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Development of Android-Based Learning Media to Improve Students' Mathematical Communication Skills in Social Arithmetic

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Abstract: Mathematical communication skills refer to students' ability to convey mathematical ideas, either orally or in writing, as well as their ability to understand and interpret the mathematical ideas of others. At MTs Negeri 2 Purbalingga, students exhibit a low level of mathematical communication skills due to the continued reliance on conventional learning media, which do not actively engage students. The selection of appropriate and innovative learning media plays a critical role in addressing this issue. As advancements in science and technology progress rapidly, it is essential to integrate technology into learning media to enhance student engagement and learning outcomes. Therefore, the objective of this research is to develop valid and effective Android-based interactive learning media to improve the mathematical communication skills of seventh-grade students in social arithmetic at MTs Negeri 2 Purbalingga. This study employs the Research and Development (R&D) method to achieve this goal. The findings indicate that the developed Android-based learning media are valid and suitable for use. Validation results show high percentages from various assessments: material experts (91.66%), media experts (93.3%), teacher assessment (92.5%), small group test assessment (88.81%), and field tests assessment (92.68%). Furthermore, the Android-based learning media developed is effective in improving students' mathematical communication skills. The t-test results show a significance value of 0.000, which is less than the threshold of 0.05, indicating that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. In conclusion, the Android-based learning media developed in this study are both valid and effective in enhancing students' mathematical communication skills, making them a valuable tool for teaching social arithmetic.

Keywords: android; learning media; mathematical communication skills

A. Introduction

The development of increasingly advanced times has resulted in almost all aspects also changing. One of the changes that we can feel is the increasingly rapid development of technology and has become an important thing in human life. It is said to be important because the influence of this technology is very large, many human activities depend on technology. Both in the economic, social, mass media, telecommunications, and even education fields cannot be separated from the influence of technology.

Education is one of the things that is mandatory or the main need that a person must have. The better the education, the better the quality of life will be. The quality of the nation's life

depends on education, as stated in the preamble to the 1945 Constitution. It is stated that one of the goals of the Indonesian State is to make the nation's life intelligent. In accordance with this goal, efforts to improve the quality of education must be given serious attention so that human resources can be greatly increased. Education today must be adapted to developments in the 21st century so that students' competence increases, so they can face competition and global challenges (Pratiwi, 2019).

Mathematics is a scientific study which includes patterns of structure, change and space. In essence, mathematics is a deductive science, structured about patterns and relationships, a language of symbols, and the queen and service of knowledge (Amelia Rosmala, 2021). Mathematics as a deductive science means that mathematics requires proof of truth. Mathematics as a structured science means that mathematical concepts are arranged hierarchically and start from undefined elements, defined elements, axioms and theorems.

Mathematics as a language of symbols means that mathematics is written using symbols that are valid, comprehensive and have a solid meaning. The process of searching for truth in mathematics is also long and requires proof with theorems, properties and postulates after proof. This long process and requires seriousness is the reason why many students experience difficulties in learning mathematics. Many students think that mathematics is a difficult subject, even calling it a horror subject. Mathematics is the basic science for studying other sciences, therefore it is very important for teachers to ensure that the learning process that occurs in the classroom can be successful as expected.

To make this happen, all efforts are made so that students' abilities during the learning process can increase. One of the abilities that students must have in learning mathematics is mathematical communication skills. Communication is a way to convey a message from the messenger to the recipient of the message to inform them either directly or through the media (Nur Zaharah, 2021).

Mathematical communication is the ability to convey mathematical ideas or thoughts, both orally and in writing, as well as the ability to understand and accept other people's mathematical ideas carefully, well and appreciatively in order to increase understanding of mathematical concepts (Hafiziani Eka Putri 2020). There are two reasons for the importance of mathematical communication that students must have and develop. First, mathematics is language, meaning that mathematics is not only a thinking tool, a tool for creating models, or solving problems, but mathematics can be used as a tool or medium to communicate ideas or thoughts clearly, accurately and comprehensively. The second reason is mathematics learning as social activity, what is meant by this is as a social activity in mathematics learning and also as a tool for interaction and communication between teachers and students (Rianti Rahmalia, 2020).

Students' mathematical communication skills really need to be developed, because mathematical communication can be used to increase students' understanding of the benefits of mathematics itself (Hafiziani Eka Putri, 2020). The aim of mathematical communication is so that students have the ability to communicate a situation or problem by conveying ideas in the form of symbols, tables, diagrams, or other media so that they can communicate events around them into mathematical symbols (Nur Zaharah, 2021). Students must master

mathematical communication skills (Ismayanti, 2021). Students' mathematical communication skills really need to be developed, because mathematical communication can be used to increase students' understanding of the benefits of mathematics itself (Hafiziani Eka Putri, 2020).

In mathematical communication, students have the opportunity, encouragement, and support to speak, write, read, and listen to mathematical equations. Mathematics can be communicated mathematically because it is often taught through symbolic, written and oral communication (Hestu, 2021). Mathematical communication skills are one of the causes of students' psychological development and effectiveness as well as influencing mathematics learning outcomes (Rianti Rahmalia, dkk, 2020). Teachers really try to ensure that students' communication skills are good and improve, because mathematical communication skills are a requirement for solving a problem and can develop their abilities by selecting ideas and then explaining them (Rindu Riyanti, 2021).

Studying mathematical concepts through 3 stages, namely enactive, iconic, and symbolic. The purpose of the enactive stage is the stage of learning by manipulation, the iconic stage is the stage of learning using pictures, and the symbolic stage is the stage of learning mathematics through symbols or symbols. Every mathematical concept can be presented correctly if the learning media used is also appropriate (Sufri Mashuri, 2019). Thus, mathematics learning media has a very big role in conveying mathematics material to students.

The learning process is said to be good if there is an activity or communication between the teacher and the students (Putri, 2020). Apart from that, one influential aspect is the use of learning media. There are five components in the definition of learning media, namely as an intermediary for providing material in the learning process, as a learning resource, as a means of helping students to stimulate learning, as an effective tool, and as a tool for acquiring and improving students' abilities siswa (Muhammad Hasan, 2021). If these five components can be implemented well, they will have an impact on achieving successful learning in accordance with the desired goals.

There are many types of media that teachers can use in the teaching and learning process, but teachers must be selective in choosing the media they will use. In this digital era, teachers must be more innovative in using media so that students do not get bored and lazy in learning. Technology that is integrated into the learning process is one way to achieve learning goals, because technology is no longer considered something (Muhammad, 2021). The use of technology can also create meaningful learning and increase student enthusiasm through various activities. Good learning media can not only increase students' motivation and desire to learn independently, but can also play a role in overcoming learning boredom (Rohmah, 2021).

Alternatives in developing learning media that are easy to use, interesting, informative and interactive so that students' interest in the mathematics learning process can increase. One way is by utilizing advanced technology in the form of smartphones. The one that is most in demand is Android. The Android operating system with various types of application development is able to create visualization learning media. Android-based learning does not

allow students to be monotonous with text alone, teachers can create audio, visual and even animation elements to help students understand learning material (Husein Hamdan, 2020).

Media in the learning process can be in the form of software and hardware which are a small part of technological development. One use of learning media is using an Android device (Ketut Sepdyana Kartini, 2020). Apart from being used as a communication tool, Android can be used as a tool in the teaching and learning process, namely in the form of interactive learning media.

Meanwhile, interactive learning is defined as a teaching method that actively involves students in the learning process. This interactive learning media must have features that allow users to be actively involved in interacting both directly and through the development media. Teachers act as facilitators so they are required to develop their creativity and innovation in creating learning media (Tedi Setiadi, 2022).. An example of learning media innovation is by utilizing technological developments, one of which is Android devices.

Based on preliminary observations that were carried out at MTs Negeri 2 Purbalingga by conducting interviews with one of the class VII mathematics teachers at MTs Negeri 2 Purbalingga, namely Mr. Arifin, S.Pd., the results showed that students still lacked mastery regarding mathematical communication skills. One of the materials is social arithmetic. This is characterized by students' low ability to solve problems related to mathematical communication skills, especially if the questions given are in the form of story problems. Students have difficulty in working on social arithmetic problems because usually the problems are presented in the form of story problems and students find it difficult to understand the meaning and translate the questions into mathematical form, students' skills in translating into mathematical sentences are still low, and there are also those who make mistakes in perform the arithmetic operation. The learning method applied by Mr. Arifin is using lecture and discussion methods. The drawback of this method was stated by Mr. Arifin that students would quickly feel bored and less interested in the material being presented. Teachers have also used various methods to improve students' abilities. However, the limitations of learning media are also one of the obstacles for teachers in delivering material.

One of the efforts that can be made is to improve the learning process that occurs in the classroom by using appropriate learning media. Through innovation in the form of Android-based interactive learning media, it can be an effort to improve students' mathematical communication skills in learning material regarding social arithmetic so that student learning achievement increases and the learning process can be said to be successful. This interactive learning media is the development of a learning media in the form of an Android application that can be used without an internet network and is packaged in an attractive form with a combination of animation, text and audio which is interactive because it has feedback. This Android-based interactive learning media contains daily activities related to mathematics, namely social arithmetic.

Previous research was conducted by Dina Rahmawati with the title "Development of Interactive Learning Media Based on Islamic Context to Improve Mathematical Communication Skills in Class VII SPLDV Material". The results showed that the development of interactive learning media was valid and effective for improving students'

mathematical communication skills siswa (Dina Rahmawati, 2021). Second, research conducted by Laili Nur Faizah with the title "Development of Android-Based Interactive Learning Media for Mathematics Subjects in Class X Science MAN 1 Cilacap" (Laili Nur Faizah, 2021).. This research also states that the development of Android-based interactive learning media is valid for mathematics subjects.

The third research was conducted by Lovieanta Arriza with the title "Development of Interactive Multimedia Based Mathematics Learning Media Using Adobe Flash on Circle Material for Class VIII of An-Nur Prima Islamic Private Middle School". This research states that the development of interactive multimedia-based mathematics learning media is practical and effective in mathematics learning (Lovienta Arriza, 2020). Lastly, there is research conducted by Unggul Pradana with the title "Development of Educational Game Learning Media Using a Contextual Approach to Improve Students' Mathematical Understanding Ability in Class VIII Statistics Material". This research aims to develop educational game learning media with a contextual approach to improve class VIII students' mathematical understanding abilities in statistics material. In this research, the results showed that educational games were valid and effective in improving students' mathematical solving abilities siswa (Unggul Pradana, 2022).

Based on these problems, the aim of this research is to develop valid and effective Android-based interactive learning media to improve students' mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga.

B. Methods

1. Types of Research

Researchers use the Research and Development (R&D) type of research, namely research by producing products and testing the effectiveness of these products. R&D research is a process used to develop and validate products (Muhammad Shaleh Assingkily, 2021). The learning media created is an Android application. When developing learning media, you need to pay attention to the development model. What is used in this research is the ADDIE development model. The ADDIE development model has 5 stages, namely Analysis, Design, Development, Implementation, and Evaluations (Cecep Kustandi, 2020).

The analysis stage is carried out to find out problems and solutions in the learning (Rayanto, 2020). The design stage is where the researcher designs the design for the learning media that will be developed. The development stage in the ADDIE model includes activities to realize the product design that has been created, the aim is to produce and validate the media being developed (Cecep Kustandi, 2020). The implementation stage means that the product that has been created must be tested first so that it can be said to be valid and its usefulness can be proven (Rayanto, 2020). The evaluation stage is the final stage. After carrying out the previous four stages, the next step is to provide an evaluation using both formative evaluation and surmative evaluation.

2. Data Selection

a. Population

The population is all the objects or subjects in the research. In this research, the population is class VII students at MTs Negeri 2 Purbalingga. Researchers took a population from 8 classes of class VII students, totaling 276 students.

b. Sampling

The sample used in this research used a purposive sampling technique. What is meant by purposive sampling is a sampling technique which is chosen deliberately so that it can provide information in the form of data with certain considerations (Bagus Sumargo, 2020). The samples in this research were class VII A with 34 students as the control class and class VII D with 34 students as the experimental class.

3. Data Collection Techniques

In this research we collected data using questionnaires and test questions. A questionnaire is a data collection technique where respondents are asked a series of questions. Responses from respondents received in this questionnaire can be collected and used as research data (Rifka Agustianti et al., 2022). Meanwhile, tests are data collection techniques by giving questions to research subjects (Agustianti et al, 2022). The test was carried out in two stages, namely pre-test and post-test. The pre-test is given before testing learning media development products, while the post-test is given after testing learning media development products.

Apart from collecting data for hypothesis testing, there are instrument tests, namely validity and reliability tests. The validity test stage consists of two parts, namely content validity test and item validity test. The content validity test consists of 4 stages, namely media expert validation test, material expert validation test, mathematics teacher trial, and small group trial. Whether it is said to be valid or not depends on the average of the assessment results from material experts, media experts, teacher assessments, and small group trials. The criteria for an instrument to be valid are that the expert has accepted the instrument without any further improvements.

Item validity is carried out to determine the number of valid and invalid instrument items. To measure whether an instrument is valid or not, researchers need to test its validity first. Validity is a measurement standard that shows the accuracy or validity of an instrument. The formula for testing the validity of test items is using *product moment correlation* (Sri Wahyuning, 2021).

Meanwhile, the reliability test is a test to determine the extent to which the measurements of an instrument remain consistent even though it has been tested many times on the same subjects and conditions. Reliability testing is used to measure the consistency of research instruments and see whether the instrument can provide the same or relatively the same score

each time it is used. The formula used to calculate the reliability of an instrument is the *Alpha Cronbach* formula (Wahyuning, 2021).

4. Data Analysis Techniques

After all the data has been collected, the data is then analyzed to provide a hypothesis whether the model under study has met the expected hypothesis or not. There are two stages carried out, namely the analysis prerequisite tests including the normality test and homogeneity test, while the hypothesis test includes the t-test.

a. Prerequisite Test

The data analysis prerequisite test aims to find out whether the data can continue hypothesis testing or not.

1) Normality Test

The normality test is used to find out whether the data is normally distributed or not, in other words whether the sample used in the research can represent the entire population (Wayan Widana, 2020). The method used by researchers is Kolmogorov Smirnov with the assumption that the data will be normally distributed (H1 is rejected and H0 is accepted) if the normality value obtained is greater than the significance level (0.05).

2) Homogeneity Test

The homogeneity test is a prerequisite test that must be proven whether two or more groups of sample data come from a population with the same variance or not. It can also be interpreted that the homogeneity test is a test carried out to find out whether the data variance from the sample is homogeneous or not (Widana dan Muliani, 2020). In testing the data, researchers used the SPSS version 22 application with a significance limit of 0.05. Data will be homogeneous if the data processing results are above the 0.05 level.

3) Hypothesis Test

This research will use the t test with independent samples. It is said to be independent because the data from one two groups does not depend on the data from the second group. The t-test was carried out to determine the effect of Android-based interactive learning media whether it was effective in improving students' mathematical communication skills or not. This test was carried out by comparing the results of the average value of the experimental class and the control class. The t-test decision is made by comparing the calculated sig and the α value of 5% or 0.05. If the value (sig) < 0.05 then H0 is rejected and H1 is accepted.

C. Results and Discussion

1. Desain Experimental

In this research, the experimental class, namely class VII D, totaling 34 students, was treated with the use of Android-based interactive learning media that had been developed.

Meanwhile, the control class was class VII A, which consisted of 34 students and was not treated with Android-based interactive learning media. The application of Android-based interactive learning media is measured using the results of test questions, namely pre-test and post-test. Data collection was carried out in 6 meetings with the aim of measuring the use of Android-based interactive learning media in learning in the experimental class and learning without media in the control class.

2. Data Collection and Analysis

The pre-test data on students' mathematical communication abilities consists of 8 questions which are adjusted to indicators of mathematical communication abilities. Pre-test questions were given to class VII A as the control class and class VII D as the experimental class. The following are the results of the pre-test scores for both classes.

Table 1. Pre-test results for control and experimental classes

No.	Information	*Pre-test*	
		Eksperimen	**Kontrol**
1.	Highest score	66	62
2.	Lowest score	24	25
3.	The number of students	34	34
4.	Average	41,06	41,41

Based on the table above, it can be seen that the pre-test scores for the experimental class and the pre-test for the control class before being given different treatment regarding the use of learning media. In the experimental class, the highest score was 66, the lowest score was 24, and the average was 41.06. Meanwhile, the highest score for the control class was 62, the lowest score was 25, and the average was 41.41. Based on these results, it can be concluded that the experimental class and control class have average results that are not much different so that the experimental class and control class do not have significant differences.

After knowing the initial capabilities of the control class and experimental class, the next step is implementing learning by applying Android-based interactive learning media in the experimental class and conventional learning in the control class. Then, to see the results of the influence of learning, post-test questions were given. The following are the results of the post-test scores for the two classes.

Table 2. Post-test results for control and experimental classes

No.	Information	*Pre-test*	
		Eksperimen	**Kontrol**
1.	Highest score	97	75
2.	Lowest score	65	50
3.	The number of students	33	34
4.	Average	82,79	63,03

Based on the table above, it can be seen that the post-test scores for the experimental class and the post-test for the control class after being given different treatment regarding the use of learning media. In the experimental class, the highest score was 97, the lowest score was 65, and the average was 82.79. Meanwhile, the highest score for the control class was 75, the lowest score was 50, and the average was 63.03.

3. Data Analysis Technique

a. Prerequisite Test

1) Normality Test

The normality test is used to determine whether the data is normally distributed or not, in other words whether the sample used in the research can represent the entire population. The method used by researchers is Kolmogorov Smirnov using the SPSS Version 22 application as follows.

Table 3. Normality test results

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
result	Pretesteksperimen	,141	34	,086	,949	34	,112
	Posttesteksperimen	,145	34	,068	,941	34	,066
	Pretestkontrol	,148	34	,058	,951	34	,135
	Posttestkontrol	,150	34	,051	,935	34	,044

a. Lilliefors Significance Correction

Based on the test results above, the significant value of the Kolmogorov Smirnov test in the control class pre-test was 0.058 and the experimental class was 0.86. Meanwhile, the post-test value for the control class was 0.51 and the experimental class was 0.68. So the significant values of the two classes are above the 0.05 significance level. Therefore, H1 is rejected and H0 is accepted, with the conclusion that the data from both sample classes are in a normal distribution.

2) Homogeneity Test

The homogeneity test is a prerequisite test that must be proven whether two or more groups of sample data come from a population with the same variance or not. In testing the data, researchers used the SPSS version 22 application as follows:

Table 4. Homogeneity test results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	,077	1	66	,782
	Based on Median	,083	1	66	,774
	Based on Median and with adjusted df	,083	1	65,677	,774
	Based on trimmed mean	,092	1	66	,763

From the table above, it shows that the significant value is 0.782, which is > 0.05, so H1 is rejected and H0 is accepted. So, the data from the pre-test scores meets the assumption of homogeneity. This means that the two classes were homogeneous (same) in terms of students' mathematical communication abilities before learning was carried out.

b. Hypothesis Test

After carrying out the validation test, the next step is the t-test to answer the second problem formulation, namely how effective the development of Android-based interactive learning media is on mathematical communication skills in class VII social arithmetic material

at MTs Negeri 2 Purbalingga. The t-test was carried out using the SPSS version 22 program and based on these results the following results were obtained.

Table 5. T-test results

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
H	Equal variances assumed	2,049	,157	9,914	66	,000	18,912	1,908	15,103	22,721
	Equal variances not assumed			9,914	64,339	,000	18,912	1,908	15,101	22,722

Based on the test results listed in the significance section (2-tailed), namely 0.000, where 0.000 < 0.05, then H0 is rejected and H1 is accepted, which means that Android-based interactive learning media is effective in improving students' mathematical communication skills in social arithmetic material at MTs Negeri 2 Purbalingga.

4. Discussion

The expert validation test was used to answer the first problem formulation, namely how valid the development of Android-based interactive learning media is on mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga. Whether it is said to be valid or not depends on the average of the assessment results from material experts, media experts, teacher assessments, and small group trials.

Android-based interactive learning media is valid based on the results of material expert validation which got a percentage of 91.66% with a very valid category, media expert validation which got a percentage of 93.3% with a very valid category, and mathematics teacher validation got a percentage of 92.5% with very valid category. This is also supported by the results of the product attractiveness questionnaire that Android-based learning media is very interesting to use in learning mathematics, social arithmetic material with an average percentage of 92,68%, which is in the very interesting category. Based on the four discussions above, it can be concluded that Android-based interactive learning media is valid for improving students' mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga.

After carrying out the validation test, the next step is the t-test to answer the second problem formulation, namely how effective the development of Android-based interactive learning media is on mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga. Based on the test results listed in the significance section (2-tailed), namely 0.000, where 0.000 < 0.05, then H0 is rejected and H1 is accepted, which means that Android-based interactive learning media is effective in improving students' mathematical communication skills in social arithmetic material at MTs Negeri 2 Purbalingga.

D. Conclusion

Android based interactive learning media is valid based on the results of material expert validation which got a percentage of 91.66% with a very valid category, media expert validation which got a percentage of 93.3% with a very valid category, and mathematics teacher validation got a percentage of 92.5% with very valid category. This is also supported by the results of the product attractiveness questionnaire that Android-based learning media is very interesting to use in learning mathematics, social arithmetic material with an average percentage of 92,68%, which is in the very interesting category. Based on the four discussions above, it can be concluded that Android-based interactive learning media is valid for improving students' mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga.

Android based interactive learning media is effective in improving students' mathematical communication skills. Based on calculations using SPSS Version 22, the test results listed in the significance section (2-tailed) are 0.000, where 0.000 < 0.05 then H0 is rejected and H1 is accepted. So it can be concluded that learning using Android-based learning media is effective in improving students' mathematical communication skills in class VII social arithmetic material at MTs Negeri 2 Purbalingga.

References

Agustianti, R., Nussifera, L., Angelianawati, L., Meliana, I., Sidik, E. A., Nurlaila, Q., Simarmata, N., Himawan, I. S., Pawan, E., & Ikhram, F. (2022). *Metode Penelitian Kuantitatif Dan Kualitatif*. Tohar Media.

Assingkily, M. S. (2021). *Metode Penelitian Pendidikan (Panduan Menulis Artikel Ilmiah dan Tugas Akhir)*. Penerbit K-Media.

Faizah, L. Nur. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Android untuk Mata Pelajaran Matematika Di Kelas X IPA MAN 1 Cilacap. *Skripsi*, 117.

Hamdan, B. H. (2020). *Media Pembelajaran Efektif*.

Hasan. (2021). Media Pembelajaran. In *Tahta Media Group* (Issue Mei).

Ismayanti, S., & Sofyan, D. (2021). Kemampuan Komunikasi Matematis Siswa SMP Kelas VIII di Kampung Cigulawing. *Plusminus: Jurnal Pendidikan Matematika*, *1*(1), 183–196.

Kartini, Ketut Sedayana & Putra. (2020). Respon Siswa Terhadap Pengembangan Media Pembelajaran Interaktif Berbasis Android. *Jurnal Pendidikan Kimia Indonesia*, *4*(1), 12.

Kustandi, Cecep, & Darmawan, D. (2020). *Pengembangan Media Pembelajaran: Konsep & Aplikasi Pengembangan Media Pembelajaran bagi Pendidik di Sekolah dan Masyrakat*. Prenada media.

La'ia, H. T., & Harefa, D. (2021). Hubungan Kemampuan Pemecahan Masalah Matematis dengan Kemampuan Komunikasi Matematik Siswa. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *7*(2), 463.

Lovienta Arriza. (2020). Pengembangan Media Pembelajaran Matematika Berbasis Multimedia Interaktif Menggunakan Adobe Flash pada Materi Lingkaran untuk Kelas VIII SMP Swasta Islam An-Nur Prima. *Skripsi*, 201.

Mashuri, S. (2019). *Media pembelajaran matematika*. Deepublish.

Pradana, Unggul. (2022). Pengembangan Media Pembelajaran Game Edukasi dengan Pendekatan Kontekstual untuk Meningkatkan kemampuan Pemahaman Matematis Siswa Mater Statistika Kelas VIII. *Skripsi*.

Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. *Jurnal Materi Dan Pembelajaran Fisika*, *9*, 34–42.

Putri, H. E., Muqodas, I., Wahyudy, M. A., Abdulloh, A., Sasqia, A. S., & Afita, L. A. N. (2020). *Kemampuan-kemampuan matematis dan pengembangan Instrumennya*. UPI Sumedang Press.

Rahmawati, D. (2021). *Pengembangan Media Pembelajaran Interaktif Berbasis Konteks Islami untuk Meningkatkan Kemampuan Komunikasi Matematis pada Materi SPLDV Kelas VIII*.

Rayanto, Yudi Hari. (2020). *Penelitian Pengembangan Model Addie Dan R2d2: Teori & Praktek*. Lembaga Academic & Research Institute.

Rianti Rahmalia, Hajidin, H., & BI. Ansari. (2020). Peningkatan Kemampuan Komunikasi Matematis Dan Disposisi Matematis Siswa Smp Melalui Model Problem Based Learning. *Numeracy*, *7*(1), 137–149.

Riyanti, R., & Mardiani, D. (2021). Kemampuan Komunikasi Matematis Siswa antara Model Pembelajaran Course Review Horay dan STAD. *Plusminus: Jurnal Pendidikan Matematika*, *1*(1), 125–134.

Rohmah, S. N. (2021). *Strategi Pembelajaran Matematika*. UAD PRESS.

Rosmala, A. (2021). *Model-model pembelajaran matematika*. Bumi Aksara.

Setiadi, T., & Effendi, K. N. S. (2022). Analisis Kebutuhan Peserta Didik Terhadap Media Pembelajaran Berbasis Android pada Materi Aritmatika Sosial SMP. *Jurnal Pembelajaran Matematika Inovatif*, *5*(1), 10.

Sumargo, B. (2020). *Teknik sampling*. Unj press.

Wahyuning, S. (2021). *Dasar-Dasar Dasar Statistik*.

Widana, W., & Muliani, P. L. (2020). Uji Persyaratan Analisis. In *Analisis Standar Pelayanan Minimal Pada Instalasi Rawat Jalan di RSUD Kota Semarang*.

Zaharah, N., Marzal, J., & Hsb, M. H. E. (2021). *Pengembangan Multimedia Pembelajaran Matematika Berbasis Quantum Learning pada Materi Segiempat dan Segitiga untuk Meningkatkan Kemampuan Komunikasi Matematis*. *05*(03), 2768–2782.