

Development of Mathematics Learning Media Based on Android Applications Using Construct2 on Number Pattern Materials

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Abstract: This research aims to produce mathematics learning media based on Android applications using constructs2. The material chosen is 'Number Pattern' for Junior High School students at SMP Negeri 3 Sungai Pua. This research and development (R&D) use the Plomp model which consists of a preliminary research phase, a development or prototyping phase, and an assessment phase. The research subjects were students in class VIII 1, which consisted of 5 students, and class VIII 2, which consisted of 25 students. This study produced an android application-based mathematics learning media using construct 2 on 'Number Pattern' that met the following criteria: (1) valid with a final validity score of 78.52%, (2) practical with an average score of 83.86%, and (3) very effective with an average score of 90.4. The number of students who achieve minimum grade standard is 24 students out of 25 with a 96% average completed score. Based on the results of the development carried out, the final product is produced, namely, Mathematics learning media based on Android applications using constructs2 on Number Pattern that is valid, practical, and very effective..

1 INTRODUCTION

The fourth industrial revolution (or "4.0 revolution") is the age of widespread use of cutting-edge technologies, including fiber optics and integrated network systems. Science and technology are developing very rapidly, these developments have an impact on the development of learning media. Technology-based learning media can be run with the help of a smartphone. A smartphone is a communication device that has various functions. Smartphones can display representations of study books in a display that is more attractive, practical, interactive, and not limited by time or place so that students can use smartphones as learning media that support learning activities (Huda in Putri Nandita Apsari et al, 2018: 162).

One of the instructional tools used by instructors to impart content and foster creativity is learning media. The term "media" refers to all tangible things that may be touched, observed, heard, read, or discussed, as well as the tools that are used to do these things. (Ruth Lautfer (in Talizaro Tafonao, 2018: 2).

Between teachers and students, learning media act as a physical and non-physical intermediate to improve the effectiveness and efficiency of learning. ((NEA (in Salahuddin 2016: 11 4),(Musfiqon (2012:28), Ruth Lautfer (in Talizaro Tafonao, 2018: 2)). Based on the definition, then it can be concluded that media is anything that can help students in the learning process so that students can understand the messages conveyed in learning.

Some research on the development of android-based mathematics learning media has been carried out by several researchers, one of which is research on the development of learning media on three-dimensional material for Senior High School students. Researchers reported that the media developed, the category was quite valid, learning completeness reached 80% in the effective category, and the results of the practicality of the media obtained an average score of 54.485 in the practical category (Dwiranata et al., (2019)). This is in line with the results of Habibur Rohman's research (2019) which states that students need a learning media that can be used at home or in class, and of them is

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learning media based on android applications using construct2. The goal is that students are helped and motivated in learning mathematics. Likewise, Atik Herawati (2018) states that discovery learning-based learning media with constructs is appropriate to use because these media can arouse student learning interest.

Lessons can be created and crafted by using the most recent technological advancements. Information and technology-assisted learning materials (ICT) can be utilized to make learning engaging and improve academic achievement through improving academic achievement in the form of learning outcomes and motivation for learning. (Chuang, 2014, p. 1969). The implementation of learning as required by PP No. 32 of 2013 article 19 paragraph (1), which states that learning activities in educational units are held interactively, inspiring, enjoyable, challenging, and motivate students' interest, can also be facilitated by the use of ICT-assisted learning media..

The use of learning media has a very important role in improving the quality of learning so that it becomes effective and efficient. Meanwhile, according to Suryani and Agung (in Liza Ainul Mila, 2019: 12), stating the objectives of using learning media are (1) increasing learning motivation, (2) facilitating the presentation of learning materials, (3) making it easier for teachers to make variations in learning methods, (4) increasing student activity during the mathematics learning process. One application of 21st century learning styles is the usage of Android-based learning resources.(Calimag et al., 2014, p. 90). The utilization of this kind of educational resources has the potential to enhance students' academic performance in terms of cognitive learning outcomes.(Chuang & Chen, 2007, p. 27; Jabbour, 2014, p. 2) and student learning motivation (Hess, 2014, p. 35; Calimag et al., 2014, p. 90).

Likewise Li et al. (2010, p.171) mentions the use of smartphones and tablets for learning can benefit the cognitive, metacognitive, emotional, and sociocultural components. Smartphones and tablets have the power to transform the learning experience. Likewise, Rohman (2018: 112) states that Android-based learning media is effective in improving student mathematics learning outcomes. In other words, Android or what is often called a smartphone can display representations of learning books in a more attractive, interactive, practical way and are not limited in time and place for study. With engaging applications, this form of learning medium enables students to learn without restrictions on time or location. (Squire, 2009, p.70; Meister, 2011, p. 28).

By 2018, there will be more than 100 million active smartphone users in Indonesia, according to digital marketing research firm Emarketer. This indicates that, behind China, India, and America,

Indonesia will have the fourth-highest percentage of active smartphone users globally. (Wahyudi, 2015). Similarly, the use of smartphones based on the type of work, namely 70.98% of users are students, while based on education level 79.56% of smartphone users are dominated by students (Kominfo, 2017).

The use of android media in the learning process is one of the efforts to create more meaningful and quality learning, can help students practice problem solving skills, especially math problems, and can concretize mathematical concepts that were initially abstract to become concrete with the visualization of mathematical concepts taught (Muhammad Takdir (2018:2) Setiawati & Qohar (2020) Argarini & Sulistyorini (2018).

Furthermore, based on the results of observations made at a Junior High School namely, SMPN 3 Sungai Pua, it was found that students felt bored learning if learning used media that was less interesting, and the method used was the lecture method. Based on these problems, the researcher developed an Android application-based learning media using construct2 because Android application-based learning media using construct2 was needed, so that effective, efficient and fun learning was achieved for students. While the goal of this research and development is to provide construct2-based mathematics instructional media that is reliable, usable, and efficient.

2 METHODS

This study belongs to the category of development research, or R&D. According to (Arliza R, Setiawan I 2019), R&D research is a process or set of activities used to create new products or enhance currently established ones.

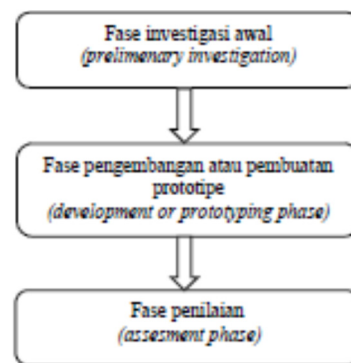


Figure 1: Plomp's research and development phase.

Plomp's research and development design is referred to throughout this research and development.

The Plomp model is thought to be more adaptable than the other versions and is therefore ideal for creating this product. Plomp's model is divided into three stages: the first stage is basic research; the second stage is development or prototyping; and the third stage is assessment. (Plomp and Nieven, 2013:30), as shown in the following figure 1.

The activity steps for each phase are as follows. Initial investigation phase (preliminary investigation). Planning work for the creation of construct2-based Android applications for mathematics learning media was done during the early inquiry phase. In this phase, researchers gather data or information in the field and, using analytical questionnaires, discover data collection-related issues.

In this phase, the researcher designed a product in the form of an android application using construct2 according to the characteristics of the students. The purpose of this phase is to prepare learning media based on Android applications using constructs2 that will be developed. At the prototyping stage, a formative evaluation is implemented. Formative evaluation is an analysis of a product's advantages and disadvantages to determine its applicability and validity.

After prototype 1 of the android application-based learning media using construct2 which was developed was declared valid and produced prototype 2, it then went through another trial to evaluate the product. The media evaluation consisted of small group evaluations. In this prototype, a small group test was carried out. Small group tests were carried out by asking 5 students to use learning media based on Android applications using construct2. Then a student practicality questionnaire was distributed to 5 students who took the test.

A limited trial (large group trial) was then undertaken in one class after the small group evaluation. At this point, the goal is to determine how well the Android application-based mathematics learning media usage construct2, which was developed in the implementation of learning, works practically and effectively.

The data from the trial results were then reviewed and the learning materials were once again updated in light of the findings of the one-class trial. It took numerous trials and data modifications before usable and efficient learning media prototypes could be produced. Figure 2 below shows the study's actions in detail.

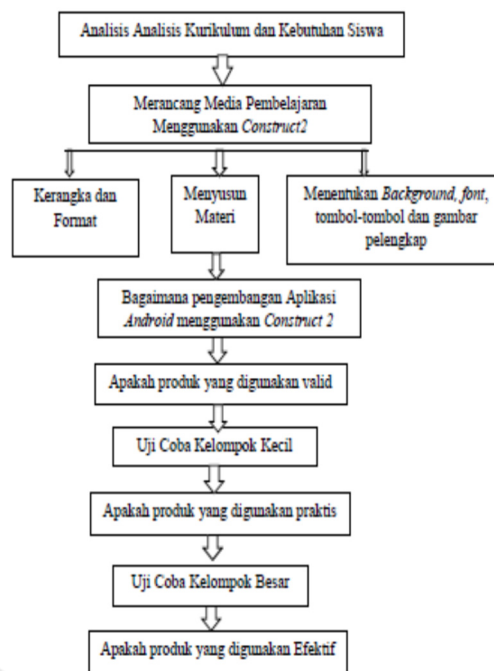


Figure 2: Research and development scheme process.

Students are used to test the product trial phase, which has been deemed valid by several validators. The feasibility of deploying learning media based on Android applications using construct2 will be evaluated after the trial period. Product trials are evaluating the viability of newly created learning mathematics products. The trials' purpose is to evaluate the viability of learning media built using construct2 for Android applications.

Class VIII 2 Junior High School students from SMPN 3 Sungai Pua, Agam District served as the study's test subjects for the 2022–2023 academic year. The experiment was carried out with class VIII to evaluate the practicality and efficacy of Android application-based learning media based on number pattern content.

In carrying out research and development (R&D), researchers used two types of data collected, namely quantitative data and qualitative data. Quantitative data were obtained from validator assessment questionnaire scores and student assessments. This qualitative data was in the form of validator suggestions for the product being developed and a description of the product trial implementation.

The instrument is a device used to make something easier to implement. The study's data collection tools included validity questionnaires, practicality questionnaires, and learning outcomes tests in activities to evaluate the efficacy of learning media based on Android applications using

construct2 on number patterns. The validation tests were conducted by media experts and material experts, and the practicality tests were conducted by teachers and students.

The Purpose of this Construct2's Technical Study of Data Regarding The Use of Learning Media Based on Android Applications Is To Characterize All The Validators' Opinions, Recommendations, And Responses As They Were Gleaned from The Description Column. an Open Assessment Questionnaire Was Used to Gather Information During the Trial Phase to Provide Feedback, Suggestions, Comments, And Improvements. The Outcomes of this Descriptive Study are Used To Assess the Degree of Validity, Applicability, And Efficacy of Products or Product Development Outcomes. A Likert Scale With Five Levels of Criteria Is Used To Collect Qualitative Data From The Questionnaire, Which Is then Examined By Computing the Percentage of the Average Item Score for Each Response to Each Questionnaire Question.

3 RESULT AND DISCUSSION

3.1 Results

Development of learning media based on Android applications using constructs on number pattern material. The material chosen in this study is material for the first semester of the 2022/2023 academic year. The initial investigation phase was carried out to plan development activities for Android application-based learning media using construct2. During this phase, the researcher collects data or information in the field and distributes student needs analysis questionnaires to students. It is obtained as follows. The recapitulation of the curriculum analysis for the Number Pattern' teaching materials is shown in Table 1 below.

Table 1: Summary of curriculum analysis results.

No	Basic competencies	Indicator
1.	3.1 Make generalizations of patterns on number sequences and object configuration sequences.	3.3.1 Determine the pattern of object configuration rows. 3.3.2 Determining patterns and syllables of number sequences. 3.3.2 Determine arithmetic sequences and series
2.	4.1 Solving problems related to patterns in number sequences.	4.4.1 Solve problems related to arithmetic sequences and series.

Source: Middle school curriculum (K-13).

The recapitulation of the student needs questionnaire analysis is presented in Table 2 below.

Table 2: Students need assessment recapitulation.

No.	Statement	Conclusion
1.	What do you think about math?	As many as 60.86% of students said that learning mathematics was very interesting and fun.
2.	What are the reasons students don't like math?	As many as 52.17% of students said that they did not like learning mathematics because there were too many formulas
3.	Are mathematics learning resources provided at school?	As many as 100% of students said that the school had provided resources.
4.	What learning resources are provided in the school?	As many as 82.60% of students said that the school had provided learning media, namely textbooks.
5.	Have you ever learned to use an Android application?	As many as 65.21% of students said that they had learned to use the Android application
6.	Do you agree to learn to use the Android Application?	As many as 78.26% of students said that they agreed if mathematics learning media were made
7.	Can you understand how to solve math problems in the learning media?	As many as 65.21% of students said that they could understand how to solve math problems in the learning media. As many as 52.17% of students showed curiosity in learning
8.	Do the teaching materials you use contain values such as: Honest; Creative; Independent; Hard work; Curiosity	As many as 52.17% of students develop curiosity in learning
9.	Can the teaching materials that you use increase your motivation in learning?	As many as 73.91% of students said that they were motivated in learning to use the Android application.
10.	How is the use of language in teaching materials that you often encounter?	As many as 65.21% of students said that the language used in previous teaching materials was easy to understand.
11.	What language is suitable in learning media?	As much as 95.65% of students agree that the language used in simple language learning media.
12.	Do you like learning media based on Android applications.	As many as 60.86% of students like to learn using mathematics learning media based on the Android application

No.	Statement	Conclusion
13.	What color do you like the most for presenting Android Application-based learning media?	As many as 34.78% of students liked the media presented in blue.

The phase of development or prototyping. Using construct2 software, the researcher creates a product at this stage that is tailored to the needs of the students and takes the form of an Android application. Basic competencies (KD), learning objectives, learning resources, and sample questions are all included in Android application-based mathematics learning media. The activities in this phase are, Material Assessment Based on the analysis stage, the material used to develop learning media based on the Android application is number pattern material for class VIII Junior High School students. Opening aims to make an Android application using construct2 software to impress the user with the appearance of the main menu. It also consists of the entrance to selection menu, the basic competency menu, and learning objectives with attractive color choices, and attractive font types to motivate and generate enthusiasm for students in learning. The opening page can be seen in Figure 3.



Figure 3: The opening menu display.

The main display of the android application uses the developed construct2 software, consisting of the basic competency main menu, the learning objectives menu, the instructions menu and the material menu in the android application. The first menu is the KD menu. In this section, if selected, it will display learning competencies KD that applies in schools, namely K13. The main menu display can be seen in Figure 4.

Figure 4 shows the main menu on the android application using this construct2 software, there is a KD menu, learning objectives menu, instructions menu and material menu in the android application using the construct2 software.



Figure 4: Display of the Android application main menu using construct2 software.

The first menu is the Basic Competency (KD) menu. In this section, if selected, it will display the KD The second menu is the hint menu. In this section, if selected, it will load an Android application-based media usage guide page. The third menu is the material menu, this page contains material and explanations of some solved problem. The appearance of the material used in this android application includes the presentation of material in a systematic manner with an initial discussion, namely the understanding of number patterns along with a discussion of sample questions. Discussion of questions that are packed as interesting as possible.

Before validating learning media based on Android applications using construct2, the validity of the research instrument was first carried out, then the validation of the instrument was analyzed according to what had been determined. Suggestions and improvements from the validator and the results of the Android Application validation are shown in Figure 5 below:



Figure 5: The display before and after validator suggestions.

Based on the criteria for assessing the validity of Android application-based learning media that had been previously determined that the product met the criteria $68 < V \leq 84$ with an average validation score of 77.24 %, it means that the android application-based learning media is feasible to use with a little revision. The results of the final assessment of learning media based on Android applications using construct2 can be seen in Table 3 below:

Table 3: Final assessment result recapitulation.

No	Validators	Score %	Description
Media Expert			
1.	01	74,28	Valid
Material Expert			
2.	01	72	Valid
Linguist			
3.	02	85,45	Very Valid
Average		77,24	Valid

Student Practicality Response Questionnaire Results. The results of the student practicality response questionnaire can be seen in Table 4 below.

Table 4: Student practicality response questionnaire results

No.	Statement	Total Score	Score Mak.	Perc enta ge	description
A. Interest to learn					
	1. Attractive Android Application cover design	110	125	88	Very Practical
	2. Instructions for using the Android Application in learning are clear and easy to understand	113	125	88	Very Practical
	3. Android application can help me in studying	100	125	80	Very Practical
	4. Android application makes me bored studying*	100	125	80	Very Practical
	5. The existence of pictures in the media makes me lazy to study*	106	125	84,5	Very Practical
	6. Android applications can generate	106	125	88,4	Very Practical

	curiosity and can increase my motivation in learning				
	7. The existence of pictures in the media makes me lazy to study *	105	125	84	Very Practical
	8. Android application can help me in studying smoothly	125	125	92	Very Practical
	9. Android applications can make learning easier for me	125	125	88,8	Very Practical
B. Material					
	1. The presentation of the material contained in the Android application is easy for me to understand	105	125	84	Very Practical
	2. The presentation of sample questions contained in the Android application is easy for me to understand	107	125	85,6	Very Practical
	3. Presentation of material using Android Application media is more interesting	109	125	87,2	Very Practical
	4. I can use Android Application Media well	113	125	90,4	Very Practical
C. Benefit					
	1. I can use the Android Application Media for independent study	102	125	81,6	Very Practical
	2. I can use Android Application Media well	103	125	82,4	Very Practical
	Average			85,4 %	Very Practical
	Category				Very Practical

Based on the criteria for assessing the practicality of learning media based on Android applications that

have been determined, the final product meet very practical criteria, namely $85 < P \leq 100$ with an average score (85.4%). So it can be concluded that mathematics learning media based on the Android application is very practical in learning.

From the results of the teacher's practicality response, it can be concluded that the presentation of number pattern material on the Android Application-based mathematics learning media using construct 2 is clear, the language and examples of questions contained in the learning media are easy to understand, the appearance of the Android application is attractive, and can make learning easier.

So, it can be concluded that Android application-based learning media is practical in terms of utilization and usage. The results of the practical response questionnaire from the teacher can be seen in Table 5 below.

Table 5: Teacher practicality response questionnaire results.

No.	Indicator	Scor (%)	Description
1.	The depth and breadth of the material achieves the learning objectives	80	Practical
2.	Suitability with students' cognitive development	80	Practical
3.	Student curiosity arises when learning to use the Android application	100	Practical
4.	Students are interested and motivated in learning to use the Android Application	80	Practical
5.	Media design with less attractive material*	80	Practical
6.	Appropriateness of the right mathematical concepts to the material	80	Practical
7.	uitability of the material with KD (K13)	80	Practical
8.	Order of presentation of systematic material	80	Practical
9.	There are no examples of questions in learning media (*)	100	Practical
10.	Availability of test questions at the end of learning	80	Practical
11.	The theme and color combinations used are attractive	80	Practical
12.	The selection of images on Android Application media is interesting	80	Practical
13.	The font used is very clear to students	80	Practical

No.	Indicator	Scor (%)	Description
14.	Ease of use of Android Application media by students	80	Practical
15.	The navigation buttons are attractive and can be used smoothly (next, back, home and sub menu buttons).	80	Practical
16.	The language used is easy for students to understand and is in accordance with (EYD)	80	Practical
17.	The language used is not in accordance with (EYD)*	80	Practical
	Average	82,35%	Practical

To see the effectiveness of the android application-based mathematics learning media using construct2 on number pattern material, a test was carried out on each student, to measure the level of student understanding of the material that had been learned and understood by using the media. The learning outcomes test can be seen in Table 6 below.

Table 6: Students test result recapitulation.

No	Information	Total students	complete%
1.	Complete >70	24	96 %
2.	No complete <70	1	4 %

The results of the assessment of the effectiveness of the android application-based mathematics learning media using construct2 on the number pattern material meet the very effective criteria, namely $80 < E \leq 100$ with an average percentage of student learning completeness of 96% or the number of students who completed as many as 24 students out of 25 students who took the test.

3.2 Discussion

The existence of the Covid-19 pandemic has motivated teachers to improve their skills in designing technology-based learning. There are many platforms available to support learning. Android applications using construct2 are a platform that provides creators to be creative in creating an application easily without coding, including teachers. Teachers can add material and quizzes in the form of text, audio, and video, attach files, and can even be integrated into websites and social media. Of course, the features that have been made can help the learning process, especially in number pattern material.

According to the research, teachers at SMP N 3 Sungai Pua were unfamiliar with the android application-based mathematics learning medium that used construct2. Construct2-based Android apps for learning maths that have been approved by professionals. Based on the results of the validation of the android application-based mathematics learning media using construct2 by 3 validators, a total score of 78.52% met the valid criteria, especially in aspects of learning, material, language, learning evaluation, and usability was considered valid. Practicality assessment can be seen from two sources, namely practical response questionnaires by teachers and practical response questionnaires by students. The results of the teacher's response questionnaire obtained an average score of 82.32% met the practical criteria. The results of the student response questionnaire obtained an average of 85.4% fulfilling very practical criteria, especially in learning interest, ease of understanding, and presentation of material and media presentation. Based on the total average score, it was obtained that mathematics learning media based on Android applications used constructs2 with practical criteria, namely 83.86%. While the assessment of effectiveness, seen from student learning outcomes tests showed that 24 students achieved the minimum completeness criteria ($KKM = 70$). Thus the percentage of student learning completeness is 96%, so effectiveness is obtained with very effective criteria. From student learning outcomes it is known that there is an effect of learning outcomes by using learning media based on Android applications using construct2.

This can happen because learning using learning media based on Android applications using construct2 can motivate students to learn the material provided quickly, and to be able to work together in completing their assignments. This is in line with the research results of Astuti & Bhakti (2018), learning media is a new strategy for learning in the classroom so that learning is meaningful, not boring, and non-abstract. The use of mobile learning has been shown to encourage student motivation and support in their learning activities (Sulisworo et al, 2016). The development of multimedia technology promises great potential in changing the way students learn.

Multimedia also provides educational opportunities for developing learning techniques (Taufiq et al, 2017). The existence of learning media made by the teacher can increase student learning motivation and students are interested in the lessons delivered by the teacher.

Likewise, according to Bhakti & Astuti (2018), the skill level or psychomotor ability of students will

increase if the learning provided by the teacher is changed (not monotonous) and uses interesting learning media. Because it is packed with games and allows students to learn at any time, anywhere, and with any device, learning with learning media based on Android applications using construct2 makes students happier in learning. Students' high levels of interest and motivation to learn considerably improve the learning results they achieve. Construct2-based learning applications for Android have several benefits, one of which is that the design of the media is appealing in terms of color, language, graphics, and animation. The buttons on this medium can function properly when used following the instructions, making it simple to use and understand by pupils. Students won't get tired of utilizing the material because it follows the SK/KD and is complemented by images and animations.

The findings of this study support the claims made by Matsuo et al. (2012, pp. 34–49), Sakat et al. (2012, p. 874), Anggraeni & Kustijono (2013, pp. 17–18), and Jabbour (2014, pp. 1-3), according to which technology-based learning media can improve learning outcomes by boosting motivation for learning, making it more interesting and fun, and increasing learning interest.

They are created under students' levels of thinking, learning media can enhance cognitive learning results (Sudjana & Rivai, 2011, p. 3). The stages of mental evolution, from concrete to abstract, from simple to sophisticated, are reflected in the degree of human thought. Because learning media allow for the concretization of abstract information and the simplification of complex information, they are strongly tied to the phases of thinking. For the mutual benefit and protection of Authors and Publishers, it is necessary that Authors provide formal written Consent to Publish and Transfer of Copyright before publication of the Book.

The signed Consent ensures that the publisher has the Author's authorization to publish the Contribution. The copyright form is located on the authors' reserved area. The form should be completed and signed by one author on behalf of all the other authors.

4 CONCLUSIONS

The conclusions from this study include, the android application-based mathematics learning media using construct2 on number pattern material has been successfully developed. The development process uses Plomp's development model through 3 phases,

namely: (1) the preliminary research phase, (2) the development or prototyping phase, and the assessment phase.

The results of evaluating the validity of the android application-based mathematics learning media using construct2 on number pattern material by the validator met the valid criteria with an average score obtained of 78.52%. So that the mathematics learning media based on the android application uses construct2 on number pattern material that is feasible to use with a slight revision according to the suggestions of the validator.

The results of the practicality assessment of the android application-based mathematics learning media using construct2 on number pattern material meet practical criteria with an average teacher response score of 82.32%, while student responses with an average of 86.25% for class VIII 1, 85.4% for class VIII 2.

The average score for practicality was 83.86%. So the Android application-based mathematics learning media uses construct -2 on number pattern material that is feasible to use. The results of the effectiveness of the Android application-based mathematics learning media using construct2 on number pattern material are very effective with an average score of 90.4. So that the average percentage of student learning completeness is 96% or the number of students who complete 24 students out of 25 students who take the learning achievement test.

Based on the results of the development carried out by going through the 3 phases above, the final product is a valid, practical, and very effective Android application-based math learning media.

Mathematical learning media products based on Android applications using construct2 on number pattern material are considered very effective for use in learning, so it is recommended that educators and students be able to use them as alternative media for learning mathematics on number pattern material. Similar media also need to be developed with other learning materials to support the implementation of learning in schools.

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