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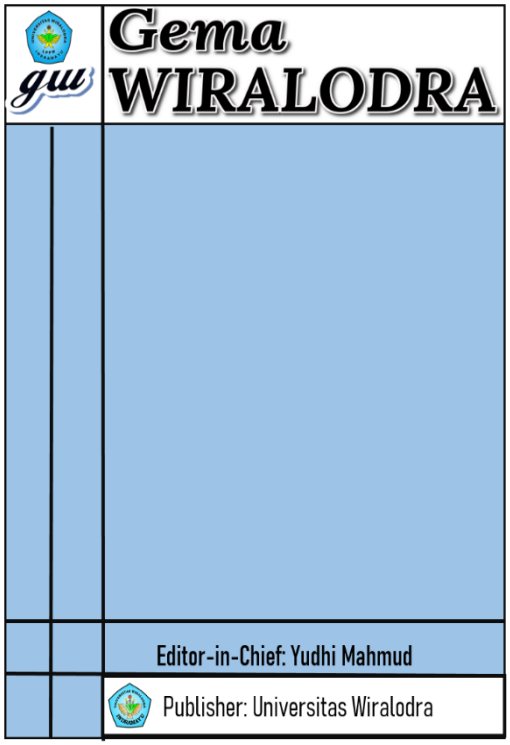

Development of Interactive Media Based on Mathflash Applications for Learning Materials of Sequences and Senses

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Abstract
The objective of this study is to explore the findings from initial observations regarding students' and teachers' understanding of sequences and series material, to identify the need for the Mathflash application in teaching this topic, and to develop an interactive learning media using the Mathflash app that is both feasible and effective through the App Inventor platform. This research employs the Research and Development (R&D) approach, following the development model by Borg and Gall, which consists of eight stages: (1) initial observation, (2) planning, (3) product development, (4) product validation testing, (5) small-scale testing, (6) revision based on small-scale test results, (7) field testing, and (8) analysis of field test data. Data collection methods include interviews, expert evaluation questionnaires (observation sheets), and questionnaires distributed to grade XI students during the limited-scale testing phase. Data were analyzed using both qualitative and quantitative descriptive statistics, with the Aiken's V index used to measure content validity. The effectiveness of the media was evaluated through a post-test administered to students. According to the results of the feasibility test, which involved assessments from five experts, the average score across three feasibility criteria was 3.53, indicating that the media is suitable for use. Additionally, six students participated in the media assessment, and their evaluations yielded an average score of 4.54 across two feasibility aspects, also falling within the feasible category. The effectiveness of the learning media was tested using a one-sample t-test, resulting in a t_observed value of 5.574 compared to a t_critical value of 1.690. Since t_observed > t_critical, the null hypothesis (Ho) is rejected, indicating that the Mathflash-based interactive media is effective for use in the learning process
Keywords: Development of Media, Interactive Media, Mathflash Application

1. Introduction

Mathematics is a fundamental science that plays a vital role in the advancement of modern technology, contributes significantly to various fields, and supports the growth of human knowledge (Dalle et al., 2019). As stated by Pirmanto et al. (2020), the topic of sequences and series is an essential part of the grade XI mathematics curriculum. It covers subtopics such as arithmetic and geometric sequences and series, as well as their real-life applications, including growth, decay, annuities, and compound interest. However, based on the study, students' understanding of sequences and series remains low, with comprehension rates at around 28% and problem-solving skills at only 16%.

Interviews conducted with four teachers and several grade XII science students at SMA Negeri 1 Sindang revealed that many students still find mathematics topics—such as calculus, trigonometry, limits, and especially applications of sequences and geometric series—difficult. Mathematics teachers confirmed that some students struggled with certain materials, mainly due to the shift to online learning over the past year caused by the pandemic. This aligns with Goldschmidt (2020), who noted that the transition to online education was driven by the health crisis brought about by the Covid-19 outbreak. Nonetheless, there are students who enjoy mathematics because they appreciate its logic and numerical nature.

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One reason students face difficulties in understanding math concepts is the lack of thorough explanations from teachers. Additionally, the time allotted for practice is limited, and teaching methods are often restricted to using blackboards, PowerPoint presentations, Google Classroom, and WhatsApp groups. Both teachers and students expressed a need for learning media that fosters interaction between them, especially in today's digital age.

To address this issue, the researcher proposed the use of an Android-based interactive learning application focused on sequences and series. Both teachers and students showed interest in adopting this media for both online and offline learning, as it can help simplify lessons and support students' independent learning anytime, anywhere. Although overall student performance in this topic is fairly satisfactory, challenges still exist, particularly with geometric sequences and their applications. This highlights the need for accessible and engaging educational media that can be used on smartphones, features game-based quizzes, and includes learning videos to explain the concepts.

According to Liliarti & Kuswanto (2018), technological advancements offer many opportunities for creating interactive learning experiences, and smartphones can be utilized as supportive educational tools in schools. However, Susilawati (2020) found that Android-based mathematics learning media are still rarely used in classrooms, and many teachers are not yet adept at integrating such tools into their teaching. Meanwhile, Negara et al. (2019) noted that the widespread ownership and use of mobile devices among students presents a promising opportunity to enhance learning through mobile-based educational technology, such as the use of MIT App Inventor.

MIT App Inventor is an online platform developed by the Massachusetts Institute of Technology (MIT) in the United States. It is designed to introduce and teach computational thinking by enabling users to create applications through a visual drag-and-drop interface (Swanson et al., 2019). Despite its potential, the use of this platform in mathematics education remains limited.

As an innovation, the researcher developed Mathflash, an application built using MIT App Inventor, which was launched around November 2, 2021. The app focuses on sequences and series material and includes menu options such as Start, Core Competencies/Basic Competencies, Learning Objectives, Material Discussion, Practice Questions, Quizzes, Profile, Learning Videos, Help, Classroom, and Search. According to Udjaja et al. (2018), interactive media elements like text, images, audio, and animations can enhance student engagement and interest in learning mathematics. Engaging learning tools can motivate students to practice problem-solving and deepen their understanding of sequences and series.

This is supported by Saputra et al. (2018), who found that Android-based interactive learning media is effective and feasible for classroom use in improving students' understanding and academic performance in mathematics. Similarly, Yunianta et al. (2019) concluded that technology-based learning using MIT App Inventor positively affects learning outcomes. Media developed using MIT App Inventor 2 received "good" ratings for content and "very good" for interface design, while the improvement in student learning outcomes reached a high category with a gain score of 0.71.

2. Method

This research method uses the stages of developing the Borg and Gall model which was modified by the researcher through eight stages, including: (1) initial observation; (2) plans; (3) making products; (4) product validation test; (5) limited scale test; (6) limited scale test revision; (7) field test; (8) analysis of field results. The data collection techniques used were interview guides and questionnaires (observation sheets) of experts and class XI student questionnaires on

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a limited scale test, the data analysis techniques used were qualitative and quantitative descriptive statistics using the validity of the Aiken index. Participants were taken using purposive sampling. This was done due to the limited time of the researcher and after coordination with the principal.Then to analyze the effectiveness of the media with the posttest given to students, the researcher first used the prerequisite test, namely the normality test of the population distribution, then used an alternative test, namely the one-sample t-test. There are several aspects that are tested by experts and students, for experts there are three aspects, namely: the quality of content and objectives, instructional quality, and technical quality. As for students, there are two aspects, namely: (1) design; (2) function. Initial observations were carried out by interviewing 3 XII grade students and 4 mathematics teachers to identify problems and the need for the Mathflash application. After the product is finished, the product validation test is carried out by 5 experts to assess the feasibility of the product. The data obtained was validated using triangulation. Based on comments and suggestions by experts, the researchers made appropriate revisions. The limited-scale test was carried out to 6 students of class XI MIPA who had obtained the material for sequences and series. Next, make revisions based on student suggestions/input on a limited scale test. The results of the expert assessments and students were then analyzed using the following criteria :

Table 1.

Quality of the Questionnaire Assessment Scale Validation

Interval Score	Value	Scale	Category
$\overline{X} > x_i + 1,8\,SB_i$	A	5	Very Eligible
$\overline{X}_i + 0,6\,SB_i < \overline{X} \leq x_i + 1,8\,SB_i$	B	4	Eligible
$\overline{X}_i - 0,6\,SB_i < \overline{X} \leq x_i + 0,6\,SB_i$	C	3	Fairly Eligible
$\overline{X}_i - 1,8\,SB_i < \overline{X} \leq x_i - 0,6\,SB_i$	D	2	Less Eligible
$\overline{X} \leq x_i - 1,8\,SB_i$	E	1	Very Less Eligible

(Proceedings: Sariyatul Ilyana and Ratna Candra Sari, 2016)

Description :

$\overline{X}$: Actual Score

$\overline{X}_i$: Actual average score with x_i

x_i : mean ideal score = $\frac{1}{2}$ (ideal maximum score + ideal minimum score)

SB_i : ideal standard deviation = $\frac{1}{6}$ (ideal maximum score - ideal minimum score)

After the application is used by 36 students in the field test, then the effectiveness test is carried out developed media. The instrument for understanding the material of sequences and series consists of 2 items of description questions. Then analyze the data obtained using a one-sample t-test.

Based on the research findings and data analysis, this study aims to describe the behavior of medical record officers and identify the causes of recurring medical record issues in healthcare facilities, particularly hospitals. The majority of medical record officers at Mamuju Tengah General Hospital are ≤30 years old, indicating limited work experience (1-2 years). While younger officers generally have good physical conditions, they tend to have lower responsibility levels compared to those over 30 years old (Bara, 2014). In terms of gender distribution, most medical record officers are female, possibly due to the lower work intensity and higher interest among women in this field. The hospital employs 38 officers, each assigned to specific roles such as BPJS verification, grouping, assembling, coding, and filing, ensuring workload distribution and reducing individual burdens. However, in terms of education, most officers hold a D3 in Midwifery, with few having formal training in medical records, leading

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to inefficiencies in their tasks. According to Green's theory, education plays a crucial role in shaping work behavior, productivity, and understanding of job responsibilities (Bara, 2014).

3. Result and Discussion

A. Preliminary Observations

Researchers conducted initial observations by interviewing 4 teachers and several students of class XII MIPA SMA Negeri 1 Sindang, some students still considered the materials in mathematics to be difficult, such as calculus, trigonometry, limits, sequence applications. , and geometric sequences and series. The factor that causes students to still find it difficult is because online learning has been carried out for the past 1 year due to the pandemic. However, there are also students who like mathematics because they like to count and think that mathematical material is only logical in the form of numbers.

The reason students are a little difficult to understand mathematical material is the lack of explanation of the material from the teacher in detail, the time provided to do the practice questions is very short, students are less focused on learning, the teacher only teaches by writing on the blackboard, still uses the lecture method (conventional), using powerpoint, classroom, and whatsapp group. Student learning outcomes on the material for sequences and series at the school are quite good, but there are still problems with the sub-materials for geometric sequences and series as well as the application of sequences, so learning media is needed, especially those that can be accessed via smartphones with an attractive appearance. Based on Cahyana et al., (2018) learning media through Android based smartphones makes learning more interesting and provides new experiences for students, and has advantages, especially in conveying material more clearly because of the composition of content such as animation, video, animation, sound, and text. interactive. In line with Jihad et al., (2018) that technology-based learning media has a role to facilitate learning, improve performance by creating, using, utilizing or managing technology appropriately, so with technological developments, teachers are required to be able to create technology-based learning media innovations. Here is a picture when the researcher made initial observations to students and teachers :

Figure 1.
Preliminary Observations

B. Identification of Needs for Mathflash Applications

Teachers and students interviewed need a learning media that is able to interact between students and teachers in learning in this all-digital era . According to Bilda, W., Fadillah, A., & Nopitasari (2021) androidbased learning media has the advantage that it can be improved

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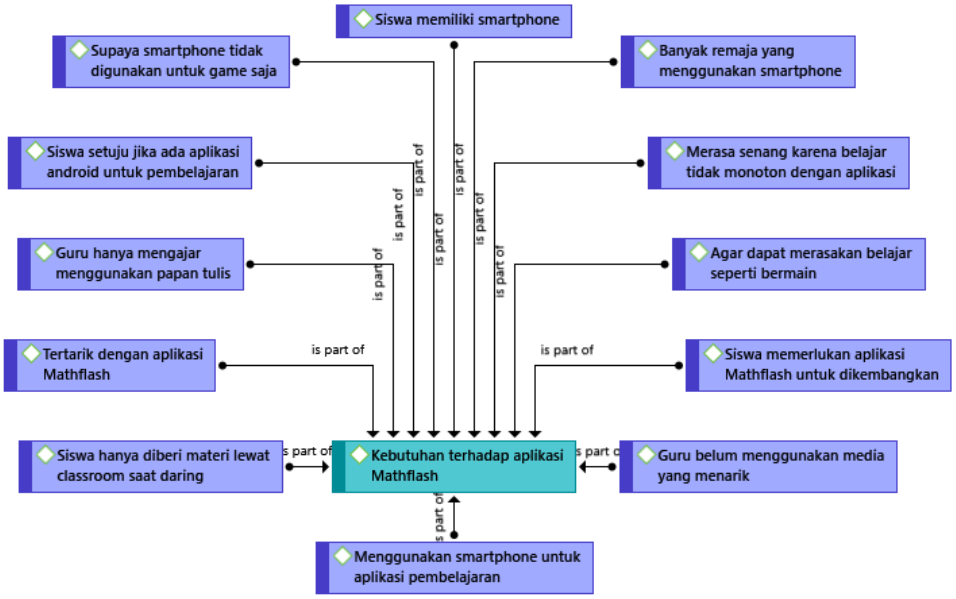
according to needs, so that the material developed in the application can be added and developed according to the needs of students. Therefore, learning using android-based media is important to be applied to mathematics learning. To analyze the needs, several things were carried out , including : assessment of learning media materials and assessment of media maker tools.

Figure 2.

Analysis of Mathflash Application Needs by S-1



Based on Figure 2. Student 1 said that they agreed and were interested if there was an android application for learning such as the Mathflash application, this was because students would be happy if learning was not monotonous. The researcher offered the Mathflash application to student 1 and student 1's response stated that students needed the Mathflash application to be developed, in order to feel learning like playing so that the smartphones that students have are not used for playing games only.

C. Plan

According to Rose et al., (2020) development requires a mature and correct plan to achieve the expected results and benefits, because the effectiveness of development is measured from the results of the development. The planning stage in this research is the researcher evaluates the results of the initial observations. Then determine the solution to the problems obtained in the initial observations. The researcher chose the material for sequences and series which according to the initial observations of researchers at SMA Negeri 1 Sindang, the material was still considered by students to be a little difficult in the submaterial of geometric sequences and series and the application of sequences. Next is the stage of collecting materials by downloading supporting software in addition to making applications.

D. Product Development

Making interactive media based on the Mathflash application at this stage begins with making an application storyboard design to make it easier in the process of designing media. Previously, the researcher had prepared several supporting software to fill in the items/content in the application. To create an application display design using App Inventor, the steps that need to be done include: 1) Creating an account on the App Inventor website; 2) Click Create App, to start creating apps; 3) Set the application display design; 4) Create Menu Search, Google Classroom, Help, Modules and KI/KD; 5) Creating Menu Materials, Exercises, Discussions,

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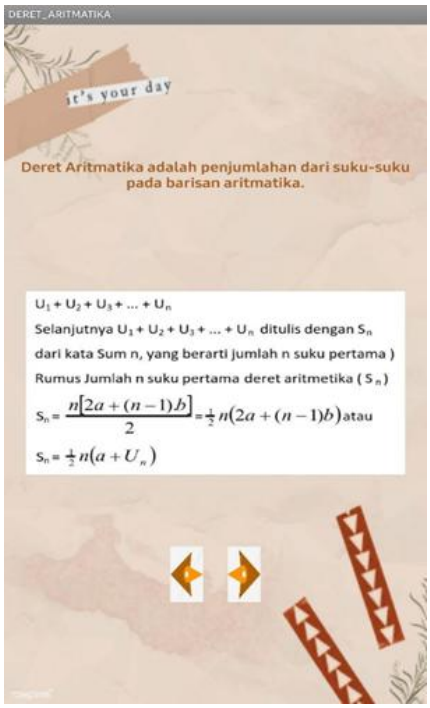
Profiles, Videos, and Bibliography; 6) Create a Quiz menu; 7) Making Coding Blocks, and; 8) Publish and download apps. Interactive learning media developed using the MIT App Inventor with apk format (Android Application Package) or in the form of an android application that can be installed via smartphones with the Android operating system and running well, can be easily used by all students and teachers both in the classroom and individually. independently wherever and whenever. According to Maihidin Pahlifi & Fatharani (2019) the use of media in the learning process is able to make learning more meaningful and quality because the learning media contains complete, practical, interesting, efficient, and flexible material that can be used anytime and anywhere with varied practice questions. Here are some views of the Mathflash application developed by the researcher :

Figure 3.
Main Menu Display

Figure 4.
Material Display



The Profile feature contains the researcher's biodata, while the KI/KD feature contains core competencies and basic competencies that students must achieve after participating in learning. The Video feature contains a video explaining the sequence and series material to help students understand the material. The Materials menu contains learning materials in the form of images and text and in it there are learning modules to support the delivery of line and series material. The Bibliography menu contains references in the creation of application content. The Help menu is used to help students if they have difficulty and to interact more with the teacher. The Quiz menu contains games in groups or individually, games created using the Quizizz website and Game Wordwall. In addition to quizzes, there is also an Exercise and Discussion feature containing individual practice questions on line and series material, there are 10 questions on line and series material and their application in activities carried out every day. Students can see the score display after all questions in the Practice menu are answered. The following is the display of the Exercise menu :

Figure 5.

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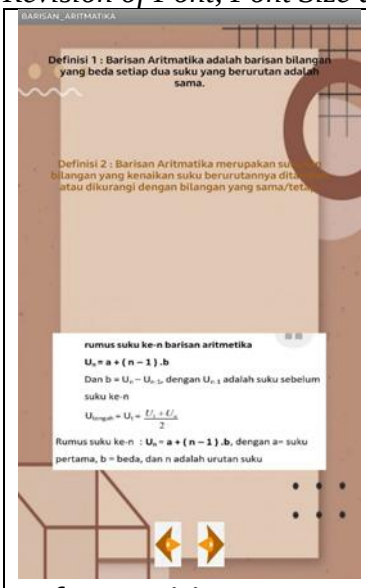
Exercise Menu

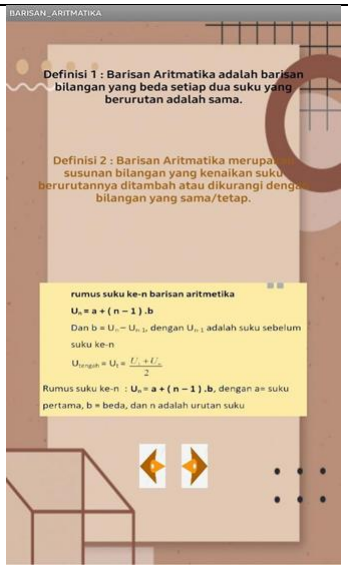
E. Product Validation Test

At this stage the researcher provides a rating scale in the form of a statement regarding the feasibility of the media on the expert validation observation sheet and all validators state that the interactive media based on the Mathflash application developed is feasible to use. Based on the results of the media feasibility test which was assessed by 5 experts , the overall average score of the three aspects of feasibility was 3.53 with a eligible category. From some suggestions given by experts, the researchers revised some of the application's appearance, the layout is not neat and the background looks contrasting. Then improvements to the typeface, font size and modules used to attract students and make it easier for students to use the Mathflash application. Figure 6.

Revision of Font, Font Size and Layout



Before Revision



After Revision

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The following is a picture of the implementation of the product validation test :
Figure 7.
Implementation of the Product Validation Test

F. Limited Scale Test

The researcher provides a rating scale in the form of a statement regarding the feasibility of the media on student observation sheets and six The student stated that the interactive media based on the Mathflash application designed by the researcher could be used properly. The feasibility of the media assessed by students got an overall average score of both aspects of feasibility of 4.54 in the eligible category. The following is a picture of the implementation of the limited-scale test for students :
Figure 8.
The implementation of the Limited-Scale Test.

G. Revision of the Limited Scale Test

Product revisions are carried out according to the suggestions and comments from students after the limited-scale test is completed, which researchers fix is to close the answers to the questions on the initial display Quizizz, then the image/icon on the oversized menu is reduced, and for the home button the size and image of the icon can be clarified to make it easier for application users to return to the previous menu or to the main menu. The following is one of the results of the limited scale test revision :

Figure 9.

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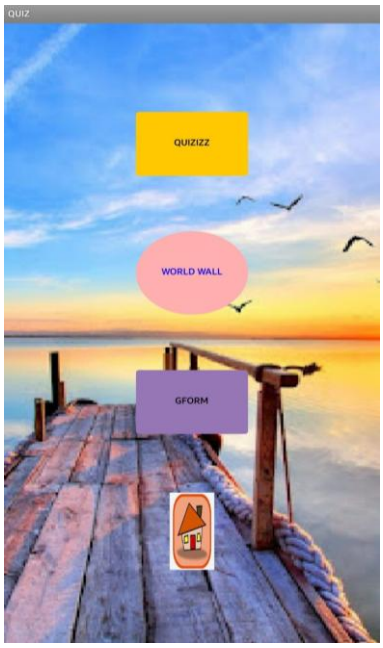
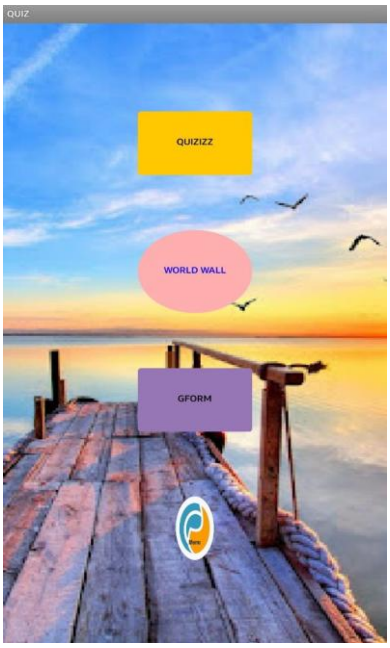
Revision on the Home Button Icon



Before Revision



After Revision

H. Field Test

Field test research is carried out with 100% face-toface learning in class, but must comply with health protocols from the government, namely wearing masks with learning allocation is only 45 minutes per one subject. The field test was carried out on March 30, 2022 in class XI MIPA 5 because they had not yet obtained the material for sequences and series. The data needed to determine the effectiveness of interactive media based on the Mathflash application was collected using a posttest technique after learning using interactive media based on the Mathflash application. The test test is in the form of two essay questions. The number of students who took part in the study were 36 students. The following is a picture of the implementation of the field test :

Figure 10.
Implementation of the Field Test

I. Analysis of Field Results

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After obtaining the data on the results of the posttest students, then conducting a prerequisite test in the form of a normality test for the experimental class before conducting the effectiveness test or one sample t test. In this study, the normality test was carried out using the Kolmogorov-Smirnov test. The results of the normality test were as follows :

Table 2.

Normality test results

n	D_0	D_k	Description
36	0,209	0,230	Samples were taken from a normally distributed population.

Table 2 shows that D_0 (the value of the Kolmogorov-Smirnov distribution from the observations/sample) = 0,209 dan D_k $(D_{(0,05;36)}) = 0,230$. Because $D_0 < D_k$, so neither reject not accept H_0 . That is, the sample is taken from a population that is normally distributed.

The normality test has been met, after that the effectiveness test is carried out using a one-sample t-test. The goal is to find out the effectiveness of interactive media based on the Mathflash application for sequences and series. The interactive media based on the Mathflash application is effective if the difference in the average score after learning using interactive media based on the Mathflash application with the effective criterion score is greater than zero.

Table 3.

Results of one sample t-test

n	μ_o	μ_k	t_{obs}	t_k
36	44,167	37,5	5,574	1,690

Table 3 shows that the mean score of understanding the concept of sequences and series = 44.167 and the effectiveness is 37.5. Obtained tobs = 5.574 and tc = 1.690. So, tobs > tc then reject Ho, so that interactive media based on the Mathflash application for Barisan and Series material is effectively used in learning. This is because interactive media based on the Mathflash application contains an attractive design display in the form of animations, videos, text and images that can increase students' motivation and interest in learning to study sequences and series material. In line with Wahid et al., (2020) that learning media can be in the form of useful hardware and software to facilitate the learning process and student understanding. The learning process using the Mathflash application, students are presented with an attractive media display with various features that make students more interactive with teachers and other students. Students get the opportunity to actively participate either in groups or individually through games, quizzes and practice questions in the Mathflash application. Materials, learning modules and learning videos with additional pictures and animations are displayed more attractively in order to be able to make students interested in practicing understanding the sequence and series material so that students are able to utilize existing concepts to solve problems related to everyday life. Interest in learning and students motivation to practice questions in the media can increase the understanding of the material of sequences and series.

This supports research conducted by Kocakoyun & Bicen (2017) that android is effectively used as a learning medium that helps students to gain knowledge anywhere and anytime, android-based learning applications can support education, increase motivation,

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improve academic achievement and can be used by students. to communicate. In accordance with Buchori et al., (2017) that mobile technology is something that allows everyone to create flexible and easy learning, or what is commonly called mobile learning (M-Learning). Based on research conducted by Dwi Siswanto et al., (2019) resulted in an attractively packaged application named "Combinatorics Application" which is a practical and attractive learning using Android-based media that can be accessed anytime and anywhere. This proves that the use of android-based learning media can increase students' interest in learning mathematics as well as a means to help students learn independently.

4. Conclusion

Interactive media based on the Mathflash application on the material of sequences and series reached the criteria for use in learning. Based on the results of the media feasibility test, which was assessed by 5 experts, the overall average score of the three feasibility aspects was 3.53 in the eligible category, and the media assessed by 6 students got the overall average score of the two feasibility aspects of 4.54 in the eligible category. Testing the effectiveness of learning media using one sample t-test resulted in tobs = 5.574 and tc = 1.690. So, tobs > tc then reject Ho, so that interactive media based on the Mathflash application material is effectively used in learning. Based on that description, it is concluded that the development of interactive media based on the Mathflash application can effectively train students to understand the material of sequences and series, so it is appropriate to use it in the learning process, especially in mathematics.

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