sequences and series. From these data, it can be seen that students have basic abilities such as expressing, understanding the meaning of questions, and associating the material studied with mathematical problems, they are already good at understanding geometric sequences and series. The following are the results of the test sheet for students' mathematical understanding abilities.



Translated to English:

A geometric sequence is a sequence consisting of terms that result from multiplication or division of each term.

Figure 4. Answer number 1 on the test by one of the students

Figure 4 is the answers to questions number 1 with the comprehension ability indicator "Restate a concept both verbally and in writing" with the question “Write down the meaning of geometric sequences that you know?” Based on these answers, the students can write down the basic concepts of forming sequences and geometric series in their answers.

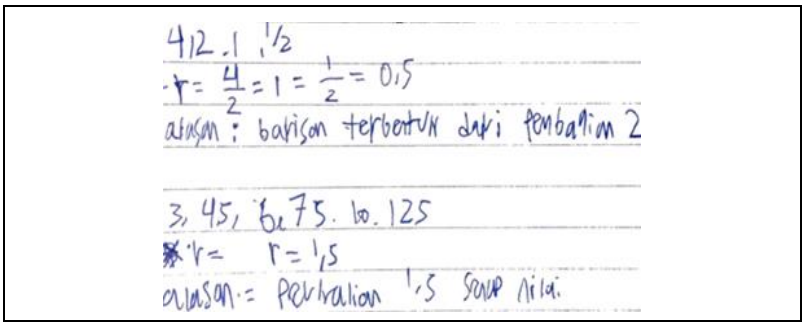


Figure 5. Answer number 3 on the test by one of the students

Figure 5 is a question number 3 about determining which geometric sequence is from the choices given with the question indicators “Identifying the relationship with the concept being studied” and “Identifying/mentioning examples and non-examples”. It can be seen that the students can answer the question by knowing the process of forming the sequence. This can be seen from the ratio (r) of the numbers and the students' reasons for choosing that answer.

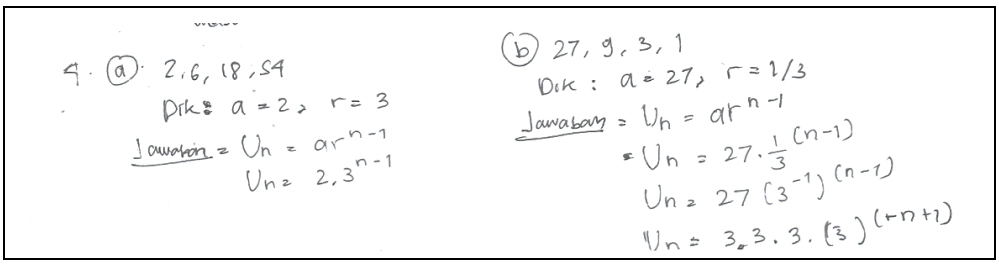


Figure 6. Answer number 4 on the test by one of the students

Figure 6 is a question number 4 about determining the formula for the nth term based on the sequence given with the question indicators "Identifying the relationship with the concept being studied" and "Identifying the relationship with the concept being studied". The ability of students to relate previously learned concepts to subsequent material can be done well by students. It is known from their answers to part 4a, the students can answer well in number problems with increasing numbers. From the students' answers in part 4a, students have no difficulty in using formulas to find answers to these problems. However, from section 4b, it is known that students can identify number elements and then apply them to formulas. However, in the final answer, the student is wrong in

solving it, so in this case it can be concluded that the student can present the concept in various forms of mathematical representation but the answer is not correct.

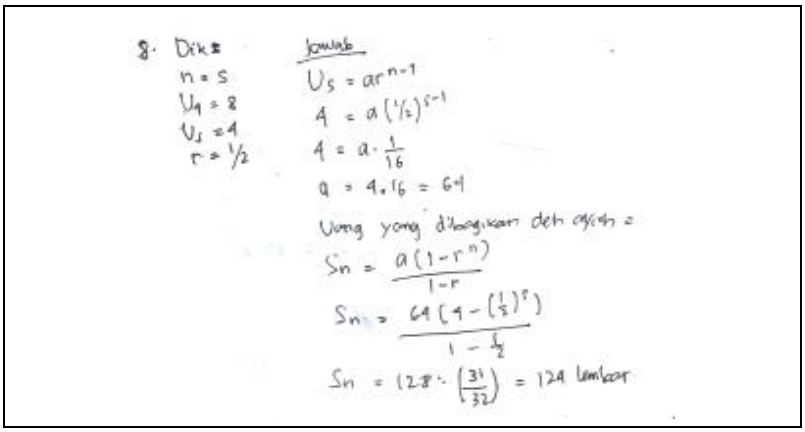


Figure 7. Answer number 8 on the test by one of the students

Figure 7 presents the students' answers to the question number 8 about determining the number of the nth terms of a geometric series in a story problem with the question indicator "Identify linkages with the concepts being studied" namely on the concept of geometric sequences. The results obtained were very good, seen from the way students solved the questions by first identifying the problem given and then using a formula to find the answer.

The developed learning media has both advantages and disadvantages. One of the strengths of the learning media is its flexibility, as it can be generated in various formats, such as .exe and .apk, as evidenced in the research product. Furthermore, the media is designed using indicators that support mathematical understanding of the learning material. However, there are some limitations associated with the research. The media lacks the capability to save students' work on practice slides, mainly due to the absence of a database. Additionally, the media is structured with only one correct answer option, and not all mathematical understanding skills are adequately addressed, potentially limiting students' ability to provide responses that reflect their comprehensive understanding. This limitation arises from the researchers' deliberate decision to create a lightweight .apk-based product without incorporating a database and offering only one predetermined correct answer. Consequently, students are constrained to selecting the one programmed correct answer, and it becomes challenging for them to track and record their learning progress using the media.

CONCLUSION

The developed learning media significantly influences mathematical understanding, particularly in the context of sequences and geometric series. This impact is assessed through eight test questions, although two of them were considered invalid, specifically the questions relating to the "restating the concept both verbally and in writing" indicator. Despite their invalidity, these questions were retained to gauge students' abilities in this indicator, serving as an initial assessment of their mathematical

understanding. Regarding the "Presenting concepts in various forms of mathematical representation" indicator, the results were rated as sufficient. The lowest rating on this indicator can be attributed to students' difficulties in solving problems. Although students could identify numerical elements and apply them to the formula, they often made errors in the final answer.

Using Malay Islam as a context in the research has both advantages and disadvantages. Some students struggled to comprehend the function and method of context utilization within the media, leading to difficulties in understanding the material. This becomes a weakness in the development of learning media. However, one advantage is that students are encouraged to independently construct their understanding based on observations and knowledge. Nevertheless, the limitations of the Malay Islamic context in relation to geometric sequences and series problems have an impact on the content of the context used in the learning media. This results in certain content aspects being somewhat forced to illustrate the given problem. Future research should aim to improve these aspects by offering more material examples and simplifying the media flow, especially in the context-delivery stage, to enhance learning media outcomes and foster better mathematical understanding abilities.

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REFERENCES

Akker, J. an van den, Branch, R. M., Gustafson, K., Nieveen, N., & Plomp, T. (1999). *Design Approaches and Tools in Education and Training* (1st ed.). Springer, Dordrecht. https://doi.org/10.1007/978-94-011-4255-7

Bakri, S. (2020). *Malay Islam: Mosaic of Islamic Culture in Singapore & Brunei* [in Bahasa]. Surakarta: PT Aksara Solopos.

Brooks, S. (2016). *Tradigital Animate CC :12 Principles of Animation in Adobe Animate*. Florida: CRC Press. https://doi.org/10.1201/9781315795614

Hendriana, H., Rohaeti, E. E., & Sumarmo, U. (2017). *Students' hard skills and soft skills in mathematics* [in Bahasa]. Bandung: Refika Aditama.

Hikmah, R. (2017). Application of the Advance Organizer Model to Improve Students' Comprehension Ability [in Bahasa]. *SAP*, *1*(3), 271–280. http://dx.doi.org/10.30998/sap.v1i3.1204

Khairani, B. P., Maimunah, & Roza, Y. (2021). Analysis of the Mathematical Concept Understanding Ability of Class XI SMA/MA Students on Sequences and Series Material [in Bahasa]. *Jurnal*

Cendekia: Jurnal Pendidikan Matematika, *05*(02), 1578–1587. https://doi.org/10.31004/cendekia.v5i2.623

Kompri. (2017). *Study the Factors that Influence It* [in Bahasa]. Yogyakarta: Media Akademi.

Mahdini. (2003). *Islam and Malay Culture* [in Bahasa]. Pekanbaru: Daulat Riau.

Meredith D. Gall, Joyce P. Gall, W. R. B. (2003). *Educational Research An Introduction* (7th ed.). Pearson Education, Inc.

NCTM. (2000). *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics.

Prastyo, I. S., & Hartono. (2020). Development of Learning Media Using Adobe Animate CC on Parabolic Motion Material [in Bahasa]. *Phenomenon : Jurnal Pendidikan MIPA*, *10*(1), 25–35. https://doi.org/10.21580/phen.2020.10.1.6854

Saniriati, D. M. D., Dafik, & Murtikusuma, R. P. (2021). Development of Adobe Animate Learning Media Assisted by Schoology on Arithmetic Sequences and Series Material [in Bahasa]. *Jurnal Riset Pendidikan Dan Inovasi Pembelajaran Matematika (JRPIPM)*, *4*(2), 132–145. https://doi.org/10.26740/jrpipm.v4n2.p132-145

Sari, V. P. (2019). *Development of Mathematics Learning Multimedia Material on Sequences and Series for Students of Muhammadiyah Vocational School 06 Medan T.P 2019/2020* [in Bahasa]. Published Thesis. Medan: Universitas Muhammadiyah Sumatera Utara.

Sugiyono. (2020). *Quantitative, Qualitative, and R&D Research Methods* [in Bahasa]. Bandung: Alfabeta.

Sundayana, R. (2015). *Media and Teaching Aids in Mathematics Learning* [in Bahasa]. Bandung: Alfabeta.

Sundayana, R. (2018). *Educational Research Statistics* [in Bahasa]. Bandung: Alfabeta.

Sutirman. (2013). *Media and Innovative Learning Models* [in Bahasa]. Yogyakarta: Graha Ilmu.

Tessmer, M. (1993). *Planning and Conducting Formative Evaluations: Improving the Quality of Education and Training*. London: Kogan Page. https://doi.org/10.4324/9780203061978

Widoyoko, S. E. P. (2009). *Learning Program Evaluation* [in Bahasa]. Yogyakarta: Pustaka Belajar.

Wijayanto, T. A., & Munandar, D. R. (2021). Error Analysis in Sequences and Series Material Judging from the Ability to Understand Concepts by Providing Learning Video Material [in Bahasa]. *Jurnal Pembelajaran Matematika Inovatif*, *4*(3), 699–708. https://doi.org/10.22460/jpmi.v4i3.699-708