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Students' Mathematical Communication Ability Judging from Self-Confidence and Cognitive Style in Missouri Mathematics Project Learning with Fast Feedback

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Abstract

The purpose of this study was to describe the mathematical communication ability of class VIII students of SMP Islam Tunas Harapan in terms of self-confidence and cognitive style. This research is qualitative with data triangulation. The population of this study were students of class VIII SMP Islam Tunas Harapan in the 2022/2023 academic year. Determining research subjects using purposive sampling technique, so that 6 subjects were obtained, namely the categories of high self-confidence reflective, high self-confidence impulsive, moderate self-confidence reflective, moderate self-confidence impulsive, low self-confidence reflective, and low self-confidence impulsive. The results of this study show that students with high self-confidence reflective are able to master all indicators of mathematical communication ability, students with high self-confidence impulsive are only able to master three indicators of mathematical communication ability, students with moderate self-confidence reflective are able to master all indicators of mathematical communication ability, students with moderate self-confidence impulsive are only able to master two indicators of mathematical communication ability, students with low self-confidence reflective are only able to master three indicators of mathematical communication ability, and students with low self-confidence impulsive is only able to master one indicator of mathematical communication ability.

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INTRODUCTION

Mathematical communication abilities are equal in importance to reasoning, proofing, mathematical representation, and solving mathematical problems (Putra, 2016: 203). Communication plays an important role in the process of learning mathematics, because through communication students are able to express their ideas, understandings, and opinions to teachers and friends. According to Hodiyanto (2017: 11), mathematical communication ability is the ability of students to convey mathematical ideas both in writing and orally.

Communication plays an important role in mathematics. Tiffany et al. (2017: 2160) explain that communication is an important factor in the process of learning mathematics, both inside and outside the classroom. In fact, students' mathematical communication abilities are still low, they have difficulty modeling problems in the form of word problems into mathematical language using symbols and mathematical equations (Nofrianto et al., 2017: 115). There are many factors underlying why students' communication abilities are low, one of which is that students feel afraid when learning mathematics and mathematics is called a very difficult subject (Haqiqi & Mariani, 2017: 22).

The weak ability of these students must be overcome. Efforts that can be implemented to improve students' communication abilities are to use relevant learning models. Teachers should use a learning model that can provide opportunities for students to play an active role in communicating the opinions and knowledge that students have, namely the Missouri Mathematics Project (MMP) learning model (Astiswijaya, 2020: 10).

The MMP model is a structured learning model designed to help teachers foster freedom of thought for students to construct their own knowledge so that they achieve extraordinary improvements. (Astiswijaya, 2020: 9). Through the freedom of thought students have to construct their own knowledge, it is hoped that students will become accustomed to solving mathematical problems. Umma & Sari (2018: 24) explain that the purpose of the MMP learning model is to emphasize students communicating ideas to make decisions in solving mathematical problems. The application of the MMP learning model is expected to improve students' mathematical communication abilities, this is in accordance with Sari & Madiun's research (2022: 1294) which explains that MMP learning has a positive effect on students' mathematical communication abilities.

The MMP learning model has characteristics. According to Tiasno as quoted by Gunadi et al. (2020: 79), the characteristic of the MMP learning model is the presence of project assignment sheets. The project worksheets were created to improve the way of communicating, reasoning, skill in making decisions, and solving problems on their own so that the MMP learning model is considered effective in providing positive changes to students' mathematics learning achievements. The MMP learning model gives students the opportunity to work in groups in a controlled practice stage and is given space to apply their understanding. Students are given project assignments in the form of student worksheets which contain a series of questions and instructions that develop a mathematical idea or concept, and students are given space to apply their understanding. The application of the MMP learning model is expected to improve students' mathematical communication abilities. The application of MMP is in line with the research conducted by Astiswijaya (2020: 15), Sari & Madiun (2022: 1295), and Rosyid & Umbara (2018: 88) which explains that MMP learning is effective and has a positive effect on students' mathematical communication ability.

The MMP learning stages are: 1) review, reviewing past lessons; 2) development, presentation of new ideas and expansion of previous mathematical concepts; 3) controlled exercises, students in groups responding to questions supervised by the teacher; 4) independent work, students individually or in study groups respond to questions; and 5) assignment, students are given homework or exercises using the correct procedure.

The application of the learning model alone is not sufficient to enhance the understanding of the students related to the materials learned. Teachers should provide feedback when students encounter difficulties in learning. The teacher can provide feedback when solving the questions given in order to increase students' understanding of the subject matter by providing fast feedback. Berg & Hoekzema as quoted by Swari et al. (2019: 660) explain that fast

feedback aims to find out the difficulties of students and prepare them to face the next lesson so that learning is effective. The advantages of fast feedback are corrections can be made quickly, results can be known immediately, and repairs can be made immediately if student misconceptions are found.

Fast feedback stages according to Berg & Hoekzema as cited by Swari et al. (2019: 662) namely: 1) the teacher informs the topic of learning; 2) the teacher provides basic and necessary provisions; 3) the teacher gives initial assignments to students, assignments are made individually or in groups; 4) the teacher goes around monitoring student work as well as several students are interviewed for 20 to 60 seconds; 5) common mistakes made by students are discussed and given an explanation of the correct answer as feedback for students; 6) the teacher gives the second task; 7) the teacher goes around monitoring the students' work and several students are interviewed for 20 to 60 seconds; 8) common mistakes made by students are discussed and given an explanation of the correct answer as feedback for students; and 9) activities continue until learning is complete.

The way to understand students in learning is to pay attention to their cognitive style (Prihastanto & Fitriyani, 2017: 92). Cognitive style is a series of control cycles or processes through temporary and situational self-control determined by conscious activities and used by students to receive, organize, and transmit information that ultimately determines student behavior (Mahendra & Mulyono, 2016: 63).

The focus of this study is on the reflective and impulsive cognitive styles of students. Students with an impulsive cognitive style can solve problems without thinking long, while students with a reflective style take a long time to solve problems. Impulsive students tend to respond quickly, while reflective students have a tendency to think about answers for a long time (Setiawan, 2016: 211).

Self-confidence also have an important role in learning. Someone who has self-confidence will believe in his ability to communicate (Roysmanto, 2018: 2). Students who have strong self-confidence can motivate students to be able to develop their mathematical communication abilities and achievements in mathematics. There are things that hinder self-confidence, for example there are still many students who tend to be silent and not confident when the teacher gives questions, students don't dare to express answers to the questions the teacher asks and are embarrassed to ask questions. Students who are not confident show that students' self-confidence when working on math problems is low. This low self-confidence is most likely due to the fact that the success of learning objectives is only measured by tests of the results of students' learning ability without paying attention to students' self-confidence.

Noviyana et al. (2020: 106) revealed that mathematical communication ability can be developed along with self-confidence by providing guidance to students to solve problems by following the stages in problem solving, starting from writing the problem, changing the problem into mathematical notation, solving the problem, and presenting their thoughts. Learning needs to direct students to actively participate in learning activities in class to improve students' mathematical communication ability and self-confidence, for example by forming group discussions. An active learning process can motivate students to hone their confidence in expressing ideas and mathematical ideas to facilitate themselves in solving a problem.

The indicators of communication ability in this study are (1) connecting real objects or images into mathematical ideas; (2) expressing daily events in the language of mathematical symbols; (3) explaining ideas, situations, and mathematical relationships with real objects, pictures, graphs, and algebra; and (4) understanding and evaluating mathematical ideas in solving problems in writing.

Based on the description that has been given, the formulation of the problem that will be discussed in this study is how students' mathematical communication abilities are seen from the perspective of self-confidence and cognitive style. The purpose of this research is to describe the students' mathematical communication ability in terms of self-confidence and cognitive style.

METHOD

The type of research is qualitative research with data triangulation. Sugiyono (2018: 372) revealed that there are several types of triangulation techniques, namely source triangulation, technical triangulation, and time triangulation. The triangulation used in this study is technical triangulation. Technical triangulation is checking the

validity of data based on different collection techniques from the same source (Sugiyono, 2018: 373). Technical triangulation was carried out by comparing the results of students' mathematical communication ability tests with the results of interviews. Qualitative research methods are used to describe the mathematical communication ability in terms of self-confidence and cognitive style of students in MMP learning with fast feedback.

This research was conducted at SMP Islam Tunas Harapan which is located at Jalan Tunas Harapan No. 1, Sendangmulyo, Kec. Tembalang, Semarang City, Central Java 50272 from January 11 2023 to February 3 2023. The research activity began with the application of learning in class VIII A by applying the Missouri Mathematics Project learning model with fast feedback for 4 meetings. Then, students were given tests of mathematical communication skills, self-confidence questionnaires, and cognitive style MFFT test sheets

Moleong (2016: 53) revealed that qualitative research requires research subjects who are people with research backgrounds who are useful in providing information about the situation and conditions of the research setting. Taking the subject with a purposive sampling technique, namely a sampling technique with certain considerations. The sample needs to represent the entire population either on the basis of individual characteristics, group characteristics, spatial characteristics or strata characteristics.

Six students were selected as research subjects based on self-confidence and cognitive style categories, namely high reflective, high impulsive, moderate reflective, moderate impulsive, low reflective, and low impulsive. Qualitative data collection techniques include tests of mathematical communication ability, self-confidence questionnaires, MFFT sheets, and student interviews. Qualitative data analysis in this study involves reduction, data presentation, and writing conclusions. Interview data were collected through direct interviews with the subject, six VIII A students at SMP Islam Tunas Harapan. After obtaining the data, a qualitative analysis was carried out.

RESULTS AND DISCUSSIONS

Learning is carried out using the Missouri Mathematics Project model with fast feedback. The number of meetings in the class is five, with details of four learning implementation meetings and one meeting of mathematical communication ability tests. MMP learning with fast feedback begins with giving motivation so that students understand the benefits they get after learning the material in everyday life. After that, the teacher gives students worksheets and invites them to find the concept of the formula. Next, students are given project assignment sheets to work on in groups, with each group consisting of 3-4 students. The teacher supervises the course of the discussion and interviews students so that the teacher can find out common mistakes made by students and can provide feedback to them. After that, the teacher appoints group representatives to present the results of their work in front of the class. The teacher gives other students the opportunity to ask questions and express opinions. Furthermore, the teacher provides practice questions that are done individually to measure students' mathematical communication ability. After the practice questions have been discussed, students who have not achieved completeness are given improvement questions to complete as feedback. The last activity is that students are given homework regarding the lessons that have been taught.

Self-confidence questionnaire of class VIII A students at SMP Islam Tunas Harapan, it was found that students who belonged to high self-confidence, are 5 students, students who belonged to moderate self-confidence, are 11 students, and students who belonging to the low self-confidence group of 4 students. The self-confidence questionnaire was made according to self-confidence indicators according to Lestari & Yudhanegara (2018: 95) which were divided into four indicators, namely (1) believing in one's own ability, (2) acting independently in making decisions, (3) having the concept of a positive self, and (4) daring to express opinions.

In this study, cognitive style tests were administered using MFFT sheets given to students. The cognitive style test aims to group students based on cognitive style categories, namely impulsive and reflective. The results of grouping the cognitive styles of class VIII A students are presented in Table 1 as follows.

Table 1. Results of Grouping Students' Cognitive Styles

Category	Amount	Percentage
Fast-Accurate	6	30 %
Reflective	7	35 %
Impulsive	7	35 %
Slow-Inaccurate	0	0 %

Based on Table 1, the number of fast-accurate students is 6 students, the number of reflective students is 7 students, the number of impulsive students is 7, and the number of slow-inaccurate students is 0. In accordance with the focus of the research, subjects who met the criteria of reflective-impulsive cognitive style were 14 students, with 7 children in the reflective cognitive style category and 7 children in the impulsive cognitive style category.

Table 2. The results of grouping self-confidence and cognitive style of students

Cognitive Style	Self-Confidence		
	High	Moderate	Low
Reflective	E-01. E-17	E-09. E-10, E-16. E-18	E-07
Fast-Accurate	E-20	E-02. E-04. E-13	E-12. E-19
Impulsive	E-06. E-08	E-03. E-05. E-11. E-14	E-15
Slow-Inaccurate	-	-	-

Selection of subjects using the purposive sampling technique. Students with a reflexive cognitive style were selected 1 student with a high self-confidence, 1 student with a moderate self-confidence, and 1 student with a low self confidence. Meanwhile, students with impulsive cognitive style were selected 1 student with a high self-confidence, 1 student with a moderate self-confidence, and 1 student with a low self-confidence. Based on the grouping of the results of the measurements of cognitive style and self-confidence, 1 student was taken for each according to Table 3 as follows.

Table 3. Selected Subjects

No.	Subject	Self-Confidence	Cognitive Style	Mathematical Communication Ability Test Scores
1	S-1	High	Reflective	100
2	S-2	High	Impulsive	75
3	S-3	Moderate	Reflective	91.67
4	S-4	Moderate	Impulsive	66.67
5	S-5	Low	Reflective	75
6	S-6	Low	Impulsive	50

Analysis of mathematical communication ability in learning the MMP model with fast feedback in terms of students' self-confidence and cognitive style, it is done by comparing the results of written tests of mathematical communication ability and the results of interviews. The analysis was carried out by taking into account the indicators of mathematical communication ability in this study, namely (1) connecting real objects or images into mathematical ideas, (2) stating everyday events in the language of mathematical symbols, (3) explaining ideas, situations, and mathematical relations with real objects, images, graphics, and algebra, and (4) understanding and evaluating mathematical ideas in solving problems in writing.

Analysis of mathematical communication ability in terms of students' self-confidence and cognitive style is presented in the following table.

Table 4. Mathematical Communication Ability in View of Students' Self-Confidence and Cognitive Style

Self-Confidence \ Cognitive Style	Reflective	Impulsive
High	1. 2. 3. 4	1. 2. 3
Moderate	1. 2. 3. 4	1. 2
Low	1. 2. 3	1

Information:

1: connecting real objects or images into mathematical ideas
2: stating everyday events in the language of mathematical symbols
3: explaining ideas, situations, and mathematical relations with real objects, images, graphics, and algebra
4: understanding and evaluating mathematical ideas in solving problems in writing

3.1 Analysis of Mathematical Communication Ability in terms of High Self-Confidence Reflective Cognitive Style

The research subjects in the high self-confidence category with a reflective cognitive style fulfilled all indicators of mathematical communication ability. The subject can solve all the questions well. The subject is able to understand the questions well and can provide answers and reasons in their own language. The subject is also able to use mathematical symbols when solving the problem correctly and is able to visualize the story problem in the form of an image correctly, and the subject can explain the steps for the answer in the correct order and calculation. This agrees with research conducted by Minrohmatillah (2018: 68) which explains that students with a reflective cognitive style are better at processing information and have better mathematical communication abilities. This is also in accordance with the research conducted by Putri et al. (2020: 91) which explains that students with high self-confidence tend to be able to do all the questions well.

3.2 Analysis of Mathematical Communication Ability in terms of High Self-Confidence Impulsive Cognitive Style

The research subjects in the high self-confidence category with an impulsive cognitive style only fulfilled three indicators of mathematical communication ability, namely indicators 1, 2, and 3. The subject could explain the answers to the questions well and their reasons for using their own language even though the answers written on the answer sheets were incomplete. Subjects are able to explains mathematical symbols in solving problems and subjects are able to visualize word problems in the form of images correctly. Impulsive category students with high self-confidence tend to be quick in solving problems but are less careful and less thorough in solving problems. There are few steps the student missed, find the surface area of the aquarium and then reduce it with its cover. The student also made a mistake in counting, so the answer was wrong. This is in accordance with Minrohmatillah's research (2018: 74) which explains that impulsive students rush in working on questions which results in misunderstandings regarding the information obtained resulting errors in answers. According to Nasriadi (2018: 4) impulsive participants only need a relatively short time to respond, this results in the accuracy and accuracy of their responses tending to be lacking.

3.3 Analysis of Mathematical Communication Ability in terms of Moderate Self-Confidence Reflective Cognitive Style

The research subjects in the moderate self-confidence category with a reflective cognitive style were able to solve problems well and fulfill all indicators of mathematical communication ability. The subject is adept at answering every query. Subjects can understand the questions and provide answers and reasons using their own language. In addition, the subject is able to use mathematical symbols in solving problems correctly and visualizing story problems in the form of pictures correctly. Subject can also provide explanations related to the steps in order with the correct calculation. Research conducted by Noviyana et al. (2019: 108) explains that students' mathematical communication ability will be good if these students have good self-confidence. Students in the reflective category with moderate self-confidence need concentration and

focus to understand the problem, because they need to recall previous material. Research conducted by Nasriadi (2018: 4) explains that reflective students go through a deep contemplation process, so that students have the opportunity to give appropriate and careful responses.

3.4 Analysis of Mathematical Communication Ability in terms of Moderate Self-Confidence Impulsive Cognitive Style

The research subjects in the moderate self-confidence category with an impulsive cognitive style could only meet two indicators of mathematical communication ability, while there were still two indicators of mathematical communication ability that could not be mastered. Subjects were able to understand the questions well by answering the questions correctly using their own language. The subject was able to explain the use of mathematical symbols when solving questions, but the subject was still confused in visualizing story problems in the form of images and was in a hurry to answer questions as best subject could so that the answers were wrong. This agrees with research conducted by Novferma et al. (2021: 133) which explains that students with an impulsive cognitive style are often in a hurry, so they tend to experience errors regarding the information obtained and result in errors in conclusions.

3.5 Analysis of Mathematical Communication Ability in terms of Low Self-Confidence Reflective Cognitive Style

The research subjects in the low self-confidence category with a reflective cognitive style were only able to fulfill three indicators of mathematical communication ability, namely in indicators 1, 2, and 3. The subjects were able to understand the problem by explaining the answers using their own language, even though the answer sheets were incomplete. The subject can provide an explanation of the mathematical symbols used in solving the problem and can visualize story problems in the form of pictures, however, the subject has doubts about the answers to be written. According to Noviyana et al. (2019: 708), it is difficult for students who have low self-confidence to get good achievements, because students always think negatively about their own abilities.

3.6 Analysis of Mathematical Communication Ability in terms of Low Self-Confidence Impulsive Cognitive Style

Subjects in the low self-confidence category with an impulsive cognitive style were only able to fulfill one indicator of mathematical communication ability. The subject was only able to write formulas without doing problem solving. Subjects are less able to provide explanations regarding the use of mathematical symbols in working on problems and have difficulties visualizing stories in the form of pictures. This agrees with the research conducted by Qomariyah & Setianingsih (2021: 32) which explains that students with an impulsive cognitive style are inaccurate and incomplete in their understanding of problems.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the description of the mathematical communication ability of class VIII students in MMP learning with fast feedback in terms of self-confidence and cognitive style is as follows. Students with high self-confidence and a reflective cognitive style fulfill all the indicators of mathematical communication ability. Students with high self-confidence and an impulsive cognitive style only fulfill three indicators of mathematical communication ability, namely indicators 1, 2, and 3. Students with moderate self-confidence and a reflective cognitive style fulfill all indicators of mathematical communication ability. Students with moderate self-confidence and a reflective cognitive style are only able to fulfill two indicators of mathematical communication ability, namely indicators 1 and 2. Students with low self-confidence and a reflective cognitive style are only able to fulfill three indicators of mathematical communication ability, namely indicators 1, 2, and 3. Students with low self-confidence and an impulsive cognitive style only meet one indicator of mathematical communication ability, namely indicator 1.

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