Prima: Jurnal Pendidikan Matematika
Vol. 8, No. 1, January 2024, pp. 89-101
P-ISSN: 2579-9827, E-ISSN: 2580-2216
Web: http://jurnal.umt.ac.id/index.php/prima

STUDENT'S MATHEMATICAL COMMUNICATION ABILITY GIVEN SELF CONCEPT IN LEARNING MATHEMATICS THROUGH DISCOVERY LEARNING

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Abstract

The aim of this research is to describe the application of the Discovery Learning learning model to mathematical communication skills in terms of self-concept. This research is a type of descriptive research with a quantitative approach. The subjects in this study were taken from class VIII students of SMP 1 Muhammadiyah. Self-concept questionnaires, observation sheets, and tests of mathematical communication abilities were the instruments employed in this investigation. Based on the research results, 15% of students fell into the high category, 65% into the moderate category, and 20% into the poor category on the self-concept questionnaire. Students with strong, medium, and low mathematical communication abilities in Discovery curriculum curriculum exhibit notable differences when taking the mathematical communication skills test. Regarding the outcomes of the teacher and student observations, it was discovered that, overall, 97% of the results from the teacher observations at meeting 1 fell into the very good category. For the second meeting, 98% was achieved in the very good category. In the very good category, 100% of the results for the third meeting were obtained. Regarding the findings from the student observations during the first meeting, 86% fell into the category of good. For the second meeting, 92% in the very good category was achieved. 89% of the results for the third meeting fell into the good category.

Keywords: Mathematical Communication, Self Concept, Discovery Learning

Abstrak

Tujuan penelitian ini adalah menggunakan paradigma Discovery Learning untuk mengkarakterisasi seberapa baik siswa dapat mengkomunikasikan ide matematika ditinjau dari konsep dirinya. Penelitian ini merupakan jenis penelitian deskriptif dengan pendekatan kuantitatif. Subyek dalam penelitian ini diambil dari siswa kelas VIII SMP 1 Muhammadiyah. Instrumen yang digunakan dalam penelitian ini adalah angket konsep diri, lembar observasi, dan tes kemampuan komunikasi matematis. Berdasarkan temuan, 15% siswa masuk dalam kategori tinggi, 65% masuk dalam kategori sedang, dan 20% masuk dalam kategori buruk pada angket konsep diri. Siswa dengan kemampuan komunikasi matematis kuat, sedang, dan rendah dalam kurikulum kurikulum Discovery menunjukkan perbedaan yang mencolok ketika mengikuti tes kemampuan komunikasi matematis. Berdasarkan hasil observasi guru dan siswa diketahui bahwa secara keseluruhan hasil observasi guru pada pertemuan 1 sebesar 97% masuk dalam kategori sangat baik. Untuk pertemuan kedua diperoleh 98% dengan kategori sangat baik. Pada kategori sangat baik diperoleh hasil pertemuan ketiga 100%. Mengenai hasil observasi siswa pada pertemuan pertama, 86% masuk dalam kategori baik. Untuk pertemuan kedua diperoleh 92% dengan kategori sangat baik. Hasil pertemuan ketiga sebesar 89% masuk dalam kategori baik.

Kata kunci: Komunikasi Matematis, Konsep Diri, Penemuan Pembelajaran

INTRODUCTION

Learning activities are processes between students and teachers with a basis of interrelationship (reciprocity) in an educative atmosphere to achieve certain goals (Akhiruddin et al., 2020). It was explained that learning activities for students and teachers to achieve effective and efficient learning were carried out by establishing scholarly

Received: October 10, 2023; Revised: January 26, 2020; Accepted: January 27, 2024

communication using certain strategies, approaches, principles, or models and methods. Students will carry out learning activities if they face a situation where they need to interact with their environment (Zubaidah et al., 2015). The interaction of learning can not be separated from communication. So the need for learning focuses on the assessment of student communication. In this case, the communication in question is mathematical communication.

Students' mathematical communication skills are influenced by several factors, one of which is influenced by psychological aspects that support students' success in completing assignments properly. Students' confidence in their abilities to learn mathematics is closely related to self-concept(Sari & Pujiastuti, 2020). Self-concept is an individual's view of ideas, thoughts, beliefs, and attitudes about himself which is also influenced by a person's view(Amaluddin & Sentryo, 2022; Hasanah, 2019). Asura & Fitri(2020) explained in their research journal that students with high self-concept categories also have high mathematical communication skills; this can be seen from students communicating the results of their work systematically and understanding the questions well. However, several processing steps still need to be improved, but this does not reduce the value of its communication capabilities (Lutfiyah et al., 2023).

Moreover, there is moderate mathematical communication in self-concept with moderate category. Last but not least, pupils with poor self-concepts also have poor mathematics communication abilities. Thus, pupils' self-concept and their mathematical communication abilities align. Students that have a positive self-concept are better at communicating mathematical ideas.

The learning process includes strategies, models, and methods to achieve learning objectives. The low ability of a student's mathematical communication is influenced by several factors, one of which needs to be facilitated by students developing their abilities in a lesson (Arcat & Fitriani, 2018; Mila Sab'ati et al., 2018; Umasugi et al., 2022). In general, the mathematics learning process takes place in one direction where the teacher tends to lecture and act as a resource. This kind of learning method tends to make students like to imitate (Arcat & Fitriani, 2018). This results in students not using mathematical communication in learning, making it difficult to convey their thoughts orally or in writing. Teachers must also be able to develop materials and determine learning models based on classroom conditions

(Widodo et al., 2021). Students' ability to communicate mathematically can be improved effectively and precisely the choice of learning model as an example is the Discovery Learning learning model.

Student's ability to communicate mathematically can be improved effectively and precisely by choosing a learning model, such as the Discovery Learning learning model. The Discovery Learning learning model is a learning model where students increase their knowledge by independently searching for material that they do not yet know or master, facilitated and guided by the teacher, LKK, or LKS (Mawaddah & Maryanti, 2016). Furthermore, involving students independently and directly in understanding and constructing their knowledge concepts makes new knowledge more embedded for a long time. Discovery learning makes understanding the material students learn much easier because this learning model encourages students to develop their potential and find links between the materials studied.(Tri Hardiat Moko et al., 2022).

Drawing from the aforementioned explanation, the researcher incorporates additional characteristics, such as self-concept, that can bolster the Discovery Learning learning model in characterizing students' mathematics communication skills. This research aims to describe the application of the Discovery Learning learning model to mathematical communication skills in terms of self-concept. In order to tackle this issue, the researchers used the problem "Students' Mathematical Communication Ability in View of Self-Concept in Mathematics Learning through Discovery Learning."

METHODS

This research employs a quantitative descriptive methodology. Participants in this study were SMP Muhammadiyah 1 Sumberpucung class VIII students; specifics of a small group of 16 students were provided. In May 2023, the research was carried out.

Data collection techniques in this study were self-concept questionnaires, observations, and tests. The questionnaire was compiled on a Likert scale to determine student attitudes regarding self-concept in doing assignments well. The following is a self-concept questionnaire grid.

Variable	Indicator	Statement Items	
		Positive (+)	Negative (-)

Self Concept	Show seriousness, interest, passion, desire, as well as persistence and courage in carrying out mathematical activities.	1, 3, 5, 6	2, 4, 7
	Able to know your own strengths and weaknesses in mathematics	8	9
	Have confidence in your abilities and complete your math assignments well.	10, 12	11
	Openness in collaboration with other people.	14, 15, 17	13, 16
	Understand each other, respect, tolerate, forgive the views or mistakes of others or yourself.	18, 20	19, 21
	Able to discuss and position oneself appropriately as a reflection of social attitudes.	22, 25, 27	23, 24, 26
	Understand the benefits of studying mathematics and like mathematics.	28, 30, 32	29, 31

The self-concept questionnaire guidelines used for the questionnaire sheet use a rating scale of 1 to 5, with the following categories.

Table 1. Self Concept Quistionnaire Scale

Alternative Answer	Score	
	Positive Statement (+)	Negative Statement (-)
Strongly Agree	5	1
Agree	4	2
Neutral	3	3
Do Not Agree	2	4
Strongly Disagree	1	5

Source : (Sugiyono, 2013)

The *self-concept* questionnaire was prepared using the seven indicators raised by(Hendriana et al., 2017), which cover: 1 Show seriousness, interest, interest desire, and be persistent and courageous in carrying out mathematical activities; 2) Able to know the strengths and weaknesses in mathematics, 3) Be confident in your abilities and complete your math assignments well, 4) Openness in cooperation with others, 5) Mutual understanding, respect, tolerance, the forgiveness of views or mistakes of others or oneself, 6) Able to discuss and place oneself appropriately as a reflection of social attitudes, and 7) Understand the usefulness of learning mathematics and love mathematics.

Observation sheets on applying the Discovery Learning learning model are used to determine teachers' and students' implementation of learning and activities. The following is a rating scale table.

Table 2. Observation Scale

Performance Indicator	Score
The teacher’s activities were carried out very well	4

Teacher activities carried out well	3
The teacher's activities were carried out poorly	2
The teacher's activities were carried out very poorly	1

The lattice table of teacher and student observation sheets in the Discovery Learning learning model is presented as follows.

Table 3. Observation Sheets of Teacher and Student Activities in Discovery Learning

Variable	Discovery Learning Steps
Discovery Learning	Preliminary activities Stimulation Problem statements Data collection Processing data Verification Generalizations Closing activities

The test used in this research is descriptive questions that measure students' mathematical communication skills. The rating scale on student tests is as guidelines for scoring mathematical communication ability tests (Dalimunthe et al., 2022).

RESULTS AND DISCUSSION

Results

In *self concep*t questionnaire analysis the results of the *self concept* questionnaire analysis showed that students were grouped into three categories, namely high, medium, and low, which can be seen in the table below:

Table 5. Descriptive Mathematics Self Concept Data for Class VIII

Self Concept	Criteria	Criteria Number	f	%
Tall	$Nilai \geq \bar{x} + SD$	$Nilai \geq 81$	3	15%
Currently	$\bar{x} - SD \leq Nilai < \bar{x} + SD$	$57 \leq Nilai < 81$	13	65%
Low	$Nilai < \bar{x} - SD$	$Nilai < 57$	4	20%
Amount				**20**

The results obtained from the *self concept* questionnaire showed that with 20 students, 15% were in the high category, 65% were in the medium category, and 20% were in the low category. From the self-concept questionnaire grouping, the researcher took 9 (nine) students who were the research subjects to work on the mathematical communication ability test questions. Each category has three students. Code names of research subjects can be seen in the table below:

Table 6. Names of Research Subjects

Subject Initials	Group	Self Concept Category
WL	VIII	High

ZF	VIII	High
MY	VIII	High
ED	VIII	Medium
MH	VIII	Medium
RM	VIII	Medium
AL	VIII	Low
JD	VIII	Low
KV	VIII	Low

Table 7. Average Score of Mathematical Communication Ability

1st Indicator	Max Score	Score	
		Average	Percentage
1	4	3.11	77.8%
2	4	2.89	72.2%
3	4	3.44	86.1%
Average		**3.15**	**78.7%**

From the results of grouping students as research subjects, the summary of the data the researchers obtained can be seen in the following table.

Table 8. Data Presentation of Findings of Students' Mathematical Communication Ability with High Self Concept

Research Subject	Findings Data	Information
WL	Students can understand the problem well.	The completion process is systematic and clear.
ZF	Students are not careful in understanding the questions, so mistakes occur in giving answers to indicators explaining ideas, situations, and mathematical relations in writing with pictures, graphic charts, tables, or algebraic presentations.	In the results of the answers, some did not make the process of solving them systematically, and the answers needed to be corrected.
MY	Students need to improve in expressing mathematical concepts correctly and precisely.	In the results of the student's answers, they could have been more thorough in solving the problem, so several steps needed to be included or made.

Table 9. Data Presentation of Findings of Students' Mathematical Communication Ability with Medium Self Concept

Research Subject	Findings Data	Information
ED	Students are not careful in the process, so the answer is incorrect.	The results of the student's answers are less thorough, so the answer is less precise.
MH	Students are not careful in the process, so some steps are wrong.	In the results of the answers, there were several that did not make the process of solving them systematically, and the answers needed to be corrected and precise.
RM	Students are not careful in understanding the questions on indicators stating daily events in language or mathematical symbols, so there are errors in the process.	In the results of the student's answers, they were not careful in solving the problem, so there was a mistake in the symbols that the students needed help understanding.

Table 10. Data Presentation of Findings of Students' Mathematical Communication Ability with Low Self Concept

Research Subject	Findings Data	Information
AL	Students are not careful in understanding the questions, so in solving them, some answers are not quite right on the indicators presenting real objects, pictures, and diagrams in mathematical ideas.	There is a problem-solving calculation that needs to be corrected and precise.
JD	Students are not precise in expressing mathematical concepts, so some steps are not listed.	In the results of the answers, some steps still need to be completed.
KV	Students try to solve the problem. However, students must be more precise in explaining mathematical concepts with pictures.	The results of the student's answers could have been more precise in conveying the concept, so there was a process that had not been included.

Based on the calculations that have been done, the results of teacher and student observations on the Discovery Learning learning model are shown in the following table.

Table 11. Teacher and Student Obsevation Descriptive Data on Discovery Learning

Observation Data	Total (%)	Teacher Observation Category	Total (%)	Student Activity Category
Meeting 1	97	Very good	86	Good
Meeting 2	98	Very good	92	Very good
Meeting 3	100	Very good	89	Good

Based on the table of teacher and student observations, it was found that for the results of teacher observations at meeting 1, a total of 97% was obtained in the very good category. 98% was obtained for the second meeting in the very good category. For the third meeting, 100% was obtained in the very good category. As for the results of student observations at meeting 1, 86% was obtained in the good category. 92% was obtained for the second meeting in the very good category. For the third meeting, 89% was obtained in the good category. Research in line with researcher Yabo (2020) which states that fun learning can improve student academic achievement, especially those who are detached during class discussions. Problems that arise during learning take place and their solutions can be seen in the following table.

Table 12. Presentation of Discovery Learning Findings Data

Findings Data	Solution
Students do not dare to answer questions from the teacher by raising their hands and only dare to answer when appointed by the teacher.	Motivate students to dare to answer by telling them that the teacher will give an appreciation for the value of activity even if the answer is not quite right.
During group discussions, there were group members who just daydreamed and didn't have discussions.	Provide approach and motivation to group members who are less enthusiastic and provide guidance.

At the time of visiting, there were students who were just silent. While his friends are busy taking notes or asking questions.	Give guest sheets for each guest, and assign guests to different groups, so that 2 people assigned to visit each group will bring information from different sources.

Discussion

Komala and Suryadi (2018) also stated that students with varying beginning mathematical abilities in problem-solving to discover external mathematical communication abilities generate replies with diverse communications, this variation is a reflection of students' problem-solving techniques in answering questions on communication abilities, namely visual abilities, expression mathematics, and words provided depending on individual students' thought patterns. It is also influenced by their beginning mathematical abilities. Another tangible indicator of the degree of comprehension of the circle content is the variety of mathematical communication offered by research participants.

The indication level "Providing real objects, pictures, and diagrams in mathematical ideas" has been passed by the majority of research subjects. Not all disciplines, meanwhile, have advanced to the indicator levels of state everyday events in language or mathematical symbols" and "Explain ideas, situations, and mathematical relations in writing with pictures, charts, graphs, tables, or algebraic presentation. Student learning outcomes are significantly impacted by their self-perception regarding mathematics (Manurung, 2020).

Three pupils fell into the high self-concept category, thirteen into the medium self-concept category, and four into the low self-concept category, according to the results of the questionnaire presented to class VIII. Students are categorized into each self-concept group according to their scores.

In addition, three pupils were chosen to represent each category, one from each degree of self-concept. The following can be used to summarize each self-concept category's discussion.

Mathematical Communication Skills obtained by High Self Concept subjects (WL et al.)

One of the results of the answer to the question with the subject WL code is as follows.

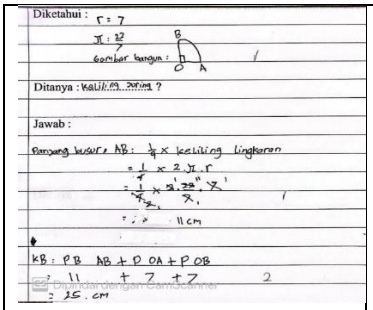

Figure 1. WL Code Subject's answers to the indicator "Explaining ideas, situations, and mathematical relations in writing with pictures, charts, graphs, tables, or algebraic presentations."

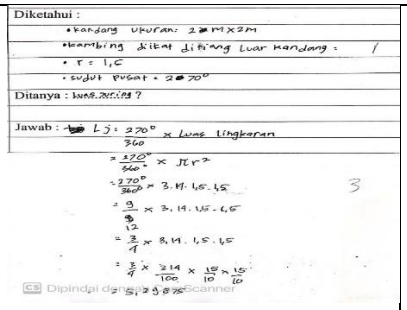

Figure 2. WL Code Subject's answers to the indicator "State everyday events in language or mathematical symbols."

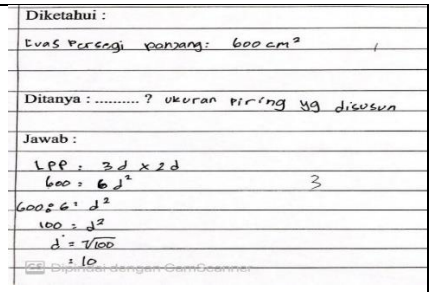

Figure 3. Subjects' answers to the WL Code on the indicator "Presenting real objects, pictures and diagrams in mathematical ideas

Based on the results of students' answers, there is a link between mathematical communication skills in solving problems with students' self-concept. The subject writes down problem-solving and explains it precisely and systematically. The reasons used by the subject for the steps to solving the problem are correct. This shows that the subject can communicate the results of his work systematically. The reasons used by the subject for the steps to solving the problem are correct. This research is in line with Purwati & Nugroho (2017) which states that students are able to demonstrate mathematical communication skills when solving problem solving in the form of linear program questions given by the supporting lecturers even though solving linear program questions is not completed perfectly.

Mathematical Communication Skills acquired by Moderate Self Concept subjects (ED, MH, RM)

One of the answers to the questions with the subject code MH is as follows.

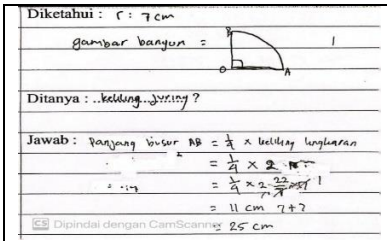

Figure 4. Subjects' answers to the MH Code on the indicator "Explain ideas, situations, and

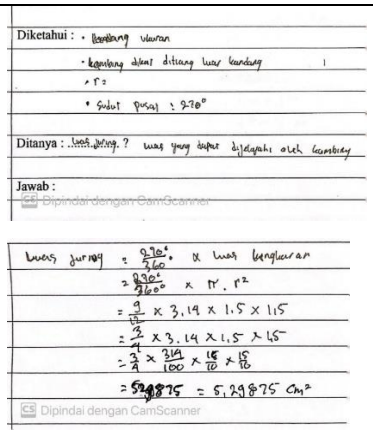

Figure 5. Subjects' answers to the MH Code on the indicator "State

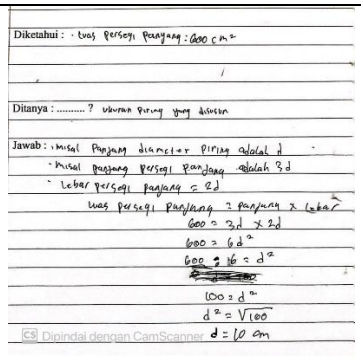

Figure 6. Subject's answers to the WL Code on the indicator "Presenting real objects, pictures

mathematical relations in writing with pictures, charts, graphs, tables, or algebraic presentations."	**daily events in language or mathematical symbols."**	**and diagrams in mathematical ideas."**

The three subjects with *self-concept* were looking at mathematical information on problems properly but needed to be better understood. There are errors and oversights in the steps for completing the answers. This shows that the subject needs to be more able to communicate the results of his work systematically. This research is in line with Hanisah & Noordyana (2022) which states that students experience errors when calculating data because they are not careful in working on the problem.

Mathematical Communication Skills obtained by Low Self Concept subjects (AL, JD, KV)

One of the results of the answer to the question with the subject code AL is as follows.

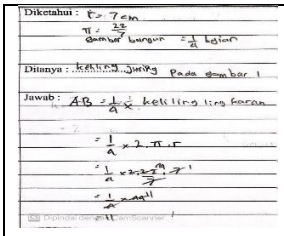

Figure 7. Answers by Subject Code AL on the indicator "Explaining ideas, situations, and mathematical relations in writing with pictures, charts, graphs, tables, or algebraic presentations."

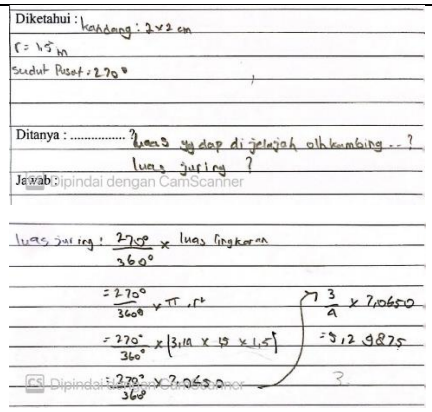

Figure 8. Subjects' answers to Code AL on the indicator "State daily events in language or mathematical symbols."

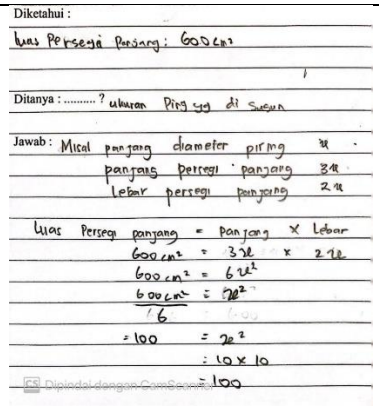

Figure 9. Subject's Answer Code AL on the indicator "Providing real objects, pictures and diagrams in mathematical ideas."

The three subjects with low self-concept needed to pay more attention to mathematical information on problems and be better understood. Subjects tend to write answers briefly and need help to explain them. This shows that the subject needs to be able to communicate the results of his work systematically. This study is in line with Cholily et al.,(2021) which states that, when viewed in terms of mathematical communication skills, students still have difficulties in working on questions that involve elimination and substitution operations, and students also cannot express or write down what they understand in writing.

CONCLUSION

Three conclusions can be drawn of data analysis and discussion of mathematics communication abilities in terms of self-concept through Discovery Learning. First, pupils who fall into the group of having a high self-concept are adept at communicating mathematical ideas. Pupils can clearly comprehend the questions and articulate the methodical findings of their work. However, there were still students who were not diligent in interpreting the questions, so there were mistakes in delivering solutions, and numerous steps of the responses were not included.

Second, the mathematics communication abilities of students in the self-concept category are mediocre. In cases when students struggle to explain the methodical outcomes of their work and require assistance in comprehending the questions, this indicates that there are still issues with the problem's resolution and processing processes that need to be fixed.

Thirdly, pupils who have poor self-esteem should work on communicating mathematical ideas more effectively. Students still lack the ability to methodically express the outcomes of their work. There are still mistakes in the replies since students are more prone to provide succinct responses without providing a thorough explanation.

Students should be able to comprehend the problem's instructions beforehand and have confidence in their solutions so they can accurately and precisely assess them, according to the findings of the research that has been conducted. Further investigation into the strategies for surmounting students' mathematics communication skills in terms of self-concept could be the next step in this research. Future research is expected to examine more sources and references related to students' mathematical communication in terms of self-concept using the discovery learning model so that the research results can be better and more complete.

ACKNOWLEDGMENTS

Alhamdulillah, thanks to Allah SWT who has provided convenience in completing this article. We also thank our parents for their support and encouragement. We also thank Prof. Dr. Yus Mochamad Cholily, M.Si and Mrs. Dr. Alfiani Athma Putri Rosyadi, M.Pd, for her guidance in completing this article. We thank PRIMA Journal for the opportunity given to be able to contribute to the publication of this article.

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