M A T H L I N E
JURNAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA
ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 7 Nomor 1, Februari 2022, halaman 66 – 76.

Analysis Of Student Answer Process On Mathematical Communication Skills Through Process Oriented Guided Inquiry Learning (POGIL) Model

Analisis Proses Jawaban Siswa Pada Kemampuan Komunikasi Matematik Melalui Model *Process Oriented Guided Inquiry Learning* (POGIL)

Anim[1,2], Sahat Saragih[1], E.Elvis Napitupulu[1], Nilam Sari[1,3]
[1]*Pascasarjana Universitas Negeri Medan, Jl. William Iskandar Psr V, Medan, Indonesia*
email: saragihpps@gmail.com, email: elvisnapit@gmail.com
[2]*FKIP,Pendidikan Matematika, Universitas Asahan, Jl. Jendral Ahmad Yani, Kisaran, Indonesia*
email: animfaqot30031991@gmail.com
[3]*Pendidikan matematika, Universitas Quality, Jl. Ngumban Surbakti, Medan, Indonesia*
email: nilamsarie@gmail.com

ABSTRAK

Penelitian ini bertujuan untuk mengetahui serta menganalisis Proses jawaban siswa pada aspek kemampuan komunikasi siswa dengan materi segiempat di MTs Quran Kisaran melalui salah satu model inovatif dan model yang berpusat pada siswa yaitu model POGIL. Sample yang diambil dalam penelitian ini adalah 30 orang siswa dari populasi seluruh siswa kelas VII MTs Quran Kisaran diambil secara acak. Adapun jenis penelitian yang digunakan adalah deksriptif kualitatif. Teknik analisis data menggunakan perhitungan penskoran dengan pengkategorian berdasarkan persentase skor siswa. Instrumen penelitian adalah soal tes kemampuan komunikasi matematik berupa 3 butir soal essay. Berdasrkan hasil analisis tes yang telah dilaksanakan pada 3 utir soal komunikasi matematik menunjukan bahwa hasil cukup baik dan tergolong tinggi pada kemampuan komuniaksi matematik siswa melalui model POGIL dengan kategori tinggi > 66%. Sehingga penggunaan model POGIL menjadi salah satu alternatif yang disarankan dalam pembelajaran matematika untuk mengukur kemampuan komunikasi matematik khususnya pada materi Segiempat. Bagi Peneliti yang ingin melanjutkan Penelitian ini dengan model POGIL agar mengukur aspek pada kemampuan matematik lainnya.

Kata Kunci : Proses Jawaban Siswa, Kemampuan Komunikasi Matematik, Model POGIL

ABSTRACT

This study aims to determine and analyze aspects of students' answer process on aspects of student communication ability with quadrilateral material at MTs Quran Kisaran through one of the innovative and student-centered models, namely the POGIL model. The sample taken in this study was 30 students from the population of all seventh grade students of MTs Quran Kisaran taken at random. The type of research used is descriptive qualitative. The data analysis technique uses a scoring calculation with categorization based on the percentage of student scores. The research instrument is a test of mathematical communication skills in the form of 3 essay questions. Based on the results of the analysis of tests that have been carried out on 3 items of mathematical communication questions, it shows that the results are quite good and quite high on students' mathematical communication skills through the POGIL model with a high category of > 66%. So the use of the POGIL model is one of the suggested alternatives in learning mathematics to measure mathematical communication skills, especially in the quadrilateral material. For researchers who want to continue this research with the POGIL model in order to measure aspects of other mathematical abilities.

Keyword(s): Students Answer process, Mathematic Communiation ability, POGIL Model

How to Cite: Anim, A., Saragih, S., Napitupulu, E. E., Sari, N. *Mathline: Jurnal Matematika dan Pendidikan Matematika*, Vol. 7 No. 1, 66 - 76.
DOI: https://doi.org/10.31943/mathline.v7i1.245

PRELIMINARY

Education is the main key in a country. Therefore education is often a symbol of the greatness, dignity and strength of a nation. In addition, education is generally seen as the key to a country's economic growth and prosperity and its ability to compete in the global economy.(Heppell & Ultralab, 2004) Education also has a very important role in shaping a generation that can act effectively in the face of a rapidly changing and complex world. Every human being has the right to get a proper and equal education. However, what is happening in Indonesia is the unequal distribution of education for all Indonesian citizens.

In addition, the current discussion is the current education system in Indonesia which is considered rigid and ineffective(Fadia & Fitri, 2021). We can see this from the lagging quality of education in Indonesia compared to other countries. It can be seen in the results of the 2018 Program for International Student Assessment (PISA) survey which was published in March 2019 and then photographed a few problems in Indonesia's education. In the categories of reading, science, and mathematics, Indonesia's score is low because it ranks 74th out of 79 countries.(Schleicher, 2018).

Based on the results of PISA above, one of the categories measured is mathematics. Mathematics is a science that is always evolving in accordance with the demands of human needs for technology.His existence in the world is very much needed and his life continues to develop in line with the demands of human needs, because there is no human activity/behavior that is separated from mathematics. Mathematics has become a queen as well as a servant for other sciences(Kamarullah, 2017). On the whole, mathematics teaching program provides a general goal, namely to prepare students to be able to face changing world conditions that are always developing, through practical actions in a logical, rational, critical thinking, careful, honest, effective and efficient manner. Then prepare students to be able to use mathematics and mathematical thinking patterns in everyday life in studying various sciences.(Princess et al., 2020).

In addition, the vision of mathematics developed by NCTM that those who have excellent mathematical competence will significantly open the door to a productive future because mathematics is the key to opportunity in an ever-evolving world (NCTM, 2000). *National Council of Teacher Mathematics* (NCTM, 2000) has set several standard processes that must be mastered by students in learning mathematics, one of which is mathematical communication. In addition, students' mathematical communication as a means for students to make logical connections in various ways to represent mathematical ideas (pictures, graphics, symbolic etc.). according to(Kosko & Gao, 2017),(Anim et al., 2019) reveals why mathematical communication is important to educators' attention (1) gains traction as an NCTM-oriented position, (2) to engage students in developing a deeper understanding of mathematics (3) student involvement in mathematical communication has been found to be able to predict students' mathematics learning achievement.

On that basis, students' mathematical communication skills need to be improved again. Furthermore, indicators of success in improving students' mathematical communication skills according to (Indah Nartani et al., 2015) , (Saragih & Anim, 2018)(1) Students are able to express mathematical ideas or ideas with verbal sentences; (2) Students are actively involved in discussions about mathematics; (3) Students can formulate definitions and generalizations about mathematics; (4) Students can formulate mathematical definitions using their own words. But the fact is that students rarely start their work by pouring information or changing mathematical models so that in the completion many students are not able to carry it out.

This is also supported by several studies showing that there are still many students in Indonesia who have low mathematical communication skills(Anim & Saragih, 2019; Ismunandar, 2018). One of the previous studies conducted by Kaselin et alit is known that students' mathematical communication skills are still low, from 4 study groups with 30 students in one class, on average there are only 6 to 8 students who have good mathematical communication skills. There are still many students who are unable to relate the problems faced with the context of events that exist in real life, are unable to utilize the data/information on the questions, so that the completion of the next step becomes stalled and difficulties in applying the previously learned knowledge(Kaselin et al., 2013). (Herdini et al., 2018) found that the students' mathematical communication skills were still low and still did not meet expectations. On the other hand, school institutions develop very slowly in improving students' abilities compared to what is expected.(Lagrange et al.,

2003).Thus, the level of students' mathematical abilities is in line with their mathematical communication skills.

The same thing is also experienced at MTs Quran Kisaran school, which is still in the low category in mathematical communication skills. This can be seen in the observations with the questions given as follows:

> "A rectangle has a side length of four times its width. If the area of the rectangle is 100 cm2, then calculate the length and width of the rectangle rightly!"

The following is one of the results of students' answers to the questions above.

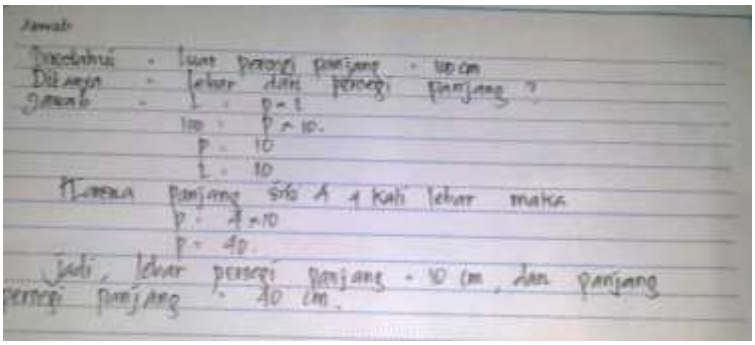

Figure 1. Results of Students' Mathematical Communication Test answers during Observation

In Figure 1, the student's answers, it is clear that the students do not know the information about the problem so they are unable to solve the problem, besides that in terms of the process of completing the answers made by the students above, it can be concluded that they are very poor and unstructured. According to Sen & Yilmaz (2015) one of the learning models that directs students to construct their own knowledge by actively involving students is Process Oriented Guided Inquiry Learning (POGIL).(Şen et al., 2015)in line with research results(Fujiati & Mastur, 2014)which states that the POGIL model assisted by teaching aids in the aspect of mathematical communication skills achieves classical mastery and is higher than those given expository learning. In addition, it is also proven by research(Riskayani & Erita, 2021)which states that the pogil model is very effective in mathematical communication skills

POGIL emphasizes cooperative learning, students work in teams, design activities to build cognitive abilities (conceptual understanding), and develop skills in a learning process such as science processes, thinking skills, problem solving (problem solving), communication skills, management, building social attitudes positive and self-assessment skills that can develop metacognitive knowledge(Hanson, 2014).

According to Bilgin & Geban (in Barthlow,(Barthlow & Watson, 2010)) the POGIL model is specifically designed to include elements of cooperative learning, where cooperative learning has been proven to be able to improve processing abilities and higher order thinking skills. Learning with the POGIL model students work in teams of up to 4 people with each person having a different role in the group. The roles that exist for each group member are: manager (group leader), spokesperson (spokesperson), note taker (recorder), and strategy analyst.

Based on the explanation above, with the existence of an innovative model, namely the POGIL model to measure mathematical communication skills, it is necessary to study how the student's answer process on mathematical communication skills through the POGIL model.

METHODS

This type of research is qualitative descriptive. Researchers conducted research on a sample of one class VII selected by random sampling at SMP Quran Kisaran as many as 30 students in the odd semester of the 2021/2022 Academic Year. While the research target is to analyze students' mathematical communication skills through the POGIL model.

The instruments are questions of rectangular material arranged based on indicators of mathematical communication skills. In Table 1 shows the indicators taken to conduct this research, including:

Table 1. Indicators of Mathematical Communication Ability

No Question	Mathematical Communication Indicator
1	Express mathematical situations or ideas into pictures
2	Explain in writing the pictures into mathematical ideas and
3	Explain the settlement procedure

Data collection techniques on the score of mathematical communication skills according to Sumarmo will be shown in table 2 (Wijayanto et al., 2018).

Table 2. Mathematical Communication Ability Scoring

Score	Criteria
4	Complete and clear response, no hesitation, complete diagrams, efficient communication, logical presentation, accompanied by examples
3	Correct response, complete and clear, complete diagrams, efficient communication, and complete presentation but not accompanied by examples
2	Correct response, complete and clear, complete diagram, incomplete communication and presentation and not accompanied by examples
1	Correct response but incomplete/clear, incomplete diagrams, communication and presentation, not accompanied by examples
0	Response, inefficient communication, misinterpretation (blank answer sheet/no answer)

RESULTS AND DISCUSSION

Results

The results of the acquisition of categories in the mathematical communication ability answer process are as follows:

Table 4. Percentage of Mathematical Communication Ability

Score	Question points		
	Question No. 1	Question No. 2	Question No. 3
	Many Students		
4	15	11	7
3	4	11	5
2	6	8	7
1	3	0	7
0	2	0	4
Total Score of Questions	87	93	64
Number of Students x Score	120	120	120
Maximum Percentage of Questions	72.5%	77.5%	53.33%
Category	Tall	Tall	Currently

In the table above, the total score of the questions is obtained by adding up the scores obtained multiplied by the number of students who got that score. So that the total score of items on each question is obtained, namely question no. 1 with a total score of 87, question no. 2 with a total score of 93, question no. 3 with a total score of 64 with a maximum score of 120. So it can be seen that the percentage obtained as a determinant of the category is obtained. question no. 1 and no. 2 are in the high category with 72.5% and 77.5% > 66% and on question no. 3 it is in the medium category with a percentage of 53.33%.

Discussion

Item number 1

For item number 1 with indicators of communication skills explaining situations or ideas in the form of pictures of students who get a maximum score of 4 means answering correctly and completely in POGIL learning as many as 15 people (50%), students who get a score of 3 as many as 4 people (13.33%), for a score of 2 as many as 6 people (20%), and for a score of 1 as many as 3 people (10%), and there are also students who did not answer question number 1 as many as 2 people (6.66%) . The following is a picture that represents one of the results of student answers in the POGIL class.

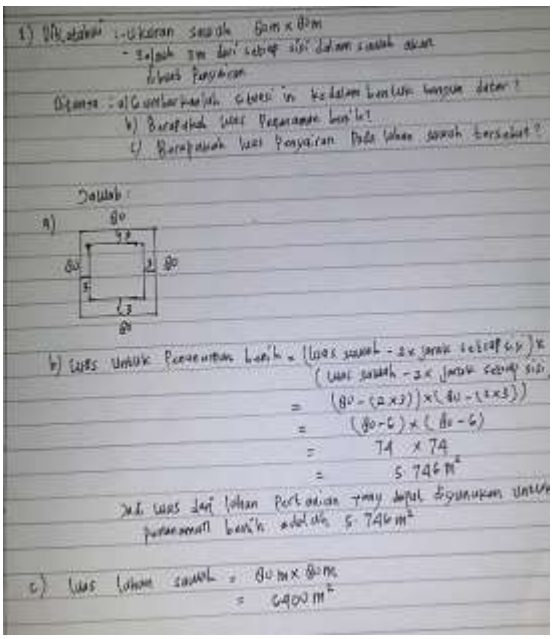

Figure 2. Student Answers to Question Number 1

Based on question number 1 above, students are able to explain mathematical ideas in the form of pictures, at the same time students are also able to explain the completion procedure to answer questions in question 1b in finding the area for planting seeds. However, for the problems in question 1c students did not understand the questions given, so the final solution was still incomplete.(Hidayati, 2019) In his research, he also found that students had difficulty and were very lacking in retrieving the information contained in the story questions. So that the solution is not answered properly and correctly.

Item number 2

In item number 2 with indicators of communication skills Explaining in writing pictures into mathematical ideas students who get a maximum score of 4 means answering correctly and completely in POGIL learning as many as 11 people (36.66%), students who get a score of 3 are 11 people (36.66%), for a score of 2 as many as 8 people (26.66%),

The following is a picture that represents one of the results of student answers through the POGIL Model

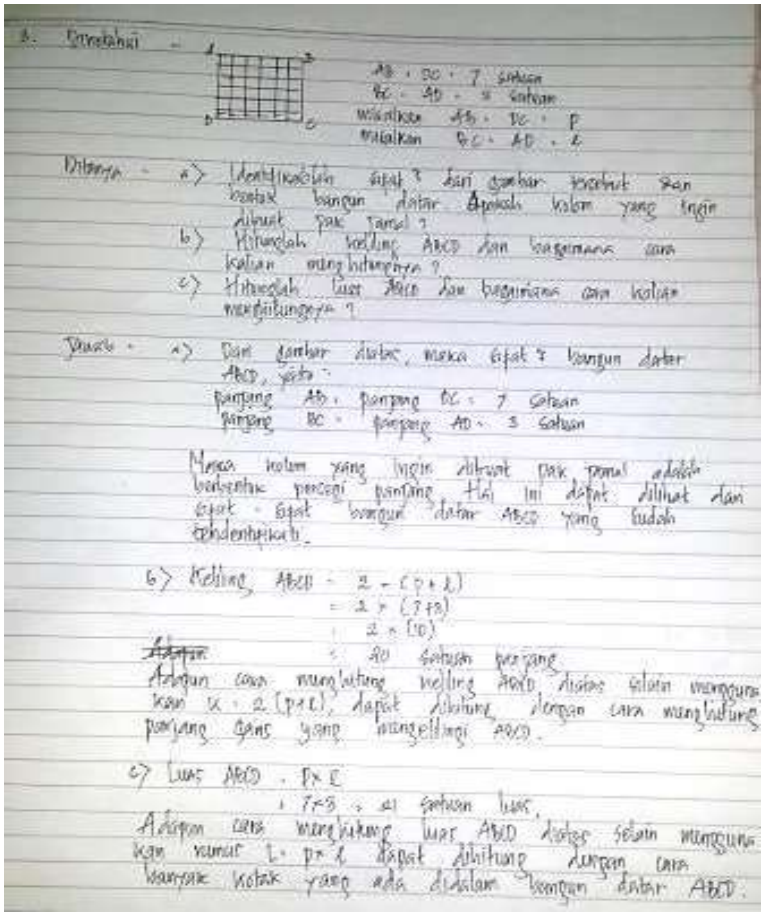

Figure 3. Student Answers to Question Number 2

Based on question number 2 above, students are able to explain in writing the picture into mathematical ideas correctly and well, at the same time students are also able to explain the completion procedure to answer questions in question 1c so that the final solution to question number 2 can be obtained by students correctly.

Item number 3

For item number 3 with an indicator of the ability to explain the completion procedure, students who get a maximum score of 4 means that they answer correctly and completely in POGIL learning as many as 7 people (23.33%), students who get a score of 3 are 5 people (16.66%) , for a score of 2 as many as 7 people (23.33%), students who got a score of 1 were 7 people (23.33%), for a score of 0 as many as 4 people (13.33%), The following is a picture that represents one of the the results of student answers through the POGIL Model.

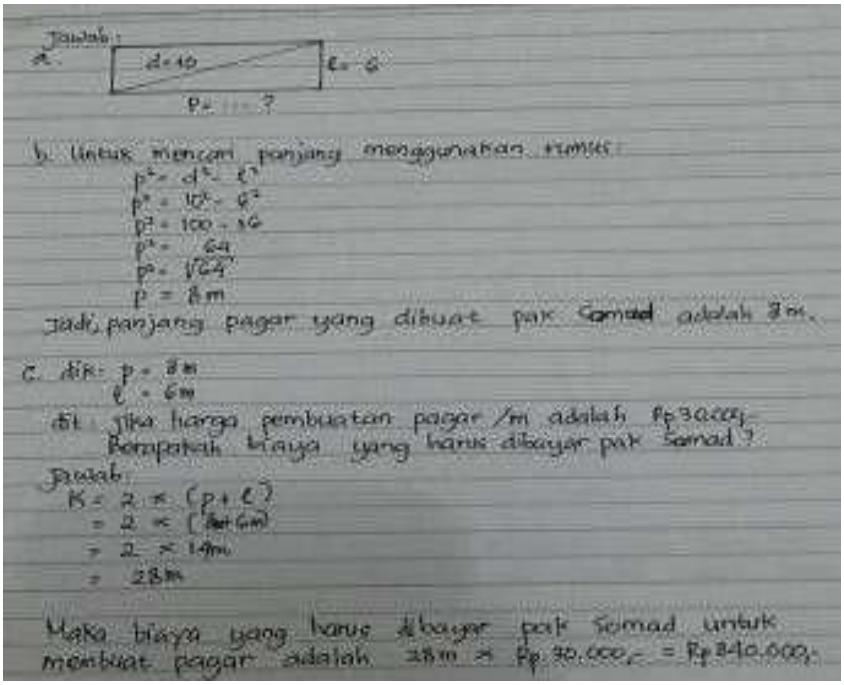

Figure 3. Student Answers to Question Number 3

Based on question number 3 above, students are able to solve problems and express mathematical situations in the form of pictures properly and correctly, but they are still not precise in making examples of questions or the examples are not clear, but students are able to write variables into other variables in the form of equations and explain the completion procedure properly and correctly so that students are able to solve the problem correctly until the final solution. Based on the results of his research, it states that if the procedure is completed properly, students will find the final solution (Hidayati, 2019).

CONCLUSION

Based on the results and discussion of the research that has been described , it can be concluded that the Mathematical Communication Ability of MTs Quran students in the quadrilateral material after being taught through the POGIL model is included in the high category . This can be seen from the results of the percentage score on each item of the 3 questions, two questions are in the High category, namely 66% and one question is in the moderate category > 33%. So that students already have good communication skills, but when working on questions there are still errors that students experience such as understanding the questions so that the final results are still not obtained by some students. However, overall students have been able to achieve the third indicator, namely until they find their own concept and are able to explain the completion procedure quite well.(Aminah et al., 2018) concluded that mathematical communication skills connecting

real objects, pictures and diagrams into mathematical ideas are classified as low and(Rahmawati et al., 2018)with the results of the study stating that the mathematical communication skills of SMK students on SPLDV material are still low.

One of the suggested alternatives is to use the POGIL model in mathematics learning to measure mathematical communication skills, especially in the quadrilateral material. For researchers who want to continue this research with the POGIL model in order to measure aspects of other abilities and other materials.

ACKNOWLEDGMENTS (Optional)

Thank you to Allah who has given me health so that I can finish this article as well as possible, besides that, I also thank the supervisors in the Cultural-Based Constructive Mathematics Learning and Information Technology course and colleagues from all B-2 class of postgraduate doctoral class who have provide input and encouragement, and thank myself for being strong, healthy and enthusiastic until today.

REFERENCE

Aminah, S., Wijaya, T. T., & Yuspriyati, D. (2018). Analisis Kemampuan Komunikasi Matematis Siswa Kelas Viii Pada Materi Himpunan. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *2*(1), 15–22. https://doi.org/10.31004/cendekia.v2i1.29

Anim, A., Prasetyo, Y. D., & Rahmadani, E. (2019). Experimentation of Problem Posing Learning Model Assisted of autograph Software to Students'Mathematical Communication Ability In Terms of Student's Gender. *Jurnal Ilmiah Peuradeun The International Journal of Social Sciences*, *7*(2), 331–3342. https://doi.org/http://dx.doi.org/10.26811/peuradeun.v7i2.301

Anim, A., & Saragih, E. M. (2019). Differences Of Students' Mathematical Communication Skills Through Contextual Teaching Learning With Problem Based Learning Model. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *9*(1), 83–90. https://doi.org/10.30998/formatif.v9i1.3186

Barthlow, M. J., & Watson, S. B. (2010). *The Effectiveness of Process-Oriented Guided Inquiry Learning to Reduce Alternative Conceptions in Secondary Chemistry*. *114*(2001).

Fadia, S., & Fitri, N. (2021). Problematika Kualitas Pendidikan di Indonesia. *Jurnal Pendidikan Tambusai*, *5*(1), 1617–1620.

Fujiati, I., & Mastur, Z. (2014). Keefektifan Model Pogil Berbantuan Alat Peraga Berbasis Etnomatematika Terhadap Kemampuan Komunikasi Matematis. *Unnes Journal of Mathematics Education.*, *3*(3). https://doi.org/10.15294/ujme.v3i3.4482

Hanson, D. M. (2014). *Instructor ' s Guide to Process Oriented Guided Inquiry Learning by*. Pacifi Crest.

Heppell, S., & Ultralab. (2004). *21st Century Schools: Learning Environments of the Future*. 36.

Herdini, R. A., Suyitno, H., & Marwoto, P. (2018). Mathematical Communication Skills Reviewed from Self-Efficacy by Using Problem Based Learning (PBL) Model

Assisted with Manipulative Teaching Aids. *Journal of Primary Education*, *8*(1), 85–73. https://doi.org/10.15294/jpe.v8i1.25311

Hidayati, N. (2019). *Analisis Kesulitan Siswa dalam Menyelesaikan Soal Literasi Matematika pada Materi Segiempat Ramiartiah*. 99–105.

Ismunandar, D. (2018). Pengaruh Karakter Kreatif pada Pembelajaran Numbered Head Together Terhadap Kemampuan Komunikasi Matematik Siswa. *Wacana Didaktika*, *10*(2), 311–340.

Kamarullah, K. (2017). Pendidikan Matematika Di Sekolah Kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, *1*(1), 21. https://doi.org/10.22373/jppm.v1i1.1729

Kaselin, Sukestiyarno, & Budi, W. (2013). Kemampuan Komunikasi Matematis Pada Pembelajaran Matematika Dengan Strategi React Berbasis Etnomatematika. *Unnes Journal of Research Mathematics Education*, *2*(2).

Kosko, K. W., & Gao, Y. (2017). Mathematical Communication in State Standards Before the Common Core. *Educational Policy*, *31*(3), 275–302. https://doi.org/10.1177/0895904815595723

Lagrange, J.-B., Artigue, M., Laborde, C., & Trouche, L. (2003). *Technology and Mathematics Education: A Multidimensional Study of the Evolution of Research and Innovation*. 237–269. https://doi.org/10.1007/978-94-010-0273-8_9

NCTM. (2000). *Principles And Standards For School Mathematics*. The National Council of Teachers of Mathematics, Inc. www.nctm.org

Putri, E. R., Budiyono, & Indriati, D. (2020). POGIL model on mathematical connection ability viewed from self-regulated learning. *International Journal of Evaluation and Research in Education*, *9*(2), 394–400. https://doi.org/10.11591/ijere.v9i2.20321

Rahmawati, N. S., Bernard, M., & Akbar, P. (2018). Analisis Kemampuan Komunikasi Matematik Siswa Smk Pada Materi Sistem Persamaan Linier Dua Variabel (SPLDV). *Journal On Education*, *1*(2), 344–352.

Riskayani, M., & Erita, S. (2021). *EFEKTIVITAS MODEL PEMBELAJARAN PROCESS (POGIL) TERHADAP KEMAMPUAN*. *3*(2), 257–266.

Saragih, E. M., & Anim, A. (2018). Interaksi Antara Model Pembelajaran Dengan Kemampuan Awal Matematik Siswa Terhadap Kemampuan Komunikasi Matematis Siswa. *Jurnal Mathematic Paedagogic*, *3*(1), 83. https://doi.org/10.36294/jmp.v3i1.382

Schleicher, A. (2018). *Insights and Interpretations*. https://doi.org/https://doi.org/10.1787/5f07c754-en.

Şen, Ş., Yılmaz, A., & Geban, Ö. (2015). the Effects of Process Oriented Guided Inquiry Learning Environment on Students' Self-Regulated Learning Skills. *Problems of Education in the 21st Century*, *66*(1), 54–66. https://doi.org/10.33225/pec/15.66.54

Wijayanto, A. D., Fajriah, S. N., & Anita, I. W. (2018). Analisis Kemampuan Komunikasi Matematis Siswa Smp Pada Materi Segitiga Dan Segiempat. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *2*(1), 97–104. https://doi.org/10.31004/cendekia.v2i1.36