IndoMath
Indonesia Mathematics Education
ISSN 2614-5103 (Print)
2614-5111 (online)
https://jurnal.ustjogja.ac.id/index.php/indomath
Vol 6, No. 2, August 2023, pp. 141-157

Analysis of students' mathematical representative ability on dimensional space subject matter in terms of sociomathematical norms

Muhammad Hilmi Fadhlurrahman
Mathematics Education, Prof. Dr. Hamka Muhammadiyah University,
muhammadhilmifadhlurrahman@gmail.com

Samsul Maarif
Mathematics Education, Prof. Dr. Hamka Muhammadiyah University,
samsul_maarif@uhamka.ac.id

ABSTRACT

The purpose of the research is to determine the ability of mathematical representation of students based on the level of sociomathematical norms owned by students. This research uses a descriptive qualitative method. The subjects were six students who had high, medium, and low sociomathematical norm categories. This study used questionnaires, written tests, and interviews to collect data. Rasch model method for questionnaires and written tests as a data analysis technique and in interviews analyzed using data reduction, data collection, and conclusion drawing using MAXQDA. The results of this research are: 1). Students with high sociomathematical norm categories have high mathematical representation abilities, and so do students with medium and low sociomathematical norm levels, 2) the characteristics of students' representation abilities tend to have symbolic ability indicators and 3) the characteristics of students' sociomathematical norms in this study tend to mathematical communication indicators.

Keywords: mathematical representation skills, socio-mathematic norms

ABSTRAK

Penelitian ini bertujuan untuk mengetahui kemampuan representasi matematis peserta didik yang berdasar kepada tingkat norma sosiomatematik yang dimiliki peserta didik. Penelitian ini menggunakan metode kualitatif deskriptif. Subjek pada penelitian ini adalah enam peserta didik yang memiliki kategori norma sosiomatematik tinggi, sedang dan rendah. Penelitian ini menggunakan angket, tes tertulis dan wawancara sebagai instrumen pengambilan data. Menggunakan metode Rasch model untuk angket dan tes tertulis sebagai teknik analisis data dan pada wawancara dianalisis menggunakan reduksi data, pengumpulan data dan penarikan kesimpulan dengan menggunakan *software* MAXQDA. Hasil dari penelitian ini adalah: 1). Peserta didik dengan Kategori norma sosiomatematik tinggi memiliki kemampuan representasi matematis tinggi dan begitu juga dengan peserta didik dengan tingkat norma sosiomatematik sedang dan rendah, 2) karakteristik kemampuan representasi peserta didik cenderung pada indikator kemampuan simbolik dan 3) karakteristik norma sosiomatematik peserta didik pada penelitian ini cenderung pada indikator komunikasi matematika.

Kata Kunci: Kemampuan representasi, norma sosiomatematik.

INTRODUCTION

Mathematics is the foundation of other fields of science (Prihandoko, 2005). In real life, our daily activities cannot be separated from mathematics. Therefore, many consider learning mathematics to be so important. Learning mathematics in the classroom certainly requires a mathematical ability to support the activeness and participation of students (Mulyaningsih et al., 2020). NCTM (2000) states

that mathematical ability is an ability that is applied to deal with problems in the form of mathematical problems or problems in real life.

Mathematical representation ability is one of the abilities that must be mastered by students (Zulfah & Rianti, 2018). Representation is important because it makes it easier for students to deal with every mathematical material and problem (Bagus, 2018). This mathematical representation ability can also be the basis of thought in every mathematics learning. Mathematical representation skills can also be used as a basis for understanding mathematical ideas and representing them in the form of images, graphs, tables, numbers, mathematical symbols, or writing.

(Hwang et al., 2007) mentioned that in general psychology, representation is changing concrete models in the real world into abstract concepts or symbols. Mathematical representation skills can be developed using sociomathematical norms. Sociomathematical norms are formed from the social culture in mathematics learning (Kadir, 2008). Sociomathematical norms in the classroom can be flexible. Teachers and students can act as agents of sociomathematical norm formation. Sociomathematical norms impact student learning achievement and play a role in developing students' personalities (Sulfikawati et al., 2016). But in reality, sometimes students are shy to ask the teacher and lazy to argue due to their low ability to sociomathematical norms. Problems regarding the reciprocal relationship of inhibited sociomathematical norms activities are often found in online learning during the Covid-19 pandemic. Students tend to be passive and uncommunicative during education.

When the pandemic covid 19 ended, students again faced changes in the learning atmosphere, significantly impacting student learning outcomes. The reason is that the consistency and commitment of students to participating in learning decreases (Nangim & Hidayati, 2021). In addition, the lack of communication or interaction between learners and teachers is also a factor in the problem. The interaction activities of students and teachers are significant to achieve educational goals. Education is a basis for developing students' character, potential, or skills to be better for themselves (Qusyairi, 2019).

The process of social interaction will be better if there are boundaries that govern it. The boundaries in question are attitudes and behaviors in exchange. The term for the rules on conduct is norms (Chaviaris & Kafoussi, 2010). Interaction in mathematics learning also requires norms. Sociomathematical norms relate to how learners believe and understand mathematics and position themselves in social interaction to construct mathematical understanding (Ramanda et al., 2021; Widodo et al., 2020; Widodo & Purnami, 2018). Communication can help learners exchange opinions, complete sense, and so on (Widodo et al., 2023). Constructivist learning assumes that the development of learners is the result of communication that occurs through social groups inherent in the routine of life.

Many researchers have examined sociomathematical norms to improve student's communication skills in mathematics. According to (Kadir, 2014), the interaction in the classroom and the materials used as teaching materials can affect the development of sociomathematical norms. Based on the above problems, the researcher wants to analyze the ability of mathematical representation in terms of the sociomathematical norms that each student has and become a

foundation in knowing the causes of why students are lacking in terms of representing the mathematical problems they face. From the above statement, there are two questions: how are the characteristics of students facing mathematical problems using representation skills based on the sociomathematical norms of students and knowing the attributes of sociomathematical norms that students have when facing mathematical problems?

METHOD

The method used in this research is descriptive qualitative, the data sampling process is carried out by purposive and snowball, and the research results focus more on meaning than generalization. A descriptive study determines the circumstances, events, and conditions in the research process whose influences are described in a report. The type of research used is descriptive qualitative because it is considered a solution to the researcher's question in explaining students' representation skills in solving mathematical problems based on the sociomathematical norms that students have in the classroom during the mathematics learning process after the co-19 pandemic. In this study, researchers analyzed students' mathematical representation abilities on space dimension material based on the sociomathematical norms possessed by students at MAN 16 Jakarta.

The purposive sampling method is the most appropriate in determining research subjects in this study because this research requires samples in three categories of participants: students with low mathematical representative ability, students with moderate mathematical usual knowledge, and students with high mathematical representative ability. Determination of the subject can be done with consideration based on what is needed in the research (Maharani & Bernard, 2018). The study began by distributing questionnaires in the form of questionnaires, then analyzing and classifying six students based on the level of sociomathematical norms that students have, which are divided into high (ST1 and 2), medium (SS1 and 2) and low (SR1 and 2). Furthermore, they carried out written tests on six students with the three levels of sociomathematical norms owned. The last stage conducted an interview session with the six students about the information on their mathematical representation abilities and sociomathematical norms.

The first instrument is a questionnaire regarding the sociomathematical norms of students. Before being tested, this research instrument was validated by experts. The questionnaire contains 25 student statements with four options: Strongly Agree, Agree, Disagree, and Strongly Disagree. In this sociopathic norm questionnaire instrument, four indicators are the objectives: experience, explanation, difference, effectiveness, and mathematical communication (Ningsih & Maarif, 2021). The second instrument is an essay question about students' representation ability which contains five questions about three-dimensional material. In this essay question about students' representation ability, three indicators become the reference for assessment, namely 1) Visual Ability, reflecting the forms described mathematically into pictures, diagrams, or tables. 2) Symbolic Ability, create a mathematical model described in the mathematical problem the problem is given. 3) Verbal Ability, illustrating mathematical concepts into daily events through descriptions or arguments. (Halim, 2020). Before collecting data, the instrument was validated first. After that, the researcher conducted a questionnaire trial for XII IPA 2 class students at SMAN 64 Jakarta. Then the researcher

calculates the validity and reliability of the instrument as said by whether or not an instrument is good (Mayowi & Maarif, 2023), namely by doing validity and reliability on the instrument.

Then interviews were conducted to obtain in-depth information on students' mathematical representation skills. Triangulation is a formula used to check the truth of research that has been undertaken. In other words, triangulation aims to check the validity of the data collected in research findings (Octaviani & Sutriani, 2019).

Then the researcher analyzes the data that has been collected. Data analysis is critical in a study because problem-solving can be found in the data analysis process (Farida, 2014). The data that has been obtained is arranged systematically for analysis by grouping data into several categories, answering into several units, making syntheses, putting them into a pattern, sorting out things that are considered urgent to learn or vice versa, and concluding solutions that many people easily understand. Activities in data analysis and its explanation include reduction, presentation, and conclusion. Activities in data reduction include selecting key points, focusing on essential things, and determining themes and patterns. The data obtained will be collected and then selected according to research needs, and researchers will assess all data from the instruments acquired. Then the data presentation is done by generalizing the results of the findings on mathematical representation abilities and the sociopathic norms of students. Next is to conclude this research is more complete results. Conclusions can also be strengthened by attaching data as a description or description of the analysis results that have been considered perfect. Researchers use MAXQDA 2020 software as a data collection tool to strengthen data based on the results of researcher interviews with students. MAXQDA is software to facilitate qualitative data analysis based on the results of interview transcripts with students. (Maarif et al., 2022).

RESULT AND DISCUSSION

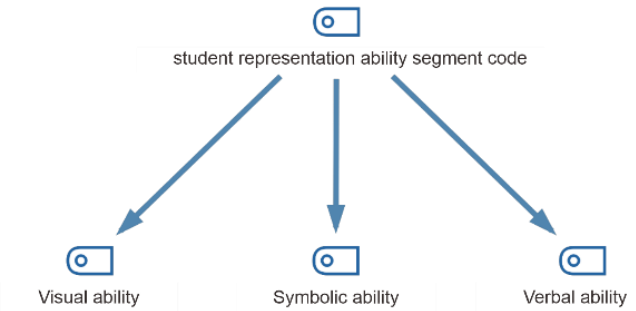

Figure 1. Segment Codes of the Learners' Mathematical Representation Ability Indicators

Figure 1 is an indicator that becomes a reference in analyzing students' mathematical representation abilities, which will determine the results of this study. Figure 2 above is the average of students' mathematical representation abilities indicators. From Figure 2, we can see that symbolic ability is more dominant in students than other indicators. Based on the written test that has been done, the researcher will then analyze the interview results of each student with high (ST1 and ST2), medium (SS1 and SS2), and low (SR1 and SR2) sociomathematical norm categories.

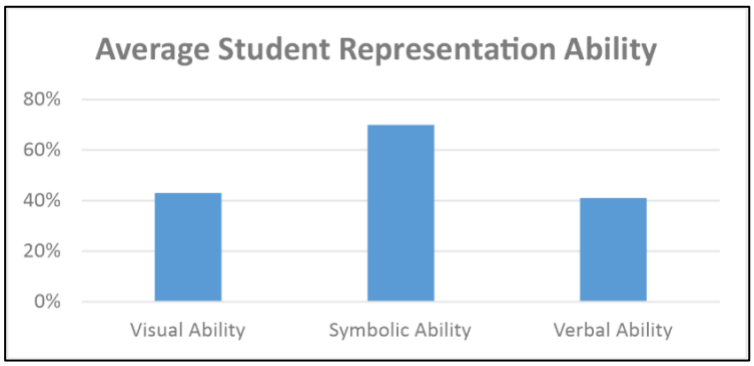

Figure 2. Diagram of Average Mathematical Representation Ability of Learners

The results section presents the research findings in tables, graphs, diagrams, or narratives describing each research result. It also discusses the researchers' report of the study results and whether they align with expectations. It then compares the findings with previous studies primarily published in reputable scientific journals or using literature. Furthermore, the paper should provide a deduction or generalization, which is how the study results can be applied to more general situations.

Mathematical Representation Ability of Learners with High Sociomathematical Norms

Figure 3 shows answer number 1, ST1 can write what is known, asked, and answered well, and correctly ST1 can write the steps in answering question number 1. Then, ST1 can provide symbols to solve the problem by using permissiveness. For example, the length of the rib is initialized with x. Then, ST1 can make a drawing that matches what is informed in the problem well and correctly. Then, ST1 could make a drawing that fits what reported the situation well and accurately. However, ST1 was incorrect in answering question number 1 because there was a mistake in operating the calculation.

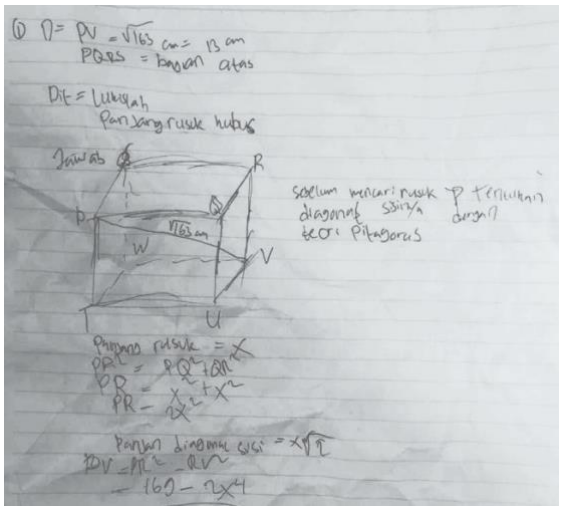
Figure 3. ST1's answer to question number 1

Then based on the results of the interview, ST1 was able to solve all mathematical problems properly and correctly, then ST1 made a picture to make it easier to see the parts of the cube, namely the ribs so that ST1 could understand which one to look for. Then ST1 read the problem three times.

In addition, ST1 replaced PQ and QR with x, which aims to shorten the writing. The following is the data analysis of the interview results to ST1 using MAXQDA.

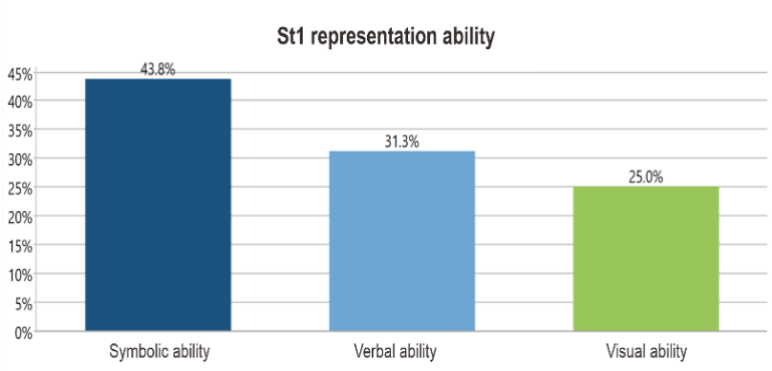

Figure 4. Diagram of ST1 Mathematical Representation Ability Indicator

Based on Figure 4, ST1 is more dominant in symbolic ability than verbal and verbal ability. It can be seen from the interview transcript analyzed using the MAXQDA application where the percentage reached 43.8%.

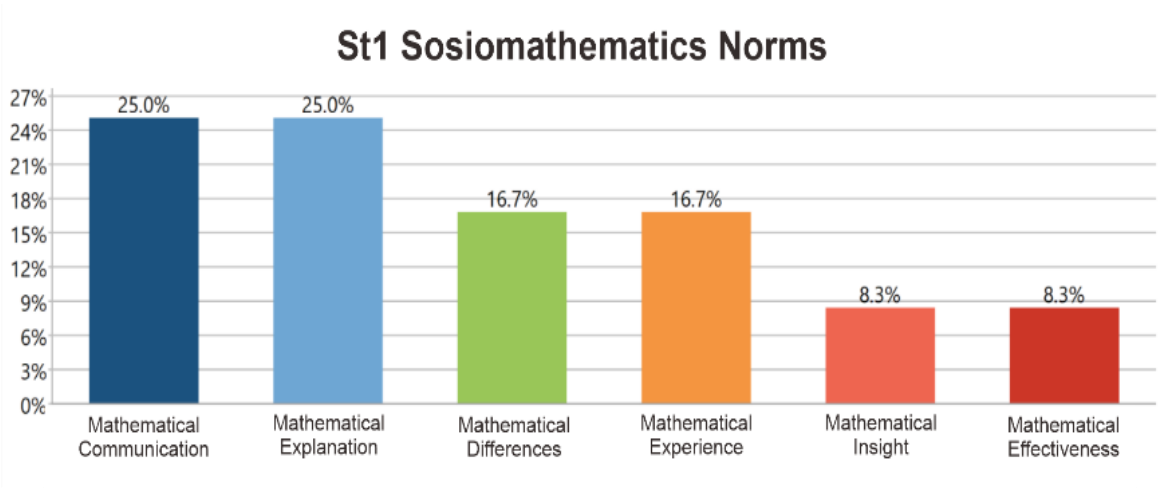

Figure 5. Sociomathematical Norm Indicator Diagram of ST1

Based on Figure 5 shows that ST1 has characteristics that lead to mathematical communication and mathematical explanation because the presentation of these two indicators is higher than other indicators, namely 25%.

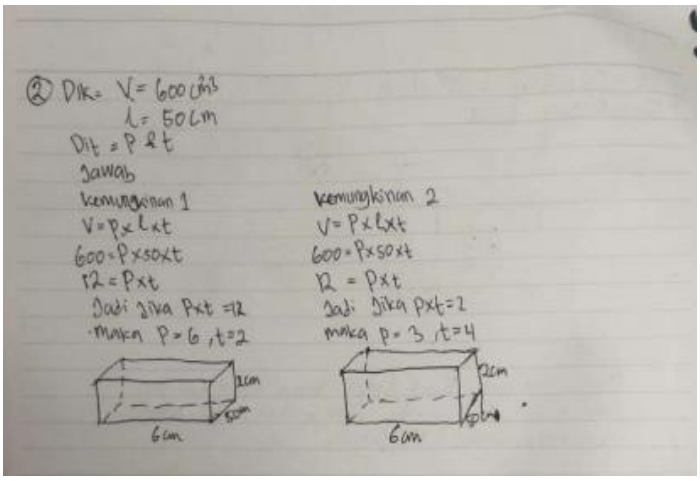

Figure 6. ST2's Answer to Problem Number 2

Figure 6 shows the answer to question number 2 from ST2, ST2 wrote what is known, asked, and answered entirely and correctly. ST2 also provided answers with two ways or two possibilities, complete with pictures of blocks, volume formulas, and symbols for solving the problem. In problem number 2, ST2 could operate every step written down, thus giving the right and correct answer.

Based on the interview conducted with ST2, it was found that ST2 could understand what was informed in the problem in detail and correctly. ST2 was able to imagine when reading the problem, and what was supposed was a block-shaped aquarium so that ST2 could determine the formula for the volume of the block. Then, ST2 can explain how the solution in answering question number 2 is excellent and correct, so the answer from ST2 is correct. The following is the data analysis of the interview results to ST2 using MAXQDA.

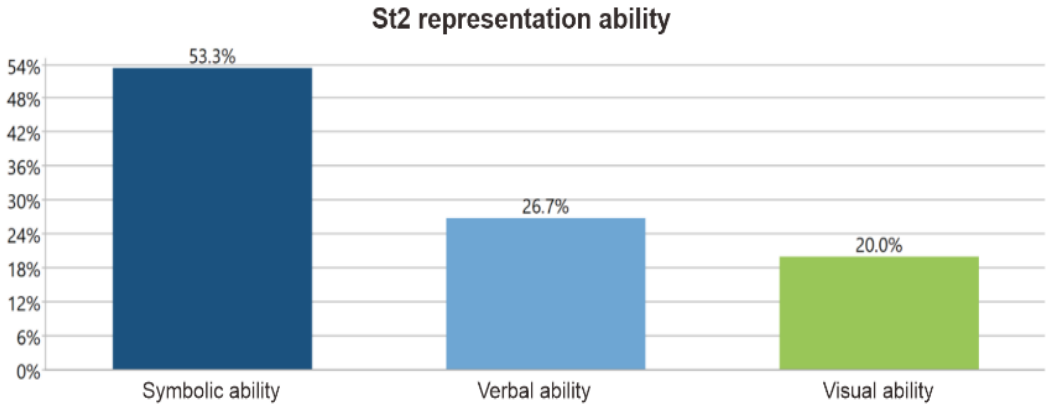

Figure 7. Diagram of ST2 Mathematical Representation Ability Indicator

Then, based on Figure 7, it is found that ST2 is more dominant towards symbolic abilities. This can be seen from the analysis of interview transcripts with the MAXQDA application, where ST2 gets 53.3%.

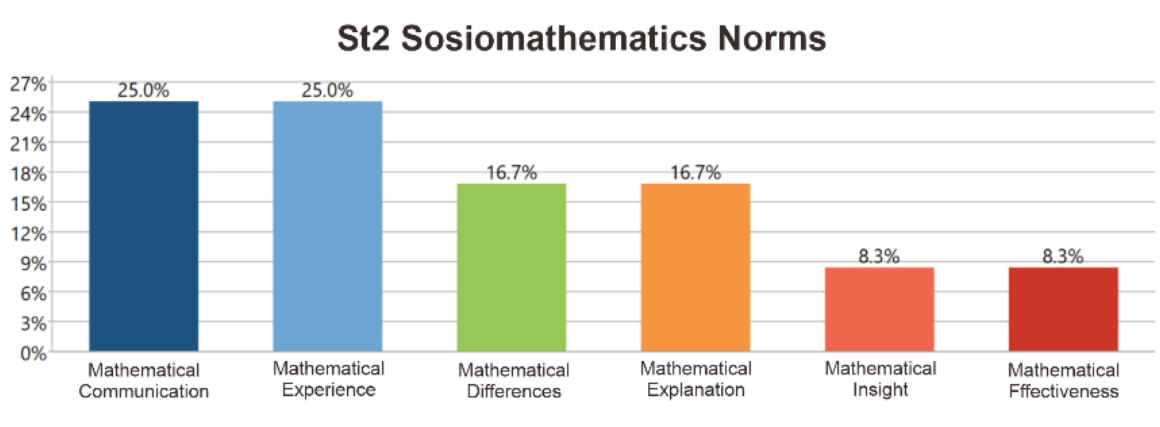

Figure 8. Sociomathematical Norm Indicator Diagram of ST2

Based on Figure 8 shows that ST1 has characteristics that lead to mathematical communication and mathematical explanation because the presentation of these two indicators is higher than other indicators, namely 25%.

Based on the results of the analysis of high-category mathematical representation abilities in students with high sociomathematical norms ST1 and ST2, both of them can work on all the problems provided to the maximum. Both understand what each question means and work on each indicator well. However, from the results of the interview analysis in Figure 4 and Figure 7, ST1 and ST2 have characteristic tendencies that lead to indicators of symbolic ability. In line with research conducted by Warisi (2016), which states that students with high representation ability will fulfill the indicators of extended ability with high scores and have a tendency to symbolic ability indicators.

For sociomathematical norms, ST1 and ST2 are high-category learners. Judging from Figure 5 and Figure 8, both of them can interact well with other students in the classroom, accept differences in mathematical solutions with other students, and re-explain the material that the teacher has explained. In line with research (Ningsih & Maarif, 2021; Sulfikawati et al., 2016), excellent sociomathematical norms can contribute to learning, understanding discussions and arguments, and identifying differences and similarities in mathematical solutions. If these things are fulfilled, students' mathematics learning results will also be maximized.

Mathematical Representation Ability of Students with Moderate Sociomathematical Norms

In Figure 9, SS1 was able to answer this question correctly. SS1 answered the form of surface area calculation results with the correct formula and operation, then gave the answer results with sentences made at points a and b, precisely and correctly. Then, SS1 was able to use symbols in the surface area formula. However, SS1 did not make a picture in question number 3.

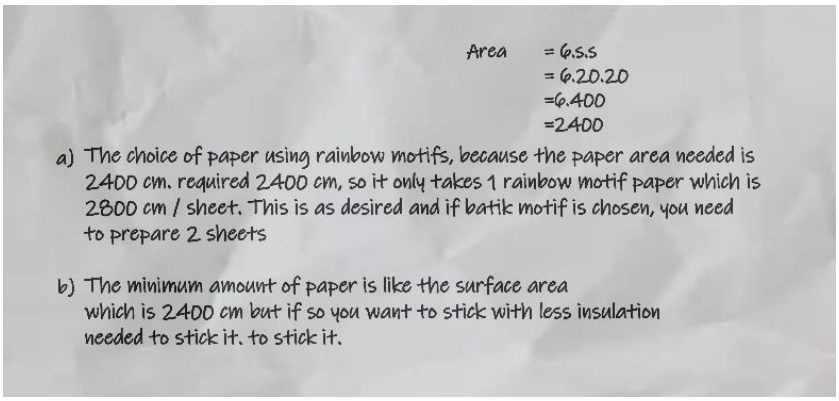

Figure 9 SS1's Answer to Problem Number 3

Then based on the interview results, SS1 could work on problem number 3 by the instructions, then SS1 could explain the formula of the surface area of the cube well and correctly, so SS1 could explain it in his language. In addition, SS1 did not make a drawing because there was no drawing order in this question. The following is the data analysis of the interview results with SS1 using MAXQDA.

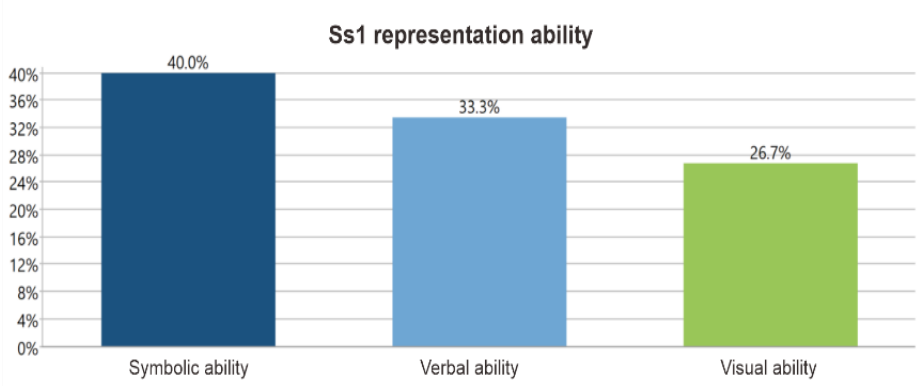

Figure 10. Diagram of SS1 Mathematical Representation Ability Indicator

Based on Figure 10, SS1 is more dominant towards symbolic ability. This can be seen from the results of Figure 12, where the percentage obtained is 40% and higher than the verbal and visual abilities.

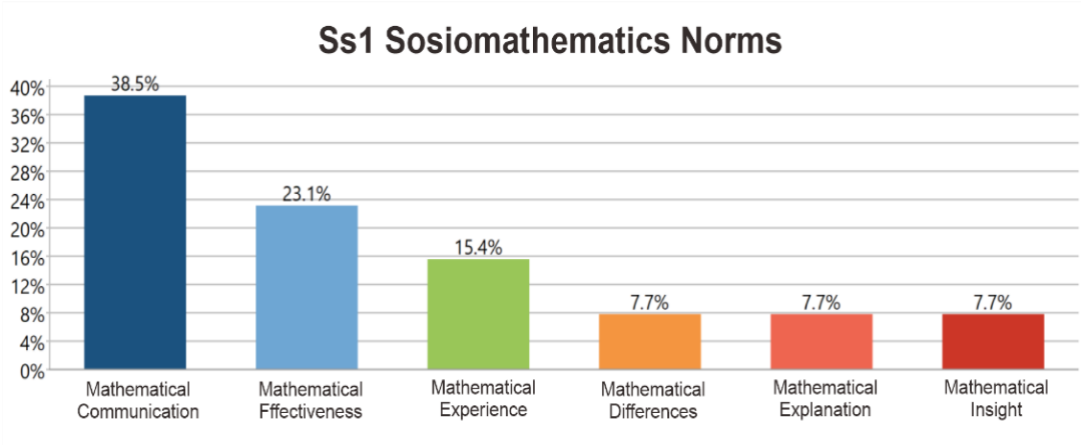

Figure11. Diagram of SS1 Sociomathematical Norm Indicator

Based on Figure 8 shows that the characteristics of the moderate category of sociomathematical norms owned by SS1 are more directed towards mathematical communication because the percentage on the mathematical communication indicator is higher than other indicators, namely 38.5%.

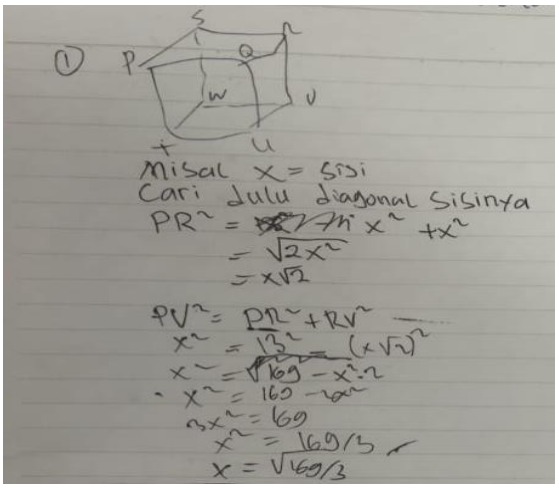

Figure 12. SS2's Answer to Problem Number 1

In Figure 12, SS2 was able to describe the shape of the cube, although not so neat, and equipped with the naming of the corner points of PQRS.TUVW. Then, SS2 is modeled if the side is x. Furthermore, SS2 made the equation in question number 1, PQ2 = x^2 + x^2, which helped SS2 answer question 1 correctly.

Based on the results of the interview, SS2 was able to work on problem number 1 well and correctly. SS2 explained how the steps in solving problem number 1 were reasonable. Then, SS2 also explained how to name each corner point on the cube and chose to draw the cube to make it easier to find the answer. SS2 also used x for QR to make it easier to answer question number 1. The following is the data analysis of the interview results to SS2 using MAXQDA.

Figure 13. Diagram of SS2 Mathematical Representation Ability Indicator

Then, based on Figure 13, SS2 is more dominant towards verbal ability. It can be seen in Figure 16 where the percentage of verbal ability reached 54.5%, which is higher than visual and symbolic abilities.

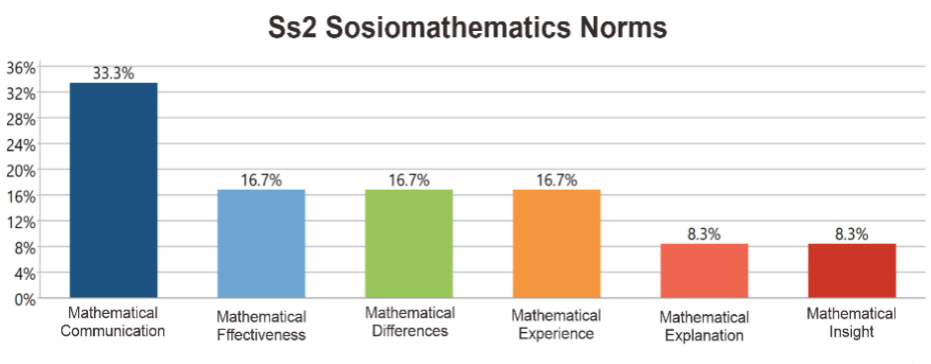

Figure 14. SS2 Sociomathematical Norm Indicator Diagram

Based on Figure 8 shows that SS2 has characteristics that lead to mathematical communication because the percentage of these indicators is higher than other indicators, namely 33.3%.

Based on the analysis of the mathematical representation ability of students with moderate category sociomathematical norms SS1 and SS2, both can solve the problem according to each indicator given. However, SS1 and SS2 have not been able to maximally write down each indicator in the problem (see Figure 9 and Figure 12). Both of them may not understand some concepts in the issue. The characteristics of the representation ability of SS1 are different from SS2 where SS1 tends to have symbolic indicators (see Figure 10), and SS2 has a tendency to have verbal ability indicators (see Figure 13), which indicates the imperfection of students with moderate representation ability due to lack of understanding of the concepts in the problems given in line with research (Melinda, 2017) which states that students with reasonable mathematical representation ability will have difficulty in making mathematical expressions in the form of symbols, visual or verbal because of their lack of understanding of the concepts in the problems of the problems being worked on.

For sociomathematical norms, SS1 and SS2 are learners with moderate sociomathematical norms. Both can contribute to learning in class, understand the material explained by the teacher, discuss with other students when solving problems, and explain the material presented by the teacher again (see Figure 11 and Figure 14). In line with research (Ningsih & Maarif, 2021; Sulfikawati et al., 2016), excellent sociomathematical norms can contribute to learning, understanding discussions and arguments, and identifying differences and similarities in mathematical solutions. If these things are fulfilled, students' mathematics learning results will also be maximized.

Mathematical Representation Ability of Learners with Low Sociomathematical Norms

Based on the interview results, SR1 could not explain why he did not draw the cube. Then, SR1 could define the steps in solving problem number 3 with complete and clear answers using the symbols written on his answer sheet according to his language. The following is the data analysis of the interview results to SR1 using MAXQDA.

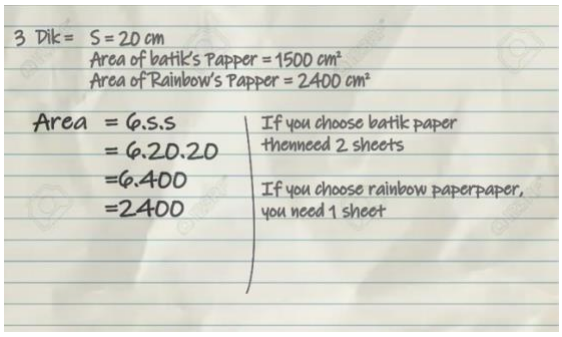

Figure 15. SR1's Answer to Problem Number 3

Based on the interview results, SR1 could not explain why he did not draw the cube. Then, SR1 could define the steps in solving problem number 3 with complete and clear answers using the symbols written on his answer sheet according to his language. The following is the data analysis of the interview results to SR1 using MAXQDA.

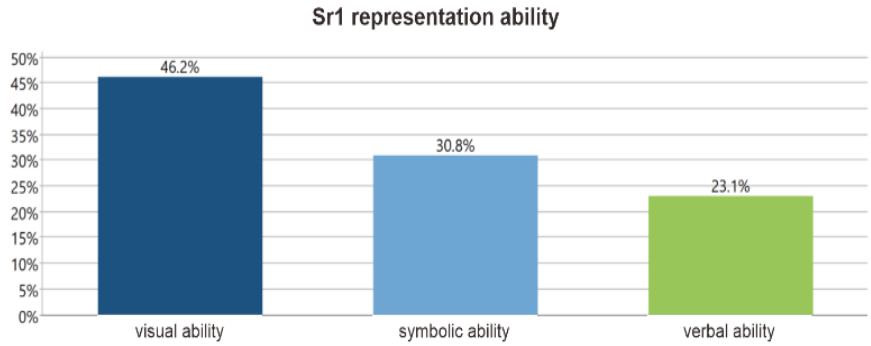

Figure 16. Diagram of SR1 Mathematical Representation Ability Indicator

Based on Figure 16, SR1 is more dominant towards verbal ability. It can be seen in Figure 16 where the percentage of verbal ability reaches 54.5%, which is higher than visual and symbolic abilities.

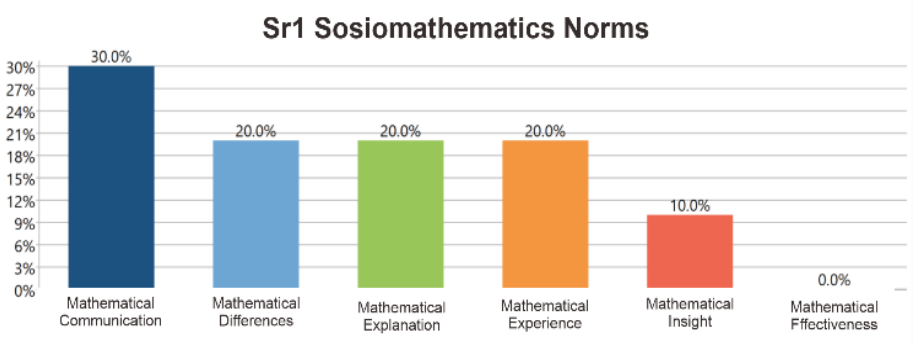

Figure 17. Diagram of SR1 Sociomathematical Norm Indicator

Then in Figure 17 shows that ST1 has characteristics that lead to indicators of mathematical communication because the presentation of the mathematical communication indicator is higher than other indicators, namely 30%.

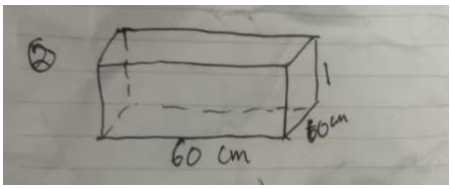

Figure 18. SR2's Answer to Problem Number 2

In Figure 18, SR2 can only draw a block with a length of 60, width of 60, and height of 1. However, SR2 has not been able to name each corner point in problem number 2. SR2 is also unable to answer this question with the correct steps.

Based on the interview results, SR2 did not understand problem number 2, then SR2 could provide a picture of problem number 2 even though it was incomplete in naming each corner point. Then, SR2 also does not remember how to answer problem number 2, so it cannot explain how the solution steps.

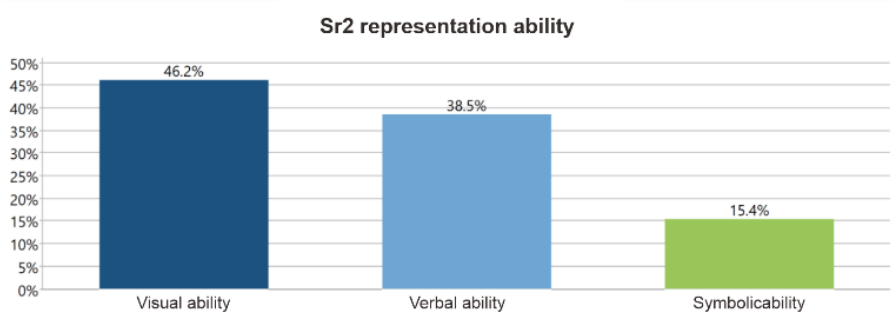

Figure 19. Diagram of SR2 Mathematical Representation Ability Indicator

Then, based on the results of the analysis of the SR2 representation ability interview transcript with the MAXQDA application in Figure 19, the NAS subject tends to lead to visual ability because it is found that the percentage of visual knowledge is higher than verbal and symbolic abilities, which is 46.2%.

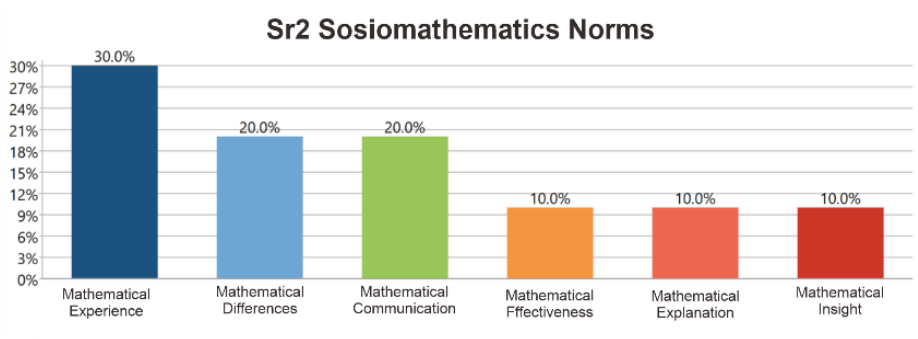

Figure 20. Diagram of SR2 Sociomathematical Norm Indicator

Then in Figure 20 shows that SR2 has characteristics that lead to mathematical experience because the presentation of the mathematical experience indicator is higher than other indicators, namely 30%.

Based on the analysis of the mathematical representation abilities of students with low category sociomathematical norms SR1 and SR2, they could only work on the problems given using one indicator. They did not work on the problem ultimately (see Figure 15 and Figure 18). From the results of the interview analysis of the two students (Figure 16 and Figure 19), they were unable to explain in detail what was meant by the problem, and they also seemed not to understand what was told by the situation. This makes SR1 and SR2 also have low representation skills. In line with research (Fuad, 2016; Mulyaningsih et al., 2020; Purnama, 2019; Triono, 2017) which states that students' mathematical representation skills are low, as seen from each indicator that is done tends to be imperfect, or students have difficulty in understanding the problems that are done.

For sociomathematical norms, SR1 and SR2 are low-category learners. Both of them still solve every mathematical problem faced individually, still cannot accept differences in mathematical solutions with other students, and tend to be inactive in classroom learning (see Figure 17 and Figure 20) (Ningsih & Maarif, 2021; Sulfikawati et al., 2016) Excellent sociomathematical norms can contribute to education, understanding discussions and arguments, and identifying differences and similarities in mathematical solutions. If these things are fulfilled, students' mathematics learning results will also be maximized.

The results section presents the research findings in tables, graphs, diagrams, or narratives, then gives the meaning or description of each research result. It also shows the discussion, which contains the researchers' description of the study results, either as expected or not. It then compares the findings with previous studies, most of which have been published in reputable scientific journals or using the literature. Furthermore, the paper should provide a deduction or generalization, which is how the study results can be applied to more general situations.

Sociomathematical Norms

After distributing questionnaires about sociomathematical norms in students, the researchers obtained the following data.

Table 1. Sociomathematical Norm Questionnaire Results

category	Score	Total of Student
Tinggi	T > 70,2	11
Sedang	67,2 < S < 70,2	96
Rendah	R < 67,2	24

Based on Table 1, 11 students have sociomathematical norms in the high category, 96 with medium-type sociomathematical norms, and 24 with low-type sociomathematical norms. Researchers also obtained information by interviewing six students with each type with the following excerpts.

Researcher : How can you find problem-solving from the problems given by the teacher?
ST1 : Usually, I work according to what the teacher has taught me, according to what I have learned.
Researcher : Do you understand or not the material conveyed by the teacher?

ST1 : If the teacher explains it well, I will understand.
Researcher : Are you able to draw conclusions and present the results of the learning that has been given?
ST1 : Can
Researcher : When discussing, can you accept arguments from other friends?
ST1 : Yes, I usually accommodate it first, and then if it doesn't fit, we discuss it again.
Researcher : How do you feel if a friend doesn't like your argument?
ST1 : It's normal because my argument is not always correct.
Researcher : How do you feel about the group discussion?
ST1 : Interesting. I like to discuss
Researcher : Who do you want to discuss math with the most?
ST1 : With my classmate
Researcher : if there is material that you do not understand, will you ask?
ST1 : Yes

Based on the excerpt above, the researcher asked about mathematical problem-solving, understanding when the teacher explains, and solving problems in group discussions. It was found that ST1 will more easily understand the material when the teacher is clear in providing material, likes mathematical solutions in groups, can find answers to every mathematical problem faced, appreciates every argument given in a discussion, and does not hesitate to ask questions when there is material that may not be understood when learning mathematics. This is in line with research (and in), which explains that the sociomathematical norms possessed by students will affect the high or low results obtained by students in learning mathematics.

CONCLUSION

Based on the results and discussion described by the researcher above, it can be seen that each student has a variety of mathematical representation abilities and also sociomathematical norms. Each student in the sociomathematical norm category also has differences in each mathematical solution to their problems. Students with high sociopathic norm categories can solve problems by understanding every indicator in the issue, especially in the indicators of symbolic ability and verbal ability, and working according to the instructions in each situation. The characteristics of students with high sociomathematical norms are mathematical communication and mathematical experience. Students with low sociomathematical norms category can solve problems according to the indicators of each issue. Still, students in this category are less than perfect in working on each indicator. The characteristics of students with moderate sociomathematical norms are mathematical communication. While in the low sociomathematical norms, students cannot work on problems perfectly and do not fulfill each expected indicator. The characteristic of students with low-category sociomathematical norms is mathematical experience.

The teacher's experience in explaining the material and interaction in the classroom dramatically influences the representation skills and sociomathematical norms that each learner has in class. Discussions between individuals can also be a solution to any mathematical problems faced by students. This research was conducted at one MA in West Jakarta. This research cannot be generalized to similar studies. It is possible if different results are obtained in research conducted at various research sites or other research subjects.

ACKNOWLEDGEMENT

With what has been obtained from this research, the researcher sincerely thanks all those involved, especially the respondents and MAN 16 Jakarta, who have been willing to be a place of data collection.

REFERENCES

Bagus, C. (2018). Analisis Kemampuan Representasi Matematis Siswa Dalam Menyelesaikan Soal Lingkaran Pada Kelas VII-B Mts Assyafi'iyah Gondang. *Suska Journal of Mathematics Education*, *4*(2), 115. https://doi.org/10.24014/sjme.v4i2.5234

Chaviaris, P., & Kafoussi, S. (2010). Developing Students' Collaboration in a Mathematics Classroom through Dramatic Activities. *International Electronic Journal of Mathematics Education*, *5*(2), 91–110. https://doi.org/10.29333/iejme/252

Farida, N. (2014). *Metode Penelitian Kualitatif*. Cakra Books.

Fuad, M. N. (2016). Representasi Matematis Siswa SMA dalam Memecahkan Masalah Persamaan Kuadrat Ditinjau dari Perbedaan Gender. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *7*(2), 145–152. https://doi.org/10.15294/kreano.v7i2.5854

Halim, E. A. (2020). Analisis Kemampuan Representasi Konsep Matematis Dalam Menyelesaikan Soal Bangun Ruang Pada Siswa Kelas IX SMP Negeri 2 Barombong. *Skripsi*. Universitas Muhammadiyah makasar. Retrieved from https://digilibadmin.unismuh.ac.id/upload/13677-Full_Text.pdf

Hwang, W.-Y., Chen, N.-S., Dung, J.-J., & Yang, Y.-L. (2007). Multiple Representation Skills and Creativity Effects on Mathematical Problem Solving using a Multimedia Whiteboard System. *Educational Technology & Society*, *10*(2), 191–212. Retrieved from http://www.jstor.org/stable/jeductechsoci.10.2.191

Kadir. (2008). Mengembangkan Norma Sosiomatematik (Sociomathematical Norms) Dengan Memanfaatkan Potensi Lokal Dalam Pembelajaran Matematika. *Pythagoras*, *4*(1), 74–85. http://dx.doi.org/10.21831/pg.v4i1.689

Kadir. (2014). Summary for Policymakers. In *Climate Change 2013 – The Physical Science Basis* (pp. 1–30). Cambridge University Press. https://doi.org/10.1017/CBO9781107415324.004

Maarif, S., Oktarina, N., Sessu, S., Sulistyowati, F., & Utami, W. B. (2022). Sociomathematical norms in online learning in the COVID-19 pandemic period. *International Journal of Evaluation and Research in Education (IJERE)*, *11*(4), 1673–1686. https://doi.org/10.11591/ijere.v11i4.23046

Maharani, S., & Bernard, M. (2018). Analisis Hubungan Resiliensi Matematik Terhadap Kemampuan Pemecahan Masalah Siswa Pada Materi Lingkaran. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *1*(5), 819. https://doi.org/10.22460/jpmi.v1i5.p819-826

Mayowi, L. I., & Maarif, S. (2023). Analisis Kemampuan Komunikasi Matematis Pada Pembelajaran Matematika Berdasarkan Aspek Norma Sosiomatematik. *Wacana Akademika: Majalah Ilmiah Kependidikan*, *7*(1), 1–17. Retrieved from https://jurnal.ustjogja.ac.id/index.php/wacanaakademika/article/view/14572

Melinda, S. D. (2017). Analisis Kemampuan Representasi Matematis Siswa Ditinjau Dari Gaya Kognitif Spasial Materi Geometri di SMA Muhammadiyah 1 Purbalingga. *AlphaMath Journal of Mathematics Education*, *3*(1), 34–41. http://dx.doi.org/10.30595/alphamath.v3i1.1931

Mulyaningsih, S., Marlina, R., & Effendi, K. N. S. (2020). Analisis Kemampuan Representasi Matematis Siswa SMP dalam Menyelesaikan Soal Matematika. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *6*(1), 99. https://doi.org/10.30998/jkpm.v6i1.7960

Nangim, N., & Hidayati, K. (2021). Analisis Kemampuan Representasi Matematis Siswa Saat Pembelajaran Dalam Jaringan Di Masa Pandemi Covid-19. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(2), 1034. https://doi.org/10.24127/ajpm.v10i2.3593

Ningsih, A. W., & Maarif, S. (2021). Analysis of Sociomathematical Norms in Mathematics Learning at 113 Junior High School. *WACANA AKADEMIKA: Majalah Ilmiah Kependidikan*, *5*(1), 43. https://doi.org/10.30738/wa.v5i1.9966

Octaviani, R, & Sutriani, E. (2019). *Analisis Data Dan Pengecekan Keabsahan Data*. Retrieved from https://osf.io/preprints/inarxiv/3w6qs/

Prihandoko, A. C. (2005). *Buku Rujukan Pgsd Bidang Matematika Memahami Konsep Matematika Secara Benar Dan Menyajikannya Dengan Menarik* (pp. 1–271).

Purnama, R. N. (2019). Analisis Kemampuan Representasi Matematis Siswa Kelas VIII SMP Al Fattah Semarang. *Kontinu: Jurnal Penelitian Didaktik Matematika*, *3*(1), 23. https://doi.org/10.30659/kontinu.3.1.23-36

Qusyairi, H. F. (2019). Interaksi Sosial Dalam Proses Pembelajaran. *PALAPA*, *4*(1), 149–166. https://doi.org/10.36088/palapa.v7i1.194

Ramanda, M. S., Subarinah, S., Amrullah, A., & Hayati, L. (2021). Profil Norma Sosiomatematika dalam Pembelajaran Kolaboratif Materi Bentuk Aljabar Siswa Kelas VII-C SMPN 13 Mataram. *Griya Journal of Mathematics Education and Application*, *1*(2), 248–253. https://doi.org/10.29303/griya.v1i2.49

Sulfikawati, D., Suharto, S., & Kurniati, D. (2016). Analisis Norma Sosiomatematik dalam Pembelajaran Kolaboratif Pokok Bahasan Segitiga dan Segiempat di Kelas VII-C SMP Negeri 11 Jember. *Jurnal Edukasi*, *3*(3), 1. https://doi.org/10.19184/jukasi.v3i3.3513

Triono, A. (2017). Analisis Kemampuan Representasi Matematis Siswa Kelas Viii Smp Negeri 3 Tangerang Selatan. *Skripsi*. Universitas Islam negeri Jakarta. Retrieved from https://repository.uinjkt.ac.id/dspace/handle/123456789/36030

Warisi, K. (2016). Representasi Matematis Berdasarkan Tingkat Kemampuan Dalam Memecahkan Masalah Sistem Persamaan Linier Dua Variabel Siswa Kelas VIII SMP Inshafuddin Banda Aceh. *Skripsi*. Retrieved from https://repository.ar-raniry.ac.id/id/eprint/1080/1/Khairul%20Warisi.pdf

Widodo, S. A., Dahlan, J. A., Harini, E., & Sulistyowati, F. (2020). Confirmatory factor analysis sosiomathematics norm among junior high school student. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(2), 448–455. https://doi.org/10.11591/ijere.v9i2.20445

Widodo, S. A., & Purnami, A. S. (2018). Mengembangkan Norma Sosiomatematik dengan Team Accelerated Instruction. *NUMERICAL: Jurnal Matematika Dan Pendidikan Matematika*, *2*(1), 29–48. https://doi.org/10.25217/numerical.v2i1.238

Widodo, S. A., Turmudi, T., Dahlan, J. A., Watcharapunyawong, S., Robiasih, H., & Mustadin, M. (2023). The sociograph: friendship-based group learning in the mathematics class. *Infinity Journal*, *12*(1), 27–40. https://doi.org/10.22460/infinity.v12i1.p27-40

Zulfah, Z., & Rianti, W. (2018). Kemampuan Komunikasi Matematis Peserta Didik Melalui Soal PISA 2015. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *7*(1), 49. https://doi.org/10.25273/jipm.v7i1.3064