ANALYSIS OF ELEMENTARY SCHOOL STUDENT'S MATHEMATICAL COMMUNICATION ABILITY ON STATISTICS

Lestari Roswahyuliani[1], Harry Dwi Putra[2], Amas Widiartini[3], Heris Hendriana[4]

[1] IKIP Siliwangi, Jl. Terusan Jendral Sudirman, Cimahi, Indonesia
lroswahyuliani@gmail.com
[2] IKIP Siliwangi, Jl. Terusan Jendral Sudirman, Cimahi, Indonesia
harrydp@ikipsiliwangi.ac.id
[3] SD Negeri Kancah, Jl. Perkebunan Sukawana, Bandung Barat, Indonesia
amaswidiartini@gmail.com
[4] IKIP Siliwangi, Jl. Terusan Jendral Sudirman, Cimahi, Indonesia
herishen@ikipsiliwangi.ac.id

ARTICLE INFO	ABSTRACT
	Students' difficulty in communicating a problem into a mathematical model is one of the important things that must be corrected. This research was carried out based on the results of a preliminary study which showed that students' mathematical communication skills in statistics material were stull low. This study aims to determine students' difficulties in solving application problems. The research method used in this research is qualitative. This research was conducted in an elementary school in West Bandung Regency with 32 V class students as subjects. The instruments used in this study were a descprition test consisting of four questions and interviews. The indicators of mathematical communication used are : (1) Expressing everyday events in symbols or mathematical language, (2) Explain ideas, situations, and mathematical relations with real objects, pictures, graphs, and algebra, (3) Expressing images in the form of ordinary language, (4) Read with comprehension a written mathematical presentation The results of the study show that students still have difficulty communicating the given application problems, especially in making diagrams. Students feel confused in communicating from ordinary forms into diagrammatic forms. Students are confused in determining the value and frequency in the form of a diagram. students also have difficulty reading diagrams and changing the results of the diagrams into ordinary language. *Copyright © 2023 IKIP Siliwangi.* *All rights reserved.*

Corresponding Author:

Lestari Roswahyuliani,
Department of Mathematics Education,
Institut Keguruan dan Ilmu Pendidikan Siliwangi,
Jl. Terusan Jend. Sudirman, Cimahi, Indonesia
Email: lroswahyuliani@gmail.com

How to Cite:

Roswahyuliani, L., Putra, H.D., Widiartini, A., Hendriana, H. (2023). Analysis of Elementary School Student's Mathematical Communication Ability on Statistics. *JIML*, 6(4), 248-261.

INTRODUCTION

Mathematical communication is one of the students' abilities to express ideas in converting them into mathematical models both orally and in writing (Yanti & Novitasari, 2021;Nazihah

& Rahadi, 2018;Hakiki & Sundayana, 2022;Arina & Nuraeni, 2022). Purwandari, Astuti, & Yuliani (2018) which reveals that mathematical communication is referred to as a dialogue or relationship that occurs in the classroom environment, where the event is a transfer of messages and the message that will be carried contains the material being studied. Through communication, ideas and ideas will become objects of reflection that can be corrected, discussed and changed (Arina & Nuraeni, 2022). When students are challenged to communicate the results of their thoughts to their friends orally and in writing using the appropriate mathematical language (Purnamasari & Afriansyah, 2021).

Communication in learning mathematics can help teachers understand students' abilities, because teachers can see information, attitudes, and a person's behavior to be interpreted regarding understanding of the material provided. Without communication in the process of learning mathematics knowledge about data and facts in carrying out processes and applications will be small (Dzarian, Salam, & Anggo, 2021). In addition to learning, communication is also important to use in everyday life, because with communication you can see the reactions and information provided (Dewi & Nuraeni, 2022).

In addition to the opinions previously described by Greenes and Schulman (Arina & Nuraeni, 2022) revealed that there is importance of having mathematical communication skills, namely: (1) Having the main strength in formulating concepts and strategies for solving mathematics, (2) Is the key to students' success in exploring and investigating mathematics, (3) having a way to communicate with friends in obtaining ideas, ideas, information, and interpreting and correcting the beliefs of others.

However, based on the results of an interview with a mathematics teacher in West Bandung Regency, it was found that students' mathematical communication abilities were still in the low category. This is also proven in several studies which state that students' mathematical communication abilities, especially in everyday application problems, are still relatively low (Kurnia, R. N., Setiawani & Kristiana, 2015;Khairunisa & Basuki, 2021)(Ariawan & Nufus, 2017;Syah & Sofyan, 2021;Ismayanti & Sofyan, 2021;Nurlaila, Sariningsih, & Maya, 2018). This is unfortunate because mathematical communication skills are needed in learning mathematics, especially in application questions. In mathematical problems there are many symbols and mathematical models which are the goals of learning mathematics (Godino et al., 2021;Davydov, 2020).

In the learning process definitely requires communication both orally and in writing. Oral mathematical communication is conveying ideas in the form of two-way speech (Nofrianto, Maryuni, & Amri., 2017). Students can be said to have carried out oral mathematical communication if they have talked about mathematical content. Written mathematical communication is the process of conveying ideas in written form from mathematical content (Tanjung & Nababan, 2019;Pansa, Caswita, & Suharsono, 2017;Alfiana & Dewi, 2021). Students can be said to have carried out written mathematical communication if they have presented mathematical ideas and ideas in writing (Harianto, 2017).

In the learning process the criteria for students do not fully have high abilities, there are students who have low and medium abilities (Diningrum, Azhar, & Faradillah, 2018). The low ability of students is based on several factors, both external factors and internal factors (Kurnia, R. N., Setiawani & Kristiana, 2015). The internal factors in question are mental, communication, expressing opinions, and self-confidence (Dzarian, Salam, & Anggo, 2021). Many of the students who have high abilities but are not confident in expressing the results they have obtained, so that the ability of these students is not visible (Tanjung & Nababan,

2019). This lack of self-confidence causes the work on solving questions during the exam to be unsatisfactory (Agustina, Bahri, & Bakar, 2019).

In addition, the low ability of students' mathematical communication is based on the low ability of students' mathematical understanding (Sugandi & Benard, 2018). The ability to understand mathematics is one of the factors in the low ability of students' mathematical communication, because the ability to understand mathematics is a basic ability that must be possessed by students to master other abilities (Roswahyuliani, Rosyana, Setiawan, & Kadarisma, 2022). A student can be said to have the ability to understand mathematics if the student can: (1) explain mathematical concepts and facts; (2) can easily make connections and relationships regarding these concepts and facts; (3) associating existing relationships into something based on their knowledge, and (4) identifying principles to get the job done well (Nurzaman, Fitriani, Kadarisma, & Setiawan, 2022).

According to Ruseffendi (Suherman, 2020) There are three kinds of mathematical understanding concepts, namely changing, giving meaning, and applying. The three kinds of mathematical understanding concepts prove that students must master mathematical understanding skills to be able to master mathematical communication skills. At the conversion stage it is used to convey information using discussion and other forms that involve giving meaning. In other words, the concept of change is an indicator and meaning of mathematical communication skills. Students are asked to communicate existing problems in a new language.

According to Baroody (Umar, 2012) there are at least two important reasons that make mathematical communication skills an important focus in learning, namely (1) mathematics as language which means that mathematics does not only help think but mathematics can be a tool for determining patterns. (2) mathematics learning as social activity which means that mathematics as a social activity in learning mathematics, interaction between students and students, interaction between students and teachers. Communicating mathematics can be said as changing application questions into mathematical language, symbols, equations, graphs, and tables to make it easier for students to solve these problems. This is supported by Sumarmo (Hendriana, Sumarmo, & Rohaeti, 2016) said that mathematical communication skills are in accordance with the nature of mathematics as an efficient symbol by having scientific regularity so that it can be understood by everyone anytime and anywhere. Communication skills can also help produce mathematical models needed to solve problems in everyday life (Asikin & Junaedi, 2013;Umar, 2012)

Seeing the importance of mathematical communication skills, it is necessary to analyze the difficulties in students' mathematical communication abilities. it aims to describe students' difficulties in mathematical communication skills both orally and in writing. NCTM (Subiyakto, Rufiana, & Dwi, 2020) states that mathematical communication skills need to be built so that students can, (1) reflect thoughts and ideas in various situations, (2) model situations verbally and in writing, (3) develop understanding in various situations, (4) use reading skills, write, listen, interpret, and evaluate, (5) examine mathematical ideas, (6) understand the value of rotation and its role in the development of ideas.

Statistics is one of the materials that students need to master in the learning process. If students have mastered statistics, it will be easy to analyze data contained in everyday life (Nadiyah, Wijaya, & Hakim, 2019). Based on this explanation, the researcher is interested in conducting research on the analysis of students' difficulties in students' mathematical communication skills in statistics material. The formulation of the problem in this study is how students' difficulties in mathematical communication skills in statistical material?

METHOD

The focus of this research is to analyze what are the students' difficulties in mathematical communication skills in statistics material. This research is included in qualitative research. According to Strauss and Corbin (Arina & Nuraeni, 2022) Qualitative research is a type of research to discover new things without using statistical or quantification procedures. In other words, qualitative research is research on the description of a person's life story, behavior, and reciprocity.

This research was conducted at Kancah State Elementary School, Parongpong, West Bandung Regency. The subjects of this study were 32 grade V elementary school students for the 2022-2023 academic year who were studying statistics material and had low, medium, and high criteria based on the results of qualifying students' abilities in the previous material..

The instrument used in this study was in the form of essay test sheets which totaled four questions and interviews with students to see descriptions of how students' difficulties in solving problems according to indicators of mathematical communication ability. the indicators used refer to the indicators according to Ramdan (Hendriana et al., 2017). For more details, see Table 1.

Table 1 Indicator of Mathematical Communication Ability

No	Indicator
1.	Expressing everyday events in symbols or mathematical language
2.	Explain ideas, situations, and mathematical relations with real objects, pictures, graphs, and algebra
3.	Expressing images in the form of ordinary language
4.	Read with comprehension a written mathematical presentation

The data analysis technique used in this study is in accordance with the presentation of Miles and Huberman (Sugiyono, 2010) which explains the activities in data analysis. Can be seen in Figure 1.
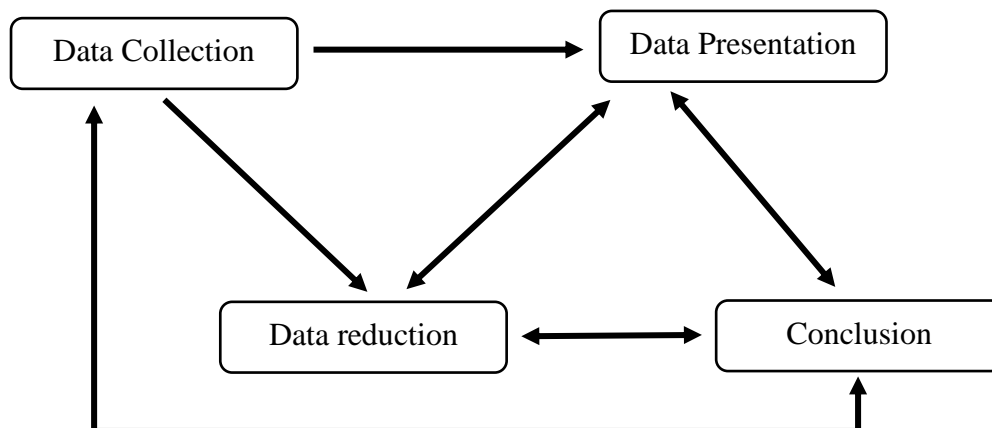
Figure 1 Illustration of Data Analysis Techniques

Data collection techniques were carried out to determine students' mathematical communication abilities in solving problems based on indicators of mathematical communication abilities in statistical material as follows:

$$P = \frac{Total\ \Sigma s}{Total\ \Sigma s + Total\ \Sigma b} \times 100\%$$

Information :

P = Presentation of errors obtained by students

Σs = the number of students who have difficulty answering questions

Σb = the number of students who have no difficulty answering the questions

To find out the criteria for the percentage of students' mathematical communication skills, the researchers used the criteria according to Anderson and Krathwohl (Roswahyuliani, Rosyana, Setiawan, & Kadarisma, 2022) as follows:

Table 2 Criteria for Students' Mathematical Communication Ability

Skor	Criteria
$0 \leq P < 20$	Very Low
$20 \leq P < 40$	Low
$40 \leq P < 60$	Medium
$60 \leq P < 80$	High
$80 \leq P < 100$	Very High

Information:

P = Student grade results

RESULTS AND DISCUSSION

Results

The researcher conducted an analysis of students' abilities by giving test questions for mathematical communication skills in statistics material for elementary schools to 32 fifth grade students as a grouping of students' communication abilities according to the criteria that had been prepared. The results obtained showed that students were divided into five categories, namely: 1) Very High; 2) Height; 3) Moderate; 4) Low; 5) Very Low.

Furthermore, the results of the mathematical communication ability test are used as a reference for researchers to find out how students' mathematical communication skills are in statistical material. After being given a test according to the indicators, several students were randomly asked questions about the difficulty in working on the problem. The following is the result of grouping mathematical communication abilities in terms of the final scores obtained by students.

Table 3. Final Score of Mathematical Communication Test

No	Scor Test	The number of students
1	Very Low	2
2	Low	12
3	Medium	10
4	High	5
5	Very High	3

In Table 3. it is shown that most students have mathematical communication abilities in the low and medium categories. This shows that students' mathematical communication skills are still weak.

Table 4. Results of Students' Mathematical Communication Ability According to Indicators

No	Indicator of Mathematical Communication Ability	Question Indicator	Group					Amount
			VL	L	M	H	VH	
1	Stating everyday events into symbols or mathematical language	Given a story problem regarding data distribution, then students are asked to shape it into a mathematical model and solve it	-	6	10	12	4	32
2	Explain ideas, situations, and mathematical relationships with real objects, pictures, graphs, and algebra	Given a problem regarding student exam data, then students are asked to describe the graph of the data.	4	12	6	7	3	32
3	Expressing images in the form of ordinary language	Given a graph regarding student scores, students are asked to answer some of the questions listed	2	4	5	12	9	32
4	Read with understanding a written mathematical presentation	Given graphs and stories about selling fruit, then students are asked to make a mathematical model and solve it	5	10	10	7	-	32

Based on Table 4. above, it can be seen that most students get very low criteria because of the answers they produce. That is, students are still low in mathematical communication skills, especially when given picture/graphic problems and have to be converted into ordinary language.

Table 5. Student Interview Results

No	Question	Student Answers
1	What difficulties did you experience when working on question number 1?	*S.1 : I forgot the formula he used* *S.2 : I don't know the symbols* *S.3 : I can't understand the problem*
2	In making graphs, what difficulties do you do?	*S.1 : I can't tell which is in the margin and which is written in the underline* *S.2 : I was confused when I read the question* *S.3 : I find it difficult to determine the height of the diagram*

3	Which question number do you think is easy?	*S.1 : Question number 3, because I only determined the numbers from the pictures which were correct, but when I changed the numbers to pictures I got confused about saving them*
		S.2 : Question number 3, the problem is I just have to fill in the numbers in the picture
		S.3 : question number 2, because I understand how to make graphs and I like to draw graphs
4	Why do you have trouble doing question number 4?	*S.1 : The problem is I can't change it into mathematical symbols*
		S.2 : I misread the graph
		S.3 : I am confused to understand the problem
5	How do you do question number 3?	*S.1 : I first looked at the height of the diagram and then filled it in*
		S.2 : I first wrote down how many children are born per year and then filled in the questions
		S.3 : I put a mark first on each diagram to answer the questions

Based on Table 5. above, it is conveyed that some students have difficulty reading diagrams to be communicated using ordinary language. Student answers in Table 5. were carried out to several different people seen from the answers given. Following are the results of student answers on indicator number 1.
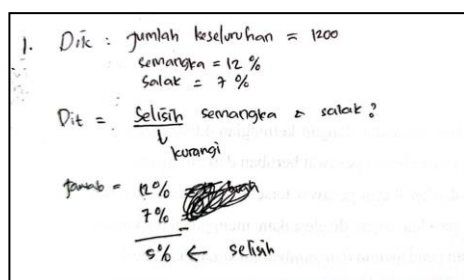

Figure 1. The Result of Students Answers Indicator Number 1

In indicator number 1, most students experience the same error, namely students cannot make changes from the mathematical model into the usual form and the usual form into the mathematical model. Students feel that if indeed the form of a mathematical model is done using a mathematical model and if the form is normal then use an ordinary model. Many students do not really understand the completion of the operation.
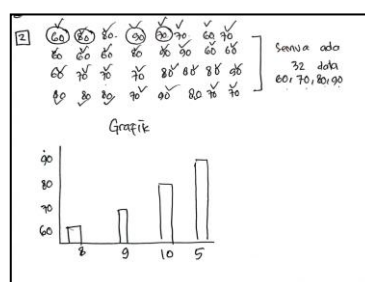

Figure 2 The Result of Students Answers Indicator Number 2

Based on the student's answer to number 2 with the 2nd indicator. The student's difficulty in solving it is when changing ordinary problems into graphical form. Students find it difficult to determine which is on the X line and Y line, so that when applying the data obtained it becomes inaccurate. Even though students' understanding of how to change ordinary problems into graphical form can already be done.
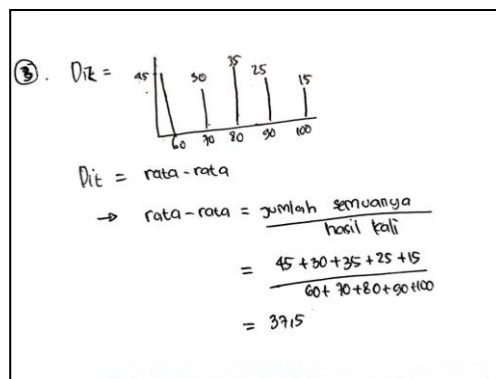

Figure 3 The Result of Students Answers Indicator Number 3

Student answers in Figure 3 show that students still have difficulty solving problems in the form of mathematical models both in the form of symbols and graphics. When given a problem with known data in the form of graphs and mathematical models, students feel a little confused about understanding it in its usual form so that it is easier to solve using the concepts and formulas they have learned. However, most students find it difficult to understand graphical forms or mathematical models because their communication skills are still low.
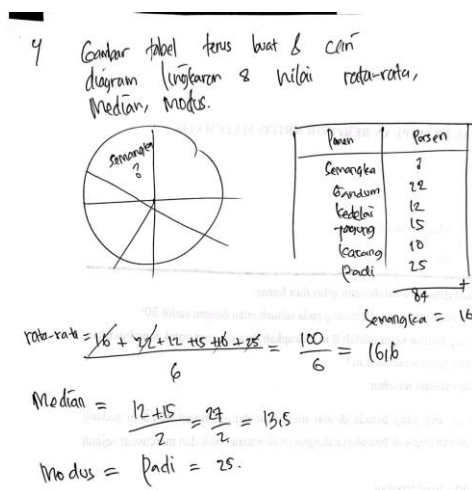

Figure 4 The Result of Students Answers Indicator Number 4

In the last number problem according to Figure 4, it was found that students were confused in solving ordinary questions in the language of mathematics. When given a problem the question must solve regarding the media, mean and mode of known data. Students are confused about how to solve it, because students can only solve it if given questions and

formulas directly. When given ordinary language, these students are confused about solving the mathematical model, and some students are even confused in solving the problem.

Discussions

Based on the results obtained, most students have difficulty communicating the available problems, the student's difficulty is based on the low ability of students' understanding. If seen from the students' answers, it turns out that many students are still wrong in determining application problems in graphical form. Students are wrong in placing known values and frequencies in their problems, so that when answering students answer wrongly. This can prove that students' mathematical communication skills are still low. Students' mathematical communication skills are still low, especially in drawing graphs if given story problems (Wijaya & Afrilianto, 2018).

Looking at the first indicator, it was found that quite a number of students got results in accordance with the predetermined rubric. There were no students who had difficulty in solving the problem. Students also don't have too much difficulty solving problems on indicator number 1, so it can be said that students are able to solve problems on indicator number 1. Students who have difficulty in modeling mathematical forms are based on several factors, namely students are not familiar with non-routine problems, students are not understand the concept of material presentation of data/statistics (Putra, Setiawan, Afrilianto, 2020). In the second indicator, most students have not been able to solve problems properly and correctly. Students are still difficult to determine the diagram of the given story problems. When adjusted to the results of the interviews, it turned out that students had difficulty determining the length of the diagram, because there was a mistake in placing known values and frequencies. Students are confused in drawing diagrams and graphs from the data because they do not understand the basics of statistical material (Dwanti & Komala, 2023). It is better to help students understand the material being studied using learning media that can help students imagine and understand learning concepts quickly and precisely (Akhyar, 2018).

In indicator number three, most students are able to understand and solve the problems given. Students can easily understand these problems because students only read pictures and describe them using everyday language. There were 2 students who did not understand the problem. The mistakes of the two students were in storing numbers and completing the wrong arithmetic operations, resulting in a low rating. Students can describe the diagrams given in ordinary language, but students have difficulty communicating ordinary language in the form of diagrams (Tri, Yenni, & Nopitasari, 2018). In the fourth indicator, almost all students said they could not understand the problem, because they did not understand story problems regarding data presentation. Students have not been able to communicate the form of word problems into the language of mathematics, in other words students have not been able to model them into the language of mathematics. The student's mistake is based on the learning process which is only given routine questions, so that when students are given non-routine questions it will be difficult to model the form of the problem (Mulyani, Indah, & Satria, 2018; Putra, Setiawan, Nurdianti, Retta, Desi, 2018). These problems can be overcome by providing approaches and learning models that are adapted to the material and conditions of students so that it makes it easier for students to understand all problems and study statistics material (Santoso, 2017;Nurul, 2018;Mirdad, 2020).

Based on the results of interviews and student work, it can be concluded that students experience difficulties in mathematical communication skills because their ability to understand mathematics is still lacking. In addition, there are factors that underlie students' difficulties in the learning process, namely classroom environmental factors that are less

conducive, students who lose focus, and students who are not confident in answering several questions so that there are several mistakes (Hidayat, Akbar, & Bernard, 2008). The learning process provided by the teacher is one of the influencing factors, because student understanding can be better if the technique and use of the models provided are good and can help students improve their understanding (Zakiah et al., 2019;Mardhiyana & Sejati, 2016;Kandaga, 2017;Nopiyani et al., 2018). So, in the learning process the teacher needs to apply approaches, techniques, models, and learning media that are appropriate to the material, student characteristics, and environmental conditions in order to help students' basic abilities up to higher abilities. (Nurrita, 2019;Sutawidjaja & Afgani, 2015;Kurnia, 2021).

CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that students' mathematical communication skills in statistics material for the elementary school level are still relatively low. Most students still have difficulty in modeling into mathematical forms or in making graphs. Students have difficulty determining the value and frequency of the increase. The low ability of these students is caused by several factors, namely: 1) the ability of students' understanding is still low; 2) students have not been able to communicate math problems either orally or in writing; 3) the learning approaches and methods used by teachers need to be improved and adapted to the characteristics of students; 4) lack of interest and self-confidence of students; 5) students' mistakes in the use of mathematical symbols; 6) students have not been able to write down the information obtained so that it is difficult to model it.

REFERENCES

Agustina, P., Bahri, S., & Bakar, A. (2019). Analisis faktor penyebab terjadinya kejenuhan belajar pada siswa dan usaha guru BK untuk mengatasinya. *Jurnal Ilmiah Mahasiswa Bimbingan Dan Konseling*, *4*(1), 96–102.

Akhyar, M. (2018). *Pengaruh Penggunaan Media Pembelajaran Berbasis Media Presentasi terhadap Minat dan Hasil Belajar Matematika Siswa Kelas X MIA SMAN 1 Soppeng*.

Alfiana, L., & Dewi, N. R. (2021). Kajian Teori: LKPD Berbasis Kontekstual pada Model Preprospec Berbantuan TIK untuk Meningkatkan Kemampuan Komunikasi Matematis. *PRISMA, Prosiding Seminar Nasional ...*, *4*, 275–281. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/44941

Ariawan, R., & Nufus, H. (2017). *Hubungan Kemampuan Pemecahan Masalah Matematis dengan Kemampuan Komunikasi Matematis Siswa*. *1*(2), 82–91.

Arina, J., & Nuraeni, R. (2022). Kemampuan Komunikasi Matematis Siswa Kelas X SMK di Ponpes Nurul Huda. *Plusminus: Jurnal Pendidikan Matematika*, *2*(2), 315–324. https://doi.org/10.31980/plusminus.v2i2.1877

Asikin, M., & Junaedi, I. (2013). Kemampuan Komunikasi Matematika Siswa SMP dalam Setting Pembelajaran RME (Realistic Mathematics Education). *Unnes Journal of Mathematics Education Research*, *2*(1), 204–213.

Davydov, V. V. (2020). The psychological characteristics of the formation of elementary mathematical operations in children. *In Addition and Subtraction*, 224–238.

Dewi, M. W. K., & Nuraeni, R. (2022). Kemampuan Komunikasi Matematis Siswa SMP ditinjau dari Self-Efficacy pada Materi Perbandingan di Desa Karangpawitan. *Plusminus: Jurnal Pendidikan Matematika*, *2*(1), 151–164.

Diningrum, P. R., Azhar, E., & Faradillah, A. (2018). Hubungan Disposisi Matematis

Terhadap Kemampuan Komunikasi Matematis Siswa Kelas VII di SMP Negeri 24 Jakarta. *Pendidikan Matematika*, *01*, 352–364.

Dwanti, F., & Komala, E. (2023). Kemampuan Pemahaman Konsep Matematika: Kajian Analisis Hambatan Epistimologi Siswa SMP Pada Materi Statistika. *WACANA AKADEMIKA: Majalah Ilmiah Kependidikan*, *7*(1), 138–147.

Dzarian, W. O., Salam, M., & Anggo, M. (2021). Analisis Kemampuan Komunikasi Matematis Siswa Ditinjau dari Gender. *Jurnal Pembelajaran Berpikir Matematika (Journal of Mathematics Thinking Learning)*, *6*(1), 173–184. https://doi.org/10.33772/jpbm.v6i1.18618

Godino, J. D., Burgos, M., & Gea, M. M. (2021). Analysing theories of meaning in mathematics education from the onto-semiotic approach. *International Journal of Mathematical Education in Science and Technology*, 1–28.

Hakiki, S. N., & Sundayana, R. (2022). Kemampuan Komunikasi Matematis pada Materi Kubus dan Balok Berdasarkan Kemandirian Belajar Siswa. *Jurnal Pendidikan Matematika*, *2*(1), 101–110.

Harianto. (2017). Penerapan Model CORE dalam Pembelajaran Matematika untuk Meningkatkan Kemampuan Komunikasi Matematik Siswa SMA. *Jurnal Gammath*, *2*(1), 11–19.

Hendriana, H., Rohaeti, E. E., & Sumarmo, U. (2017). *Hard skill dan soft skill matematik siswa*. PT Refika Aditama.

Hendriana, H., Sumarmo, U., & Rohaeti, E. E. (2016). Kemampuan Komunikasi Matematik Sertakemampuan Dan Disposisi Berpikir Kritis Matematik. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *2*(1), 35–45. https://doi.org/10.33387/dpi.v2i1.97

Hidayat, F., Akbar, P., & Bernard, M. (2008). Analisis kemampuan berfikir kritis matematik serta kemandiriaan belajar siswa smp terhadap materi SPLDV. *Journal On Education*, *01*(02), 515–523. http://jonedu.org/index.php/joe/article/view/106/88

Ismayanti, S., & Sofyan, D. (2021). Kemampuan Komunikasi Matematis Siswa SMP Kelas VIII di Kampung Cigulawing. *Plusminus: Jurnal Pendidikan Matematika*, *1*(1), 183–196. https://doi.org/10.31980/plusminus.v1i1.1036

Kandaga, T. (2017). Penerapan Model Pembelajaran Time-Token Untuk Meningkatkan Kemampuan Pemahaman dan Disposisi Matematis Siswa SMA. *Edumatica*, *7*(01), 21–28. https://online-journal.unja.ac.id/edumatica/article/view/3628

Khairunisa, R. W., & Basuki, B. (2021). Perbandingan Kemampuan Komunikasi Matematis Siswa antara Model Pembelajaran Kooperatif Tipe TPS dan CIRC. *Plusminus: Jurnal Pendidikan Matematika, 1*(1), 113–124.

Kurnia, R. N., Setiawani, S., & Kristiana, A. I. (2015). Analisis Kemampuan Komunikasi Matematis Siswa Kelas VII C SMP Negeri 1 Rogojampi Tahun Pelajaran 2014/2015. *Artikel Ilmiah Mahasiswa, 1*(1), 1–6.

Kurnia, D. (2021). Dinamika Gejala Kejenuhan Belajar Siswa Pada Proses Belajar Online Faktor Faktor Yang Melatarbelakangi Dan Implikasinya Pada Layanan Bimbingan Keluarga. *TEACHING : Jurnal Inovasi Keguruan Dan Ilmu Pendidikan*, *1*(1), 1–10. https://doi.org/10.51878/teaching.v1i1.70

Mardhiyana, D., & Sejati, E. O. W. (2016). Mengembangkan Kemampuan Berpikir Kreatif dan Rasa Ingin Tahu Melalui Model Pembelajaran Berbasis Masalah. *PRISMA,*

Prosiding Seminar Nasional Matematika, 672–688. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/21686

Mirdad, J. (2020). Model-Model Pembelajaran(Empat Rumpun Model Pembelajaran). *(Indonesia Jurnal Sakinah) Jurnal Pendidikan Dan Sosial Islam*, *2*(1), 14–23.

Mulyani, A., Indah, E. K. N., & Satria, A. P. (2018). Analisis Kemampuan Pemahaman Matematis Siswa SMP Pada Materi Bentuk Aljabar. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(2), 251–262.

Nadiyah, S., Wijaya, F. Y., & Hakim, A. R. (2019). Desain Komik Strip Matematika pada Materi Statistika untuk Kelas VI Tingkat Sekolah Dasar. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *4*(2), 135. https://doi.org/10.30998/jkpm.v4i2.3870

Nazihah, V., & Rahadi, M. (2018). Penerapan Model Numbered Heads Together dalam Pembelajaran Matematika untuk Meningkatkan Kemampuan Komunikasi Siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(2), 219–228.

Nofrianto, A., Maryuni, N., & Amri, M. A. (2017). Komunikasi matematis siswa: pengaruh pendekatan matematika realistik. *Jurnal Gantang*, *2*(2), 113–121.

Nopiyani, D., Turmudi, & Prabawanto, S. (2018). Penerapan Pembelajaran Matematika Realistik Berbantuan GeoGebra untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa SMP. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 45–52. https://doi.org/10.31980/mosharafa.v5i2.259

Nurlaila, S., Sariningsih, R., & Maya, R. (2018). Analisis Kemampuan Komunikasi Matematis Siswa Smp Terhadap Soal-Soal Bangun Ruang Sisi Datar. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *1*(6), 1113. https://doi.org/10.22460/jpmi.v1i6.p1113-1120

Nurrita, T. (2019). Pengembangan Media Pembelajaran untuk Meningkatkan Hasil Belajar Siswa. *Journal of Physics: Conference Series*, *1321*(2), 171–187. https://doi.org/10.1088/1742-6596/1321/2/022099

Nurul, A. (2018). Pengaruh Model Pembelajaran E-Learning Berbasis Edmodo untuk Meningkatkan Pemahaman Konsep Matematis Pada Peserta Didik SMA. *Director*, *1*(2), 2018. https://www.uam.es/gruposinv/meva/publicaciones jesus/capitulos_espanyol_jesus/2005_motivacion para el aprendizaje Perspectiva alumnos.pdf%0Ahttps://www.researchgate.net/profile/Juan_Aparicio7/publication/2535 71379_Los_estudios_sobre_el_cambio_conceptual_

Nurzaman, W., Fitriani, N., & ... (2022). Penerapan Pendekatan Saintifik Untuk Meningkatkan Kemampuan Pemahaman Matematis Siwa Smp Pada Materi Spldv. *JPMI (Jurnal ...*, *5*(3), 693–702. https://doi.org/10.22460/jpmi.v5i3.693-702

Pansa, H. E., Caswita, & Suharsono. (2017). Pengembangan LKPD dengan Model Problem Based Learning untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa. *Jurnal Pendidikan Matematika Universitas Lampung*, *5*(3).

Purnamasari, A., & Afriansyah, E. A. (2021). Kemampuan Komunikasi Matematis Siswa SMP pada Topik Penyajian Data di Pondok Pesantren. *Plusminus: Jurnal Pendidikan Matematika*, *1*(2), 207–222.

Purwandari, A. S., Astuti, M. D., & Yuliani, A. (2018). Evaluasi Kemampuan Komunikasi Matematis Siswa SMP Pada Materi Sistem Persamaan Linear Dua Variabel. *IndoMath: Indonesia Mathematics Education*, *1*(1), 55–62.

Putra, H. D., Setiawan, H., Nurdianti, D., Retta, I., & Desi, A. (2018). Kemampuan Pemahaman Matematis Siswa Smp Di Bandung Barat. *Jurnal Penelitian Dan Pembelajaran Matematika*, *11*(1), 19–30. https://doi.org/10.30870/jppm.v11i1.2981

Putra, H. D., Setiawan, W., & Afrilianto, M. (2020). Indonesian high scholar difficulties in learning mathematics. *International Journal of Scientific and Technology Research*, *9*(1), 3466–3471.

Roswahyuliani, L., Rosyana, T., Setiawan, W., & Kadarisma, G. (2022). Penerapan Media Geogebra untuk Meningkatkan Kemampuan Pemahaman Matematis Siswa SMA. *Jurnal Pembelajaran Matematika Inovatif*, *5*(3), 771–778. https://doi.org/10.22460/jpmi.v5i3.771-778

Santoso, E. (2017). Penggunaan Model Pembelajaran Kontekstual untuk Meningkatkan Kemampuan Pemahaman Matematika Siswa Sekolah Dasar. *Jurnal Cakrawala Pendas*, *3*(1), 1–14. https://doi.org/10.31949/jcp.v3i1.407

Subiyakto, A., Rufiana, I. S., & Nur Hidayah, D. A. (2020). Peningkatan Kemampuan Komunikasi Matematis Siswa Menggunakan Pembelajaran Kooperatif Tipe Two Stay Two Stray (TSTS) Berbantuan Teknik Scaffolding. *Jurnal Edukasi Matematika Dan Sains*, *8*(1), 7. https://doi.org/10.25273/jems.v8i1.5673

Sugandi, A. I., & Benard, M. (2018). Penerapan Pendekatan Kontekstual terhadap Kemampuan Pemahaman dan Komunikasi Matematis Siswa SMP. *Jurnal Analisa (JA)*, *4*(1), 16–23.

Suherman, A. (2020). ac The Effort Of Inquiry Approach In Upgrading Knowledge Of Fact, Concept, Tenet And Skill Of Indonesian Language. *Journal of English Language and Literature (JELL)*, *5*(01), 63–74. https://doi.org/10.37110/jell.v5i01.96

Sutawidjaja, A., & Afgani, J. (2015). Konsep Dasar Pembelajaran Matematika. *Pembelajaran Matematika*.

Syah, J. M., & Sofyan, D. (2021). Kemampuan Komunikasi Matematis Siswa SMP di Kampung Paledang Suci Kaler pada Materi Segiempat dan Segitiga. *Plusminus: Jurnal Pendidikan Matematika*, *1*(2), 373–384. https://doi.org/10.31980/plusminus.v1i2.1270

Tanjung, H. S., & Nababan, S. A. (2019). Pengembangan Perangkat Pembelajaran Berbasis Masalah Untuk Meningkatkan Kemampuan Pemecahan Masalah Dan Komunikasi Matematis Siswa SMA Negeri 3 Kuala Kabupaten Nagan Raya. *Genta Mulia*, *10*(2), 178–187.

Tri Ribkyansyah, F., Yenni, Y., & Nopitasari, D. (2018). Analisis Kemampuan Representasi Matematis Siswa Smp Pada Pokok Bahasan Statistika. *Prima: Jurnal Pendidikan Matematika*, *2*(2), 149. https://doi.org/10.31000/prima.v2i2.711

Umar, W. (2012). Membangun Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika. *Infinity Journal*, *1*(1), 1. https://doi.org/10.22460/infinity.v1i1.2

Wijaya, T. T., & Afrilianto, M. (2018). Kemampuan Komunikasi Matematis Siswa Smk. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *1*(1), 53. https://doi.org/10.22460/jpmi.v1i1.p53-60

Yanti, A. W., & Novitasari, N. A. (2021). Penggunaan jurnal reflektif pada pembelajaran Matematika untuk melatih kemampuan komunikasi matematis siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(2), 321–332.

Zakiah, N. E., Sunaryo, Y., & Amam, A. (2019). Implementasi Pendekatan Kontekstual Pada

Model Pembelajaran Berbasis Masalah Berdasarkan Langkah-Langkah Polya. *Teorema: Teori Dan Riset Matematika*, *4*(2), 111. https://doi.org/10.25157/teorema.v4i2.2706