EFFECTIVENESS OF PROBLEM SOLVING MODEL ASSISTED BY GEOGEBRA ON MATHEMATICAL REASONING ABILITY ON SIMILARITY MATERIAL

Rio Jaya Lestari Br Lumban Gaol[1] , Simon M. Panjaitan[2] , Christina Sitepu[3]

Email : riojayalumban.gaol@student.uhn.ac.id, simon.panjaitan@uhn.ac.id, christinaSitepu@uhn.ac.id

[1,2,3] Program Studi Pendidikan Matematika, Fakultas Keguruan dan Ilmu Pendidikan Universitas HKBP Nommensen Medan, Indonesia

Abstrak

Penelitian ini bertujuan untuk mengetahui efektivitas model pemecahan masalah berbantuan GeoGebra terhadap kemampuan penalaran matematis siswa pada materi pembelajaran di SMP Negeri 13 Medan. Jenis penelitian ini adalah penelitian eksperimen semu dengan populasi penelitian yaitu seluruh siswa kelas VII SMP Negeri 13 Medan. Dengan teknik Cluster Random Sampling, sampel penelitian diperoleh dari kelas eksperimen (VII-2) yang berjumlah 32 siswa dan kelas kontrol (VII-1) yang berjumlah 32 siswa. Instrumen yang digunakan adalah tes hasil belajar siswa berupa esai yang telah dilakukan tes prasyarat, instrumen tes, dan lembar observasi. Setelah dilakukan perlakuan berbeda diperoleh perhitungan pada kelas eksperimen dengan rata-rata skor pre-test sebesar 9,84375 dan rata-rata skor post-test sebesar 80,4375. Pada kelas kontrol rata-rata nilai pre-test sebesar 9,75 dan rata-rata nilai post test sebesar 60,0938. Oleh karena itu, berdasarkan hasil perhitungan kualitas tingkat pembelajaran kemampuan penalaran matematis menunjukkan bahwa nilai Sig. (2-tailed) adalah 0,000 < 0,05 pada taraf signifikansi 5% yang berarti terdapat perbedaan antara model pemecahan masalah berbantuan GeoGebra dengan model konvensional. Berdasarkan lembar observasi diperoleh kesesuaian tingkat pembelajaran pada aktivitas guru dengan skor 3,458333 dan aktivitas siswa diperoleh dengan skor 3,125 yang berarti kesesuaian tingkat pembelajaran berada pada kriteria baik.

Kata Kunci: Efektivitas, Model Pemecahan Masalah, GeoGebra, Kemampuan Penalaran Matematis

Abstract

This study aims to determine the effectiveness of the GeoGebra-assisted problem solving model on students' mathematical reasoning abilities in learning materials at SMP Negeri 13 Medan. This type of research is a quasi-experimental study with the research population being all students of class VII of SMP Negeri 13 Medan. With the Cluster Random Sampling technique, the research sample was obtained from the experimental class (VII-2) totaling 32 students and the control class (VII-1) totaling 32 students. The instruments used were student learning outcome tests in the form of essays that had been tested for prerequisites, test instruments, and observation sheets. After different treatments were carried out, the calculation in the experimental class was obtained with an average pre-test score of 9.84375 and an average post-test score of 80.4375. In the control class, the average pre-test score was 9.75 and the average post-test score was 60.0938. Therefore, based on the results of the calculation of the quality of the learning level of mathematical reasoning abilities, the Sig. value shows that the value of Sig. (2-tailed) is 0.000 < 0.05 at a significance level of 5% which means there is a difference between the GeoGebra-assisted problem solving model and the conventional model. Based on the observation sheet, the suitability of the learning level in teacher activities was obtained with a score of 3.458333 and student activities were obtained with a score of 3.125 which means that the suitability of the learning level is in the good criteria.

Kata Kunci: *Effectiveness, Problem Solving Model, GeoGebra, Mathematical Reasoning Ability*

Introduction

Education has an important role for humans. In general, education can be interpreted as a process in life that aims to develop the potential of each individual to be able to live and live life well . (Alpian, Anggraeni, Wiharti, & Soleha, 2019) stated that the role of education is very large in preparing and developing reliable Human Resources (HR) who are able to compete healthily. Education cannot be separated from the teaching and learning process. As a formal educational institution, schools have an important role in efforts to shape students to become useful members of society. In line with that, Law No. 20 of 2003 concerning the National Education System in Article 3 (Suwartini, 2017) states that national education plays a role in developing abilities , shaping character and creating a dignified national civilization to educate the nation's life. In this case, mathematics is one of the important elements in educating the nation's life.

Mathematics is one of the basic sciences studied by students at all levels of education. (Tarigan, 2021) mentions that mathematics is a science with absolute and unchangeable truth because it is based on pure deduction. (Gunawan, Sulistyowati, & Rusdiana, 2022) likens mathematics to a queen *and* a servant *with* the intention that mathematics is a servant of science that can be created and provides benefits for other sciences. This is because mathematics can train someone to think logically, critically, creatively, and skillfully in solving various problems faced in everyday life (Panjaitan, 2017). Many problems in life require solutions using mathematics, such as calculations , measurements , predictions, and so on . Therefore, mathematics has an important role in education and the development of science. In studying mathematics, students are not only required to understand the material taught but are also expected to have mathematical abilities that are useful in facing today's global challenges. Mathematical abilities are identified in 5 components, including: 1) mathematical understanding; 2) mathematical problem solving; 3) mathematical reasoning; 4) mathematical connections; 5) mathematical communication. Among these mathematical abilities, mathematical reasoning ability is very important. for each student in learning mathematics because according to (Kusumawardani, Wardono, & Kartono, 2018) reasoning plays an important role in mathematics as a foundation for other process standards that cannot be separated in solving mathematical problems.

Reasoning is an activity or process of thinking to produce conclusions or make new statements based on previous statements whose truth has been proven according to Sumartini (Fadillah, 2019). According to Schoenfield (Fajriyah, Nugraha, Akbar, & Bernard, 2019) , reasoning is important in life including mathematics, because mathematics involves an active, dynamic , and creative process carried out by users and practitioners of mathematics. In line with that, based on Permendiknas No. 22 of 2006 (Gustiadi, Agustyaningrum, & Hanggara, 2021), one of the goals of learning mathematics is to apply reasoning to patterns and properties, carry out mathematical manipulations to form generalizations, compile evidence, and explain ideas along with mathematical statements. Reasoning and mathematics cannot be separated because in solving mathematical problems, reasoning is needed while reasoning can be trained through learning mathematics (Kusumawardani et al., 2018).

Mathematical reasoning is the process of thinking about mathematical objects that are needed to conclude or put forward new statements that are true based on several statements whose truth has been proven (Kusumawardani et al., 2018). (Akuba, Purnamasari, & Firdaus, 2020) state that mathematical reasoning ability is a person's ability to draw a conclusion using thinking, based on mathematical premises that are considered true, by analyzing the relationships between these premises. Sumartini (Agustin, 2016) added that mathematical reasoning skills make it easier for students to conclude and prove statements, create new ideas, and solve mathematical problems. Therefore, it can be concluded that mathematical reasoning is a thinking process in concluding statements based on evidence and a deep understanding of mathematics. According to the Regulation of the Director General of Elementary and Secondary Education, Ministry of National Education Number 506/C/Kep/PP/2004 (Sari, Yenni, & Raditya, 2017) , it is explained that the indicators

mathematical reasoning skills include the ability to : 1) make conjectures; 2) perform mathematical manipulations; 3) draw conclusions, compile evidence, provide reasons or evidence to support the truth of the solution; 4) draw conclusions from statements; 5) check the validity of an argument; 6) find patterns or properties of mathematical phenomena to make generalizations. In line with that, according to (Romadhina et al., 2019) several indicators of mathematical reasoning, namely: 1) presenting mathematical statements through writing, pictures, sketches or diagrams; 2) submitting conjectures; 3) carrying out calculations based on certain rules or formulas; 4) checking the validity of an argument; 5) drawing conclusions or making generalizations.

Mathematical reasoning ability greatly influences student learning outcomes. Someone who has good reasoning tends to study diligently and work on problems more easily so that the interest in learning that arises will increase, conversely someone who has poor reasoning will have difficulty in solving problems, so that a person's lack of self-confidence arises which results in decreased interest in learning (Kadarisma, Rosyana, & Nurjaman, 2019) . In reality, students' mathematical reasoning abilities are still low with sufficient criteria (Sofyana & Kusuma, 2018) , which means that students are unable to solve math problems correctly. Based on data (Kemendikbud, 2019), the results of the 2018 *Program for International Student Assessment* (PISA) study stated that the average score achieved by Indonesian students in mathematics was 379. Indonesia is ranked 73 out of 79 participating countries in PISA in the category of mathematical ability (Hewi & Shaleh, 2020).

Based on observations made on mathematics teachers of SMP N 13 Medan, it was stated that the mathematical reasoning ability in SMP N 13 was still less than optimal, especially in the indicators of presenting mathematical statements and carrying out mathematical calculations. This is evidenced by the learning outcomes of students who are still below the KKM and the answer sheets of students who have not met the indicators of mathematical reasoning ability in the table and picture below.

Low mathematics scores are related to mathematical reasoning (Ariati & Juandi, 2022) . It can be concluded that mathematical reasoning skills in Indonesia are still very low. This means that the objectives of mathematics learning have not been achieved properly in the subject matter, one of which is in the similarity material.

Similarity material is one of the learning materials taught at the junior high school level that discusses angles, relationships between angles, and proof of similarity in flat shapes. In this material, students are required to understand angles, lines, types of angles, angle sizes and comparisons of sides and angles. However, not many junior high school students are able to solve problems in similarity material. This fact is supported by research conducted by (Islami, Rahmawati, & Kusuma, 2019) which shows that 60% of students have difficulty in calculations and according to (Fitriyani, Sakur, & Maimunah, 2020), students also have difficulty when working on similarity problems where the flat shape images are in different positions or where there are no images.

This happens because the mathematics learning process still uses conventional learning dominated by teachers (Yusdiana & Hidayat, 2018) . Many teachers design learning by focusing students on memorizing facts given by the teacher, teachers are considered as sources of information, so that communication only occurs in one direction, namely between teachers and students, which ultimately results in learning becoming monotonous, rigid and lacking enthusiasm (Panjaitan, 2020). Mathematics learning is still not optimal , teachers' efforts in teaching are not optimal and the methods, approaches and evaluations mastered by teachers are still in traditional patterns (Simanjuntak & Sihombing, 2022). .Based on observations made on mathematics teachers at SMP N 13 Medan, it was found that teachers were lacking in the use of learning media so that the learning carried out tended to be monotonous. In line with that, (Setyowati, Susilo, & Masrukan, 2016) added that the cause of low mathematics learning outcomes was the lack of variation in teaching methods provided by teachers. Such things make students have difficulty and have negative perceptions of mathematics learning which ultimately causes a lack of interest and involvement of students during the learning

process, and considers mathematics learning as an uninteresting, difficult and very boring lesson. If this happens continuously, it will affect students' mathematical abilities which can result in less than optimal learning outcomes.

Challenges like this show that it is necessary to improve interactive and fun learning in order to improve students' mathematical abilities, especially in mathematical reasoning abilities. One solution to overcome this problem is to utilize learning media (Efron Manik et al., 2023) . Learning media can facilitate the learning process (Siahaan & Situmorang, 2022) . Permendikbud No. 22 of 2016 expects that in planning learning, teachers need to prepare learning resources, learning assessment tools, learning scenarios and learning media (Sihombing & Simanjuntak, 2020).

Learning media is a tool used in learning to convey messages or information that can stimulate students' thoughts, feelings, interests, and attention and ensure that the interaction process between teachers and students can take place effectively (Mashuri, 2019) . According to (Tafonao, 2018), learning media is defined as a tool in the learning process that can encourage the learning process. In line with that (E Manik, 2021) added that learning media makes it easier for students to understand concepts, increase absorption and memory , strengthen the impressions received, and motivate students in the learning process. The use of appropriate media and in accordance with learning objectives and learning needs can improve mathematical reasoning skills (Sudiantini & Shinta, 2018) . Through the use of learning media, students will be more interested in capturing learning, actively involved in the learning process such as asking or answering, and motivated to follow the learning process continuously. Based on the statements that have been put forward, it can be concluded that learning media is important to use to support the mathematics learning process.

In the world of education, learning innovation is needed as a tool that can support students' needs in the learning process so that the objectives of learning mathematics can be achieved optimally. Nowadays, the use of technology has been widely used in the learning process. The quality of mathematics learning high can be measured through the application of the technology used . The more complete the technological facilities utilized, the more optimal learning becomes. Current technological developments allow for learning media in the form of *software* . One *software* that can support the mathematics learning process and can improve mathematical reasoning skills is *GeoGebra.*

GeoGebra is one of the software created by Markus Hohenwarter. The use of *GeoGebra* is very useful as a learning medium, especially in mathematics learning (Anggraenia & Dewi, 2021) . The existence of *GeoGebra* can help teachers in conveying abstract material to make it easier to understand (Ekawati, 2016). *GeoGebra* provides facilities that can support and communicate mathematical concepts. With this geometry-based system, it is hoped that it can improve students' ability in solving problems and reasoning in mathematics Kariadinata (Haq, Susilawati, Maryono, & A, 2022).

Based on the description above, the author is interested in conducting research with title " The Effectiveness of *GeoGebra* -assisted *Problem Solving* Model on Mathematical Reasoning Ability of Similarity Material at SMP N 13 Medan.

Method

This research was conducted at UPT SMP Negeri 13 Medan located on Jalan Sampali, Pandau Hulu Ii, Medan Area District, Medan City, North Sumatra Province. This research was conducted in the Even Semester of the 2023/2024 Academic Year.

The type of research used is a quasi-experiment, namely research that aims to determine the effectiveness of the GeoGebra-assisted problem solving learning model on students' mathematical reasoning abilities. This study uses a pre-test - post-test group design.

This study involved two groups of students who were compared. The first group of students will

receive treatment with the GeoGebra-assisted problem solving learning model while the second group of students will receive treatment with the conventional learning model without GeoGebra assistance. To measure students' mathematical reasoning abilities, an initial test (pre-test) and a final test (post-test) will be conducted on both classes, both those who received treatment with the GeoGebra-assisted problem solving learning model and those who were given the conventional learning model without GeoGebra assistance .

Study According to Sugiyono (Komala & Nellyaningsih, 2017), population is a generalization area consisting of subjects/objects with certain qualities and characteristics that researchers determine to be studied and conclusions drawn. The population in this study were all students of class VII at SMP N 13 Medan.

A sample is a part of a population that reflects the number and characteristics of the population Sugiyono (Komala & Nellyaningsih, 2017). Sampling in this study used *cluster random sampling,* namely taking sample members from the population randomly without considering the strata in the population. So in this study used two classes, namely the experimental class (VII-2) and the control class (VII-1).

Data collection is a process of collecting information in the field that will be used to answer research problems. According to Sugiyono (Tumanggor, 2023), data collection techniques are a strategic step in research because the main purpose of research is to obtain data.

Result And Discussion

Research result

This research was conducted at SMP Negeri 13 Medan and used a quasi-experimental research method. The purpose of this study was to determine the effectiveness of the GeoGebra-assisted problem solving learning model on mathematical reasoning abilities in class VII of SMP Negeri 13 Medan. The research activities were carried out on April 15, 2024 - May 8, 2024. This study consisted of several meetings, namely one meeting for testing the test instrument (time allocation 90 minutes). One meeting for the pre-test for each experimental and control class (time allocation 80 minutes), three meetings for learning activities using the GeoGebra-assisted problem solving model in the experimental class (time allocation 305 minutes), and one meeting for the post-test of the experimental class and control class (time allocation 80 minutes).

The experimental class consisted of 32 students in class VII-2, while the control class consisted of 32 students in class VII-1. The material taught in this study was the similarity material to determine mathematical reasoning ability by giving a test consisting of a pre-test and post-test. Furthermore, these data were processed with stages starting from instrument trials, instrument prerequisite testing, and hypothesis testing, but before conducting the instrument trial, the test instrument and observation sheet were first validated by the validator.

The test instrument trial was conducted to determine the validity, reliability, level of difficulty and discriminatory power of the test instrument. The test instrument trial was conducted on 24 students of class VIII-2 of SMP Negeri 13 Medan. After the test trial was conducted, the next stage would be the pre-test, learning process, and post-test research in the experimental and control classes.

N-Gain Calculation

Calculation of N-Gain percent using SPSS in appendix 19 for the experimental class with an average gain index value of 78.2596, the gain index value is 0.782596 and for the control class in appendix 20 with an average gain index value of 58.0128, the gain index value is 0.580128. Based on the calculation results by considering the criteria, namely; N-Gain ≤ 0.30 low category, 0.30 < N-Gain ≤ 0.70 medium category, N-Gain ≥ 0.70 high category, the results are obtained in the following table:

Table 1. N-Gain Calculation Results

No	Class	Average N-Gain score	Criteria
1	Experiment	0.782596	Tall
2	Control	0.580128	Currently

The table above shows that the increase or achievement of students' abilities in the experimental class with an average of 0.782596 "high" criteria is different from the achievement of students' abilities in the control class with an average of 0.580128 "moderate" criteria. Thus, it can be concluded that the achievement of students' abilities with the GeoGebra-assisted Problem Solving Learning Model is different from the achievement of students' abilities with the Conventional Model.

Hypothesis Testing

With the fulfillment of the prerequisite tests, namely the normality and homogeneity tests, a t-test was conducted to show that there was a significant difference between the control class and the experimental class on students' mathematical reasoning abilities using the results of the N-gain value from the pre-test and post-test scores of the experimental class and the control class with the condition that the Sig. (2-tailed) value > 0.05 then H_0 is accepted and H_a is rejected, but conversely if Sig. (2-tailed) < 0.05 then H_0 is rejected and H_a is accepted.

Table 2. t-test using SPSS

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
NGain_Persen	Equal variances assumed	2.159	0.147	10.421	62	0.000	20.24685	1.94289	16.36307	24.13063
	Equal variances not assumed			10.421	58.199	0.000	20.24685	1.94289	16.35802	24.13568

With the help of SPSS 25.0 for windows program, the output of the Sig. (2-tailed) value of the independent sample t-test is shown as 0.00. Based on the significant value, it is shown that 0.00 <0.05 so that the conclusion is drawn that H_0 is rejected and H_a is accepted, which means that the GeoGebra-assisted Problem Solving Model has a difference with the Conventional Model on mathematical reasoning ability in the Similarity material.

Results of Observations on the Suitability of Learning Levels

To determine the suitability of the learning level can be seen through teacher observations in managing learning with *the GeoGebra* -assisted *problem solving model* using the teacher observation sheet and the suitability of student learning activities with the *GeoGebra* -assisted *problem solving model* using the student observation sheet. The calculation of the suitability of the learning level can be seen in (Appendix 24) by considering the predetermined criteria, namely; interval 1.00 - 1.99 category less, interval 2.00 - 2.99 category sufficient, interval 3.00 - 3.49 category good and interval 3.50 - 4.00 category very good. Based on the results of observations of teacher activities in managing learning with *the GeoGebra-* assisted *problem solving model* showed a value of 3.45 or the "good" category and the results of observations of student activities with learning with *the GeoGebra - assisted* *problem solving model* showed a value of 3.125 or the "good" category. This shows that the suitability of the learning level using the *GeoGebra* -assisted *problem solving model* is in the good category.

Time Observation Results

To find out the time, it can be done through observation of teacher allocation in learning *problem solving model* assisted by *GeoGebra* with observation sheet. Calculation of learning level suitability can be seen in (Appendix 25) by considering the predetermined criteria, namely; $1 \leq$ time allocation <2 category is not good, $2 \leq$ time allocation <3 category is not good, $3 \leq$ time allocation <4 category is quite good, $4 \leq$ time allocation <5 category is good, time allocation $= 5$ category is very good. Based on the observation result of time allocation learning *problem solving model* assisted by *GeoGebra* shows a value of 4 or "good" category. This shows that the observation result of time is in good category.

Discussion

The research conducted at SMP Negeri 13 Medan is a quasi-experimental research with the aim of determining whether the *GeoGebra-* assisted *problem solving learning model* is effective for students' mathematical reasoning abilities in class VII of SMP Negeri 13 Medan. This research was conducted with a population of all class VII students of SMP Negeri 13 Medan and the sample used was the experimental class was class VII-2 with 32 students and the control class was class VII-1 with 32 students. This research was conducted on April 15, 2024 - May 8, 2024 starting from instrument validation by teachers or lecturers, trial of test instruments, *pre-test* of experimental and control classes, learning activities, and *post- test* of experimental and control classes.

The instrument trial was conducted on April 16, 2024 in class VIII-2 of SMP Negeri 13 Medan with a trial sample of 24 students. The instrument trial sample was taken based on a population that was carried out randomly *(cluster random sampling)* . Based on the four instrument tests including validity test, reliability test, difficulty level and discriminatory power, the researcher used 5 questions out of 9 questions that had met the instrument trial criteria to be used in the *pre-test* and *post-test* . Furthermore, *the pre-test was carried out* in the experimental class and the control class, then continued with learning in the control class using the conventional model and the experimental class using the GeoGebra-assisted problem solving model and then the post-test was carried out in the experimental class and the control class.

In accordance with the effectiveness indicators, there are three factors measured to see the effectiveness of the GeoGebra-assisted problem solving model on mathematical reasoning ability, namely the quality of learning, the suitability of the learning level, and time allocation. Based on the research that has been carried out, it is shown that the quality of learning of the GeoGebra-assisted Problem Solving Model has differences with the Conventional Model on mathematical reasoning ability, the suitability of the learning level using the GeoGebra-assisted problem solving model is in the good category and the results of time allocation are in the good category.

The GeoGebra-assisted problem solving model is the answer to the low reasoning ability of students and the lack of media that supports the mathematics learning process. This finding is also

supported by several previous studies, such as research conducted by (Zebua, Harefa, & Harefa, 2022) which stated that students' mathematical reasoning abilities with the problem solving model showed 56.7% of students in the very good category. In addition, research conducted by (Fahmi, Syahputra, & Rajagukguk, 2017) which stated that the increase in students' mathematical reasoning abilities with the GeoGebra-assisted problem-based learning model was better than students' mathematical reasoning abilities with the usual learning model.

Conclusion

Based on the formulation of the problem and the research hypothesis proposed from the results of the research and data analysis that have been carried out, it can be concluded that the GeoGebra-assisted problem solving learning model is effective for students' mathematical reasoning abilities in the similarity material at SMP N 13 Medan in the 2023/2024 academic year.

Reference

Agustin, R. D. (2016). Kemampuan Penalaran Matematika Mahasiswa Melalui Pendekatan Problem Solving. *Pedagogia : Jurnal Pendidikan*, *5*(2), 179–188. https://doi.org/10.21070/pedagogia.v5i2.249

Akuba, S. F., Purnamasari, D., & Firdaus, R. (2020). Pengaruh Kemampuan Penalaran, Efikasi Diri dan Kemampuan Memecahkan Masalah Terhadap Penguasaan Konsep Matematika. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *4*(1), 44. https://doi.org/10.33603/jnpm.v4i1.2827

Alpian, Y., Anggraeni, S. W., Wiharti, U., & Soleha, N. M. (2019). Pentingnya Pendidikan bagi Manusia. *Jurna Buana Pengabdian*, *1*(1), 66–72.

Anggraenia, E. D., & Dewi, N. R. (2021). Kajian Teori : Pengembangan Bahan Ajar Matematika Berbantuan GeoGebra untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Melalui Model Pembelajaran Preprospec Berbantuan TIK pada Materi Bangun Ruang Sisi Datar. *Prisma, Prosing Seminar Nasional Matematika*, *4*, 179–188.

Ariati, C., & Juandi, D. (2022). Kemampuan Penalaran Matematis: Systematic Literature Review. *Jurnal Lemma*, *8*(2), 61–75. https://doi.org/10.22202/jl.2022.v8i2.5745

Ekawati, A. (2016). Penggunaan software geogebra dan microsoft mathematic dalam pembelajaran matematika. *Math Didactic: Jurnal Pendidikan Matematika*, *2*(3), 148–153. https://doi.org/10.33654/math.v2i3.43

Fadillah, A. (2019). Analisis Kemampuan Penalaran Deduktif Matematis Siswa. *JTAM | Jurnal Teori dan Aplikasi Matematika*, *3*(1), 15. https://doi.org/10.31764/jtam.v3i1.752

Fahmi, A., Syahputra, E., & Rajagukguk, W. R. (2017). Model Pembelajaran Berbasis Masalah Berbantuan Geogebra Di Kelas Viii Smp N 1 Samudera. *Jurnal Paradikma*, *10*(2), 27–39.

Fajriyah, L., Nugraha, Y., Akbar, P., & Bernard, M. (2019). Pengaruh Kemandirian Belajar Siswa Smp Terhadap Kemampuan Penalaran Matematis. *Journal On Education*, *01*(02), 288–296.

Fitriyani, F., Sakur, S., & Maimunah, M. (2020). Media Pembelajaran Matematika berbasis Komputer pada Materi Kesebangunan dan Kekongruenan bagi Siswa SMP/MTs Kelas IX. *JURING (Journal for Research in Mathematics Learning)*, *3*(1), 081. https://doi.org/10.24014/juring.v3i1.9006

Gunawan, E., Sulistyowati, & Rusdiana, L. (2022). Aplikasi Game Edukasi Matematika Tingkat Dasar Berbasis Android. *Jurnal Teknoinfo*, *16*(1), 107. https://doi.org/10.33365/jti.v16i1.806

Gustiadi, A., Agustyaningrum, N., & Hanggara, Y. (2021). Analisis Kemampuan Penalaran Matematis Siswa dalam Menyelesaikan Soal Materi Dimensi Tiga. *Jurnal ABSIS*, *2*(2), 32–36. https://doi.org/10.33365/ji-mr.v2i2.1413

Haq, M. T., Susilawati, W., Maryono, I., & A, T. T. W. (2022). Peran Software Geogebra dalam Memacu Mathematical Problem Solving Ability Siswa The Role of Geogebra Software in

Stimulating Students ' Mathematical Problem Solving Ability. *Mathematics Education on Research Publication (MERP I)*, *12*, 96–100.

Hewi, L., & Shaleh, M. (2020). Refleksi Hasil PISA (The Programme For International Student Assesment): Upaya Perbaikan Bertumpu Pada Pendidikan Anak Usia Dini). *Jurnal Golden Age*, *4*(01), 30–41. https://doi.org/10.29408/jga.v4i01.2018

Islami, A. N., Rahmawati, N. K., & Kusuma, A. P. (2019). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Matematika Pada Materi Kekongruenan dan Kesebangunan. *Simposium NasionalIlmiah*, *November*, 158. https://doi.org/10.30998/simponi.v0i0.444

Kadarisma, G., Rosyana, T., & Nurjaman, A. (2019). Pengaruh Minat Belajar Terhadap Kemampuan Penalaran Matematik Siswa SMP. *Jurnal Absis*, *2*(1), 121–128.

Kemendikbud. (2019). Pendidikan di Indonesia Belajar dari Hasil PISA 2018. In *Pusat Penilaian Pendidikan Balitbang Kemendikbud* (Number 021).

Komala, R. D., & Nellyaningsih. (2017). Tinjauan Implementasi Personal Selling pada PT. ASTRA Internasional Daihatsu ASTRA BIZ Center Bandung padda Tahun 2017. *Jurnal Fakultas Ilmu Terapan Universitas Telkom*, *3*(2), 330–337.

Kusumawardani, D. R., Wardono, W., & Kartono, K. (2018). Pentingnya penalaran matematika dalam meningkatkan kemampuan literasi matematika. *Prisma, prosiding seminar nasional matematika*, *1*, 588–595. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/20201%0A

Manik, E. (2021). Ethnomathematics and realistic mathematics education. *Proceedings of the Ethnomathematics Webinar*.

Manik, Efron, Simanjuntak, R. M., Luvita, G., Simanjuntak, S., Matematika, P., Keguruan, F., Ilmu, D., & Hkbp, U. (2023). *Analisis Penerapan Media Pembelajaran Geogebra Dalam Meningkatkan Hasil Belajar Siswa Pada Materi Sistem Pertidaksamaan Linear Dua Variabel*. *3*, 7075–7087.

Mashuri. (2019). *Media Pembelajaran Matematika*. Deepublish.

Panjaitan, S. (2017). Penerapan Strategi Pembelajaran BBM (Berfikir, Berbicara, Menulis) Untuk Meningkatkan Aktivitas Mahasiswa di Prodi Pendidikan Matematika FKIP Universitas HKBP Nommensen T.A. 2016/2017. *Jurnal Suluh Pendidikan (JSP)*, *4*(1), 1–23.

Panjaitan, S. (2020). Upaya Meningkatkan Kemampuan Berfikir Kreatif Peserta Didik Dengan Pembelajaran Kontekstual Humanistik. *Sepren*, *1*(02), 68–77. https://doi.org/10.36655/sepren.v1i02.222

Romadhina, D., Junaedi, I., & Masrukan. (2019). Kemampuan Penalaran Matematis Peserta Didik Kelas VIII SMP 5 Semarang. *Seminar Nasional Pascasarjana UNNES*, 547–551.

Sari, I. P., Yenni, Y., & Raditya, A. (2017). Pengaruh Pendekatan Pembelajaran Contextual Teaching and Learning (Ctl) Terhadap Kemampuan Penalaran Matematis Siswa Smp. *Prima: Jurnal Pendidikan Matematika*, *1*(1), 19. https://doi.org/10.31000/prima.v1i1.251

Setyowati, N., Susilo, B. E., & Masrukan, M. (2016). Penggunaan Alat Peraga untuk Meningkatkan Hasil Belajar dan Keaktifan Siswa Mata Diklat Matematika Materi Peluang Di Kelas X AP B Semester 2 SMK N 1 Bawen. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *7*(1), 24–30. https://doi.org/10.15294/kreano.v7i1.4831

Siahaan, F. B., & Situmorang, A. S. (2022). LASER SUDUT SEBAGAI MEDIA PEMBELAJARAN MATEMATIKA REALISTIK. *Journal of Maritime and Education*, *4*(1), 382–385.

Sihombing, D. I., & Simanjuntak, R. M. (2020). Etnomatematika dalam Transposisi Akord Ende Mandideng. In *Prosiding Webinar Ethnomathematics Magister Pendidikan Matematika, Pascasarjana Universitas HKBP Nommensen*.

Simanjuntak, R. M., & Sihombing, D. I. (2022). PENGEMBANGAN MODUL MATEMATIKA BERBASIS STRATEGI PROBLEM SOLVING UNTUK KELAS IX SMP. *AXIOM : Jurnal Pendidikan dan Matematika*, *11*(1), 88–96.

Sofyana, U. M., & Kusuma, A. B. (2018). Upaya Meningkatkan Kemampuan Penalaran Matematis Siswa Menggunakan Pembelajaran Generative pada Kelas VII SMP Muhammadiyah Kaliwiro. *Kontinu: Jurnal Penelitian Didaktik Matematika*, *2*(1), 14. https://doi.org/10.30659/kontinu.2.1.14-29

Sudiantini, D., & Shinta, N. D. (2018). Pengaruh Media Pembelajaran Terhadap Kemampuan Berpikir Kreatif Dan Penalaran Matematis Siswa. *Jurnal Penelitian dan Pembelajaran Matematika*, *11*(1), 177–186. https://doi.org/10.30870/jppm.v11i1.2996

Suwartini, S. (2017). Pendidikan Karakter Dan Pembangunan Sumber Daya Manusia Berkelanjutan. *Trihayu: Jurnal Pendidikan Ke-SD-an*, *4*, 223–226.

Tafonao, T. (2018). PERANAN MEDIA PEMBELAJARAN DALAM MENINGKATKAN MINAT BELAJAR MAHASISWA. *Jurnal Komunikasi Pendidikan*, *2*(2), 103. https://doi.org/10.32585/jkp.v2i2.113

Tarigan, R. (2021). Perkembangan Matematika Dalam Filsafat Dan Aliran Formalisme Yang Terkandung Dalam Filsafat Matematika. *Sepren*, *2*(2), 17–22. https://doi.org/10.36655/sepren.v2i2.508

Tumanggor, F. L. L. (2023). Efektivitas Model Pembelajaran Problem Based Learning (PBL) terhadap Kemampuan Berpikir Tingkat Tinggi (HOTS) Siswa pada Materi Persamaan Kuadrat Kelas IX SMP Gajah Mada T.A. 2022/2023. In *Universitas HKBP Nommensen* (Vol 2007, Number 2015).

Yusdiana, B. I., & Hidayat, W. (2018). Analisis Kemampuan Penalaran Matematis Siswa pada Materi Limit Fungsi. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *1*(3), 409. https://doi.org/10.22460/jpmi.v1i3.409-414

Zebua, D. M., Harefa, A. O., & Harefa, A. R. (2022). Analisis Kemampuan Penalaran Matematis Siswa dalam Pemecahan Masalah Matematika dengan Menggunakan Model Pembelajaran Problem Solving di SMK Negeri 1 Hiliserangkai Tahun Pelajaran 2021/2022. *Formosa Journal of Applied Sciences*, *1*(4), 525–536. https://doi.org/10.55927/fjas.v1i4.1327