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Analysis of Sociomathematical Norms Aspect Based on Mathematical Reflective Thinking Ability

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Abstract

In Learning mathematics, sociomathematical norms are needed. Sociomathematical norms are rules set during mathematics learning regarding truth, cooperation, freedom of opinion, and responsibility. This study aims to determine aspects of sociomathematical norms based on the mathematical reflective thinking ability of class VIII students at SMPN 12 Bekasi. This research uses a descriptive method with a qualitative approach. The instruments used in this study used questions, questionnaires, interviews, and observations. The selected respondents were 3 respondents with high, medium, and low category mathematical reflective thinking abilities. The data validity technique in this study uses triangulation of methods, namely questionnaires, interviews, and observations. The conclusion of this study found that respondent R1 with high mathematical reflective thinking ability has a high sociomathematical norms aspect, R2 with medium mathematical reflective thinking ability has a medium sociomathematical norms aspect, R3 with low mathematical reflective thinking ability has a low sociomathematical norms aspect. Researchers suggest that further research can be conducted at different levels of education so that it can discuss more broadly the aspects of sociomathematical norms that students have.

Keywords: sociomathematical norms, mathematical reflective thinking ability, students

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INTRODUCTION

Mathematics is a scientific field that emerged as a result of human civilization processes (Duwila et al., 2022). The results of learning mathematics are said to be good if students realize what they are doing is right, can look for other ways if what is done fails, and evaluates the activities that have been carried out (Duwila et al., 2022). In solving mathematical problems students' abilities need to be developed, not only through the formulas and questions given but by practicing through the problems directly (Muzaimah & Noer, 2019). Mathematics can be learned from everyday life, practicing through problems directly so that you can overcome the failures of the activities carried out and improve your math skills.

Mathematics is a means of critical, logical, and creative thinking, which cannot be separated from everyday human life (Salim & Ma'arif, 2021). The character values in the class are formed by interaction and *interactivity* which then produces regulations with moral principles (Utari, 2017). There are two kinds of norms encountered in learning, namely, social norms and sociomathematical norms (Salim & Ma'arif, 2021). Sociomathematical norms have differences from social norms, namely forming the structure of class participation, because sociomathematical norms concern normative aspects of class action that are specifically mathematical, through interactions with mathematical objects, and social values with the class environment (Dickes et al., 2020). Sociomathematical norms are very closely related to how students believe in and understand mathematical knowledge, and place themselves in social interactions to build mathematical knowledge (Indriani & Ardiani, 2019). To build

mathematical knowledge, sociomathematical norms are related to beliefs, understanding, and awareness of placing oneself in social interactions in the classroom (Ningsih, 2022). Because sociomathematical norms relate to humans, society, and mathematics, these norms also have an impact on how students do mathematics learning. Sociomathematical norms relate to learning mathematics and regulate learning in the classroom for teachers and students. Thinking is a mental activity that occurs in the brain as an activity of remembering and understanding (Ngadino et al., 2022). Reflective thinking is a combination of critical and creative thinking, which aims to make students able to try to unite ideas, experiences, knowledge, and opinions of others, by connecting the knowledge they have to solve new problems related to their old knowledge (Karli, 2018). Higher-order thinking is needed in solving a math problem, applying high-order thinking skills such as reflective thinking can arouse students' curiosity (Syamsuddin, 2020).

The ability to think is an important skill that must be owned by every student (Muntazhimah et al., 2021). Having the ability to think reflectively is needed in solving math problems. Reflective thinking is one of the factors leading to students' success in solving math problems (Duwila et al., 2022). By reflection, students can develop thinking skills by relating the knowledge gained and their previous understanding to solve new problems (Noer et al., 2020). The ability to think reflectively is the skill of reasoning quickly and precisely by devising strategies to solve problems (Kajori & Soebagyo, 2022). In learning mathematics, reflective thinking is one of the abilities that must be facilitated in its development (Muntazhimah et al., 2021). So that students get a thorough education, are given opportunities, are empowered, and can use their skills, reflective thinking is needed, this will enable them to understand the material being taught (Jaenudin et al., 2017). Reflective thinking has three stages: re-examining the methods that have been used, reviewing and reviewing the sequences that have been owned based on memory to correct, and adopting ways so that they find new ways. In other words, the ability to think reflectively is the ability to combine information that has been obtained with new information to conclude a problem (Avianti & Ratu, 2020).

In previous research, it was shown that the level of reflective thinking ability was still relatively minimal at several junior high school levels because there were no facilities for developing learning (Muntazhimah et al., 2021). The minimum ability to think reflectively due to the low level of mastery of students' learning towards mathematics, including students who think that mathematics is difficult to understand, the low desire of students to learn mathematics, variations in mathematics questions are less related to the surrounding conditions, students have not optimally analyzed and communicated problems with good to solve, these things are caused by students who are very fixated with the example questions given (Syadid & Sutiarso, 2021). In line with the ability to think reflectively and the self-efficacy of students, in general, is still at a minimum, based on the results of observations and interviews that have been conducted, it was found that most students are constrained in understanding contextual questions related to higher order thinking, students cannot understand the problems presented and are confused about solving the problem, they only focus on the difficulty, not the ability (Noer et al., 2020).

In several studies that discuss reflective thinking and sociomathematical norms, the authors found that reflective thinking has an attachment to *prior knowledge*, the higher it is *prior knowledge* students have, the higher their ability to think reflectively (Muntazhimah et al., 2021). Reflective thinking influences how to solve problems, from the results of good answers and interviews *comparing* and *contemplating* students who are proficient in reflective thinking can respond to the narrative questions given, but they lack accuracy in connecting questions, understanding questions, and providing conclusions, causes students to be inaccurate in giving answers (Sihaloho et al., 2020). In addition, sociomathematical norms affect learning interest, students who have high sociomathematical norms have a high learning interest, while students who have low sociomathematical norms have low learning interest (Anisa et al., 2019).

Previous studies by Arwadi et al., (2022) and Mayowi & Maarif, (2023) have discussed the analysis of sociomathematical norms aspects associated with mathematics learning and mathematical communication skills. Based on this, researchers are interested in researching aspects of sociomathematical norms based on mathematical reflective thinking ability to know how aspects of students' sociomathematical norms are viewed through mathematical reflective thinking ability.

METHOD

The purpose of this research is to find out how aspects of sociomathematical norms are based on mathematical reflective thinking skills. This research was conducted using a descriptive method through a qualitative approach. Qualitative descriptive is a research method that moves to a simple qualitative approach with an inductive flow, which begins with an explanatory process or event and is then ultimately drawn as a generalization for the conclusion of the process or event (Yuliani, 2018). In this study, questionnaires, interviews, and observations were used to explore aspects of sociomathematical norms owned by students.

This research was conducted at SMP Negeri 12 Bekasi in the odd semester of the 2022/2023 school year. Data collection techniques in this study were through tests, questionnaires, interviews, and observations, then the results of the data obtained were tabulated through *Microsoft Excel* for easy analysis. Data collection began with giving test questions in the form of descriptions containing indicators of mathematical reflective thinking given to 30 class VIII student respondents. From the test questions, 3 respondents were found in the high, medium, and low categories. The three respondents were then given a questionnaire and conducted interviews according to the indicators of socio-mathematic norms, then the researchers made observations to see aspects of the sociomathematical norms that each respondent had.

All instruments used in this study have been validated by the validator team and are said to be valid. The following are the results of the validation of the sociomathematical norms aspect instrument.

Table 1. Instrument Validation Results Aspects of Sociomathematical Norms

No	R Table	R Count	Conclusion	No.	R Table	R Count	Conclusion
1.	0,344	-0,06794	Invalid	16.	0,344	0,71347	Valid
2.	0,344	0,14317	Invalid	17.	0,344	0,58592	Valid
3.	0,344	0,12448	Invalid	18.	0,344	0,64285	Valid
4.	0,344	0,14891	Invalid	19.	0,344	0,79616	Valid
5.	0,344	0,33835	Invalid	20.	0,344	0,65127	Valid
6.	0,344	0,54042	Valid	21.	0,344	0,77247	Valid
7.	0,344	0,54049	Valid	22.	0,344	0,8101	Valid
8.	0,344	0,63041	Valid	23.	0,344	0,57433	Valid
9.	0,344	0,75835	Valid	24.	0,344	0,66453	Valid
10.	0,344	0,6321	Valid	25.	0,344	0,52288	Valid
11.	0,344	0,63419	Valid	26.	0,344	0,53139	Valid
12.	0,344	0,61631	Valid	27.	0,344	0,51978	Valid
13.	0,344	0,41961	Valid	28.	0,344	0,52241	Valid
14.	0,344	0,62042	Valid	29.	0,344	0,54171	Valid
15.	0,344	0,71856	Valid	30.	0,344	0,75936	Valid

Of the 30 questions tested, there were 5 questions that were invalid, namely questions number 1, 2, 3, 4, and 5. The questions were said to be invalid because the r count was smaller than the r table. The following are invalid statement items.

1. Saya senang dan menerima perbedaan pendapat jawaban dari teman saya
2. Saya tidak peduli jika jawaban saya berbeda dengan teman saya
3. Saya senang jika bisa mengajari teman saya saat kesulitan mengerjakan
4. Saya tidak peduli jika ada teman yang lebih pintar pelajaran matematika daripada saya
5. Saya percaya diri dengan jawaban yang saya kerjakan sendiri

Figure 1. Invalid Statement of Aspects Sociomathematical Norms

On the results of the instrument validation of the ability to think reflectively mathematically, all questions were declared valid. The following is the result of the validation of the mathematical reflective thinking ability instrument.

Table 2. Results of Mathematical Reflective Thinking Instrument Validation Instrument

Question No	R Table	R Count	Conclusion
1.	0,344	0,702037	Valid
2.	0,344	0,902931	Valid
3.	0,344	0,789884	Valid
4.	0,344	0,779152	Valid

The indicators of reflective thinking used are: *r*eacting, comparing or elaborating, and contemplating (Noviyanti et al., 2021). The indicators of sociomathematical norms used in this study are that students can accept diversity from the level of thinking and do not feel humble or arrogant, students agree to write down solutions to problems, students can describe their opinions or ideas orally to reach an agreement using mathematical proof, students can express their solutions orally to reach agreement on the problem, students can describe their opinions or ideas through orally in a systematic way using everyday language that is easy to understand (Sulfikawati et al., 2016).

RESULTS AND DISCUSSION

Mathematical Reflective Thinking Ability Test Results

The data obtained from this study is data on the ability to think reflectively mathematically. From these data, 3 respondents were selected to be analyzed at the sociomathematical norms level. The following is data on the ability to think reflectively mathematically from 3 selected respondents

Table 3. Data on Mathematical Reflective Thinking Ability

Respondent	Score	Category
R1	36	High
R2	26	Medium
R3	13	Low

R1 with respondents in the high level of mathematical reflective thinking category obtained a score of 36 and were able to fulfill all indicators of reflective thinking *by reacting, comparing,* and, *contemplating* perfectly. R2 with medium category respondents obtained a score of 26 and was able to fulfill the indicators of mathematical reflective thinking *reacting* and *comparing*. R3 with a low category obtaining a score of 13 is only able to meet the indicators of mathematical reflective thinking, namely *comparing*. The three respondents were then given questionnaires, interviews, and observations to see sociomathematical norms. The following is data on sociomathematical norms from the three respondents

Results Aspects of Sociomathematical Norms

Respondents with High Category (R1)

Based on the results of the questionnaire regarding indicators of sociomathematical norms, R1 was able to fulfill the second indicator, namely, students agreed to write down solutions to problems, based on the results of the questionnaire R1 was able to write down solutions in front of the class, and R1 was able to work on finding ways to solve problems. The third indicator, namely students can describe their opinions or ideas orally which aims to reach an agreement by using mathematical proof, based on the results of the questionnaire R1 can accept different opinions, and R1 can provide input if there are wrong statements or answers from the teacher or friends. The fourth indicator is that students can express their solutions verbally to reach an agreement on the problem, based on the results of the questionnaire R1 can pay attention and understand the material provided by the teacher, and R1 actively asks if there is material that cannot be understood. The fifth indicator is that students can express their opinions or ideas verbally systematically using everyday language that is easy to understand, based on the results of the questionnaire R1 has high initiative to find other solutions besides those given by the teacher, and R1 is always actively involved as well as in group discussions.

Based on the results of interviews that have been conducted related to sociomathematical norms R1 fulfills all indicators. Following are some of the results of interviews with respondent R1:

P: What do you think when you see a friend who always answers the questions the teacher gives correctly?
R1: My opinion is that friends who like to answer correctly feel happy because they can be motivated so that I can be even more active in learning.
P: What would you think if the teacher asked you to come forward to give answers, and it turned out that your friend came first to answer the teacher's question on the blackboard?
R1: I accept it gracefully if it turns out that one of my friends asks to do the questions in the future, apart from that it gives other friends a chance.

In addition, the conclusion from the interview results with respondent R1 is that R1 will work on the questions confidently and give the best answers according to his ability, and feel satisfied with the learning outcomes if he can solve the problem correctly, but if it is not correct then he is determined to study even harder.

Based on the results of observations, the researcher found that R1 always pays attention when the teacher is explaining learning material and then takes notes, R1 can always answer and explain questions correctly and correctly confidently both orally and in writing, R1 is not shy to ask questions and discuss the material he doesn't understand.

Based on the results of questionnaires, interviews, and observations, R1 fulfills all indicators of sociomathematical norms, that is, students can accept a variety of levels of thinking and do not feel humble or arrogant. It can be seen that R1 can accept different opinions. Indicators of students agreeing to write down solutions to problems can be seen that R1 can work on and write solutions in front of the class with confidence. Indicators of students being able to describe their opinions or ideas verbally to reach an agreement using mathematical proof, it is seen that R1 can make corrections to the teacher or friends if an error occurs. The indicator of students being able to express their solutions orally to reach an agreement on the problem was seen when R1 dared to ask questions regarding material that was not understood. Indicators of students being able to express their opinions or ideas through speech in a systematic manner using everyday language that is easy to understand, it can be seen that R1 can argue and actively participate in group discussions. It can be concluded that R1 with high mathematical reflective thinking skills has high sociomathematical norms aspects.

Respondents with Medium Category (R2)

Based on the results of a questionnaire containing indicators of sociomathematical norms, R2 was able to fulfill the first indicator, that is, students could accept a variety of levels

of thinking and did not feel humble or arrogant, R2 felt confident about the answers they had done. The second indicator is that students agree to write down solutions to problems, R2 can find solutions to solving problems more easily from the problems given by the teacher. The fifth indicator is that students can express their opinions or ideas verbally and systematically using everyday language that is easy to understand, R2 always participates actively in group discussions.

Based on the results of the interviews that have been conducted, R2 can fulfill all indicators of sociomathematical norms. Following are some of the results of interviews with respondent R2:

P: What do you think when you see a friend who always answers the questions the teacher gives correctly?
R2: I'm happy because I can set a good example for myself, so I have the motivation to always learn.
P: What would you do if the teacher asked you to come forward and answer the questions given?
R2: I'll think about the answer first and complete the answer carefully.

In addition, the conclusions from the interview results with respondent R2, namely, R2 received a different agreement from his friends, R2 will be persistent in answering questions given by the teacher, R2 is happy with learning outcomes if he gets a satisfactory grade, and feels sad if his grades are low and not as expected.

Based on the observations the researcher found, R2 actively responded to questions given by the teacher when explaining the material and made notes about the material was able to convey the answers given by the teacher but was still unsure of the answers given, was able to help explain how to solve them to his friends through oral and written.

Based on the results of questionnaires, interviews, and observations, R2 meets the indicators of socio-mathematical norms, namely, students can accept a variety of thinking levels and do not feel humble or arrogant. always study hard. Indicators of students agreeing to write down solutions to problems, it can be seen that R2 can write down answers that are done on the blackboard carefully. Indicators of students being able to express their solutions orally to reach an agreement on the problem, it is seen that R2 can explain the results of answers that have been done systematically according to his abilities. Indicators of students being able to describe their opinions or ideas through speech in a systematic manner using everyday language that is easy to understand, it can be seen that R2 is active in conducting discussions and can provide solutions when conducting group discussions. It can be concluded that R2 with medium mathematical reflective thinking skills has medium aspects of sociomathematical norms.

Respondents with Low Category (R3)

Based on the results of the questionnaire containing indicators of sociomathematical norms, R3 was able to fulfill the fourth indicator, namely, students were able to express their solutions orally to reach an agreement on the problem, R3 was able to understand the material explained by the teacher and dared to ask questions when there was an explanation that was not understood. The fifth indicator is that students can express their opinions or ideas verbally in a systematic manner using everyday language that is easy to understand, R3 can find easier and systematic ways, and always participates in giving opinions in group discussion activities,

Based on the results of the interviews that have been conducted, R3 can meet several indicators of sociomathematical norms. Following are some of the results of interviews with respondent R3:

P: What would you do if the teacher asked you to come forward and answer the questions given?
R3: I will prepare myself to go forward and must be able to answer as best I can.
P: What do you think if you were appointed by the teacher to solve the problems given?
R3: I prepare myself to come forward and take the book to answer.

In addition, the interview results with respondent R3 conclude that they feel happy with the expertise they have, and do not feel inferior or arrogant about their abilities.

Based on the observations the researcher found, when the explanation of the material took place R3 chose to write the material and did not listen to the explanation until it was finished, R3 preferred to focus on the objects around him and talked to his peers, when asked R3 it was difficult to answer and express the answers he got.

Based on the results of questionnaires, interviews, and observations, R3 meets the indicators of socio-mathematic norms, namely, students can express their solutions verbally to reach an agreement on the problem. Indicators of students being able to express their opinions or ideas through speech in a systematic manner using everyday language that is easy to understand, it can be seen that R3 can give opinions during group discussions. It can be concluded that R3 with low mathematical reflective thinking skills has low sociomathematical norms.

Discussion

Based on the research data that has been presented, it can be concluded that R1 with high mathematical reflective thinking skills has high sociomathematical norms, seen from the fulfillment of the indicators of sociomathematical norms, that is, students can accept diversity from the level of thinking and do not feel humble or arrogant, students agree to write down solutions to problems, students can describe their opinions or ideas verbally which aim to reach an agreement by using systematic evidence, students can express their solutions orally to reach agreement on the problem, and students can describe their opinions or ideas through speech systematically using everyday language that is easy to understand. R2 with medium mathematical reflective thinking skills has medium aspects of sociomathematical norms, seen from the fulfillment of sociomathematical norms indicators, namely, students can accept diversity from the level of thinking and do not feel humble or arrogant, students undertake to write down solutions to problems, students can express solutions orally to reach agreement on the problem, and students can express their opinions or ideas through orally in a systematic manner using everyday language that is easy to understand. Whereas R3 with low mathematical reflective thinking skills has low sociomathematical norms, seen from the fulfillment of sociomathematical norms indicators, namely students can express their solutions orally to reach an agreement on problems, and students can describe their opinions or ideas orally in a systematic way using everyday language easy to understand.

The results of the study show that the aspects of sociomathematical norms owned by students are influenced by the ability to think reflectively mathematically. Respondent R1 with high mathematical reflective thinking skills has good confidence in answering questions orally and in writing and can explain the results of the answers obtained systematically. It is relevant to the results of the study that students who have aspects of high sociomathematical norms are more confident in being able to conclude learning, therefore sociomathematical norms affect the level of understanding students acquire when learning mathematics (Salim & Ma'arif, 2021). Respondent R2 with reflective thinking skills is having good communication with teachers and classmates, but sometimes it is still difficult to express opinions. Relevant to the results of research Anisa et al., (2019) that students with sociomathematical norms have confidence in learning mathematics but still lack understanding of learning mathematics. In line with Sulfikawati et al., (2016) that students with reflective thinking skills can express responses but have difficulty using everyday language and have problem-solving abilities that

sometimes have to be assisted by friends or teachers. In addition, respondent R3 was unable to reveal how what is asked and what is known relates to one another, and cannot describe strategies that have previously been used and are considered effective in solving problems. Relevant to research Avianti & Ratu, (2020) it is stated that differences in the ability to think reflectively occur due to a lack of accuracy and a lack of strategy in answering questions. Following the results of research Dini & Maarif, (2022) that sociomathematical norms are low because they are not able to pay attention to learning mathematics properly in class and are passive during learning mathematics. Based on the research results obtained, there is a relationship between aspects of sociomathematical norms with the ability to think mathematically reflectively. The solution so that students' mathematical reflective thinking skills meet the criteria is that students are expected to be more thorough in answering questions and summarizing and writing down the information obtained. In accordance with research Pamungkas et al., (2018) it is explained that the low ability of reflective thinking can be improved by determining the appropriate student learning style in absorbing and obtaining information with the help of directions and suggestions from the teacher.

Where students with high mathematical reflective thinking skills can work on the questions perfectly and have high sociomathematical norms, students who do well but incompletely have medium sociomathematical norms, while students who only work without knowing the truth have sociomathematical norms low. This is relevant to research conducted by Saputri & Maarif, (2022) which states that students who can give good, precise, complete, and structured answers have high sociomathematical norms, whereas students who can give good, structured answers, but incomplete students have medium sociomathematical norms, while students with low sociomathematical norms give their answers without connecting with mathematical concepts. The level of sociomathematical norms is related to students' understanding and beliefs while learning mathematics. In accordance with Arwadi et al., (2022) that sociomathematical norms in learning have 4 stages, the stage of giving math questions, the stage of offering students to solve problems, the stage of offering students questions about mathematics learning material, and the stage of giving math assignments to work on independently.

Research Mayowi & Maarif, (2023) found that students' high mathematical communication skills affect aspects of high sociomathematical norms, as well as at medium and low levels. It can be concluded based on the results of research on respondents R1, R2, and R3, that R1 with high mathematical reflective thinking ability has a high sociomathematical norms aspects, R2 with medium mathematical reflective thinking ability has a medium sociomathematical norms aspects, and R3 with low mathematical reflective thinking ability has a low sociomathematical norms aspects.

CONCLUSION

Based on research that has been conducted at SMPN 12 Bekasi, it is known that student who have high mathematical reflective thinking abilities, these students have high sociomathematical norms aspects. R1 with high mathematical reflective thinking ability has a high sociomathematical norms aspects. Where R1 can accept a diversity of thoughts and does not feel high or low, can systematically describe his opinions or ideas, and express solutions to problems either orally or in writing systematically using language that is easy to understand confidently. R2 with medium mathematical reflective thinking ability has a medium sociomathematical norms aspects. Where R2 can accept a diversity of thoughts and does not feel high or humble, can express orally or in writing a systematic completion although sometimes he doubts the answers he is working on. Meanwhile, R3 with low mathematical reflective thinking ability has a low sociomathematical norms aspects. Where R3 can accept diversity of thought without feeling high or humble, but R3 is less able to accept a mutual agreement.

RECOMMENDATION

This research is qualitative so it cannot be generalized to junior high school students in the city of Bekasi. To find out the sociomathematical norms of junior high school students in general, survey and experimental research can be carried out. In addition, the researcher also proposes that further research be carried out on respondents at different levels so that they are able to discuss more broadly related aspects of sociomathematical norms owned by students.

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