MATHE*dunesa*
Jurnal Ilmiah Pendidikan Matematika *Volume 3 No. 6 Tahun 2017*
ISSN :2301-9085

PROFILE OF STUDENTS' MATHEMATICAL COMMUNICATION ABILITIES IN LEARNING USING RECIPROCAL PEER TUTORING STRATEGY

Aprilia Damayanti
Mathematics Education, Faculty of Mathematics and Natural Sciences, State University of Surabaya
e-mail: apriliadamayanti04@gmail.com

Rini Setianingsih
Mathematics Education, Faculty of Mathematics and Natural Sciences, State University of Surabaya
e-mail: rinisetianingsih@unesa.ac.id

Abstract

Mathematical communication ability is the skill of students in expressing the set of problem or idea in mathematics by using concrete object, picture, graph, table or mathematical symbols as the content of the message to be delivered. Mathematical communication ability should be created in the learning process so an appropriate learning strategy should be chosen by teacher. One of the learning strategies that can be used to do so is Reciprocal Peer Tutoring Strategy. It is a strategy that focuses on the learning process in which the teacher divides the students into some groups consisting of two students in each group.

This study aims to describe students' mathematical communication ability during discussion, on writing and in oral form while they are learning mathematics using Reciprocal Peer Tutoring Strategy. This study is descriptive in nature, and using qualitative approach. There are six research subjects. They are two students with high mathematics ability, two students with medium mathematics ability and two students with low mathematics ability. The data were collected by using observation sheet to know students' mathematical communication ability during discussion, then Mathematical Communication Ability Test to know students' mathematical communication ability on writing and the last interview to know students' oral mathematical communication ability.

The result of the research showed that the students' mathematical communication ability during discussion can be categorized as 'very good', while the one in writing form shows that students only fulfill two indicators, namely writing the formula or condition that were used to solve the problem, and writing the calculation related to the formula. In addition, in the oral form, the results show that students fulfill only the indicators of accurateness and fluency.

Keywords: *mathematical communication, reciprocal peer tutoring strategy*

INTRODUCTION

The Law number 20 year 2003 about National Education System on paragraph 37 states that mathematics subject is one of the required subject for students in the elementary and middle education level. Lerner (in Abdurrahman, 2009:252) proposes that mathematics in addition to being symbolic language is also as universal language allowing humans to think, record and communicate ideas about elements and quantities. Every symbol in mathematics has a clear meaning and it is shared by everyone. In accordance with it, Sumarmo (2010) explained that mathematics as symbolic language delivers meaning that mathematics is universal and easily understood by everyone. Based on these definitions, we know that mathematics as universal language allows humans to communicate ideas.

Communication is an essential part of mathematics and mathematics education (NCTM, 2000). NCTM (2000) sets out five basic abilities that students can gain when learning mathematics, namely (1) problem solving ability; (2) reasoning ability and proof; (3) communication ability; (4) connection ability; and (5) representational ability. It means that one of the basic abilities that students must possess is communication ability. In addition, NCTM (2000) also states that mathematical communication is a way to share ideas and clarify understanding, through the communication of ideas into subjects that can be reflected, corrected, discussed and revised.

A study conducted by Umar (2012) explains that mathematical communication is one of the heart learning, so it is necessary to develop in the activity of learning mathematics. Similarly, the research conducted by Yang (2016) explains that mathematical communication

emphasizing the interaction and exchange of mathematical ideas, which is an important ability for students to express their own mathematical concept, understand and evaluate the mathematical equations of other students. From both researches, it is known that mathematical communication is very important in the learning of mathematics so the improvement for mathematical communication ability is required.

The teacher should choose an appropriate learning strategy to build mathematical communication ability in the classroom. According to Sanjaya (2007), learning strategy can be defined as planning that contains about a series of activities designed to achieve certain educational goals. Learning strategy that can be used to make the learning activity more effective as students can take turns in explain and convey opinions, thoughts and strategies is Reciprocal Peer Tutoring Strategy (Brendefur & Frykholm, 2000). Pigott, etc., (1986) says that Reciprocal Peer Tutoring, formalizes a process enabling both students in a peer tutoring pair to participate and experience the role of tutor. Reciprocal Peer Tutoring Strategy is designed to improve students' mathematical communication ability in learning the subject matter as well as possible and giving responsibility to learn and provide explanations to other students in one group.

The importance of mathematical communication ability in learning and implementation of Reciprocal Peer Tutoring Strategy in learning make researcher to conduct research about profile of students' mathematical ability in learning with Reciprocal Peer Tutoring Strategy. This research is try to describe students' mathematical communication ability during discussion, describe students' mathematical communication ability on writing and describe students' oral mathematical communication ability.

METHOD

The research is descriptive research with qualitative approach. This research is conducted in one class of grade eleven at SMAN 4 Sidoarjo. There are 39 students who involve in this research. But, there are only six students who become research subjects. They are two students with high mathematics ability, two students with medium mathematics ability and two students with low mathematics ability.

The research is doing twice. The first is the implementation of learning with Reciprocal Peer Tutoring Strategy related to permutation and the second is the implementation of learning with Reciprocal Peer Tutoring Strategy related to combination. Because the research doing twice, so the data taken as much as 2 times. Observation is doing during discussion in learning activity. Test and interview are doing after learning activity.

Data collected by using observation sheet to know students' mathematical communication ability during discussion, then about the mathematical Communication Ability Test (TKKMT) to know students' mathematical communication ability on writing and interview to know students' oral mathematical communication ability.

There are four aspects that using in observation sheet. They are (1) Student explains the answer of the question; (2) Student appreciates the another student in the group when explaining the answer of the question; (3) Student gives respond to the another student's explanation; and (4) The effectiveness of student during discussion. The minimum value for each aspect is one and the maximum value of each aspect is four.

Data related observation sheet to know students' mathematical communication ability during discussion analyzed by using four category. They are bad category for $4 \leq S < 7$, not good category for $7 \leq S < 10$, good category for $10 \leq S < 13$ and very good category for $13 \leq S \leq 16$.

Data related Mathematical Communication Ability Test to know students' mathematical communication ability on writing analyzed by using three indicators. They are (1) writing relevant statements to the question; (2) writing formula or requirement relevant to the question; and (3) writing calculation corresponding to the formula.

Data related interview to know students' oral mathematical communication ability analyzed by using three indicators. They are (1) completeness of the students' explanation; (2) accurateness of the students' explanation; and (3) fluency of the students' explanation.

RESULT AND DISCUSSION

The research was conducted in one class of grade eleven at SMAN 4 Sidoarjo. There were 39 students who involved in this research. But, there were only six students who became research subjects. The research subjects selected by using the score of students' examination on previous material, that is Advanced Statistics Material. Based on the score, students grouped into high mathematics ability, medium mathematics ability and low mathematics ability.

Table 1. Students' Mathematics Ability

No.	Name	Gender	Value	Mathematics Ability
1.	APL	P	75	High
2.	ASR	P	56	Low
3.	AA	P	30	Low
4.	AKR	L	79	High
5.	AY	L	10	Low
6.	AM	P	69	Medium
7.	AD	P	50	Low
8.	AAS	P	15	Low
9.	BP	L	69	Medium
10.	BGS	L	81	High
11.	DMP	P	79	High
12.	DSR	L	20	Low
13.	EM	P	78	High
14.	ETY	P	68	Medium
15.	FA[	L	36	Low
16.	FRS	P	50	Low
17.	HAH	P	50	Low
18.	HNA	L	70	Medium
19.	IQN	P	35	Low
20.	IDA	P	46	Low
21.	LDZ	P	79	High
22.	MDR	L	72	Medium
23.	MIM	L	34	Low
24.	MAB	L	60	Low
25.	MAF	L	53	Low
26.	NSD	P	69	Medium
27.	NPT	P	15	Low
28.	RHP	L	33	Low
29.	RD	L	63	Low
20.	RH	P	72	Medium
31.	RPA	P	65	Medium
32.	RO	P	45	Low
33.	STW	P	56	Low
34.	SPS	P	71	Medium
35.	SA	P	69	Medium
36.	WLB	L	25	Low
37.	ZJK	P	38	Low
38.	GM	L	20	Low
39.	ARP	L	20	Low

From Table 1, knowing that there were 6 students have high mathematics ability, 10 students have medium mathematics ability and 23 students have low mathematics ability. In this research, researcher selected two students with high mathematics ability, two students with medium mathematics ability and two students with low mathematics ability. Based on teacher's recommendation, research subjects who had been chosen can be seen in Table 2.

Table 2. The List of Research Subjects

No.	Name	Gender	Value	Mathematics Ability
1.	BGS	L	81	High
2.	AKR	L	79	High
3.	RH	P	72	Medium
4.	SA	P	69	Medium
5.	ZJK	P	38	Low
6.	FAP	L	36	Low

The researcher was making the code for research subjects to analysis the data easier. The code of research subjects presented in Table 3.

Table 3. The Code of Research Subjects

No.	Research Subject	Code	Explanation
1.	BGS	SP1	The first research subject
2.	AKR	SP2	The second research subject
3.	RH	SP3	The third research subject
4.	SA	SP4	The fourth research subject
5.	ZJK	SP5	The fifth research subject
6.	FAP	SP6	The sixth research subject
Researcher was named by "P"			

The answers of LKPD and TKKMT were encoded by researcher to analysis the data easier. The code of LKPD's and TKKMT's presented in Table 4.

Table 4. The Code of The LKPD's and TKKMT's Answer

Code	Explanation
T-i	The question-i
SPn-i.x	The answer of subject-n for question-i ke-i sequence-x

The result of interview were encoded by researcher to analysis the data easier. The code of interview's result presented in Table 5.

Table 5. The Code of Interview's Result

Code	Explanation
P–i	The question-i
SPn-i	The answer of subject-n for question-i

1. Data Analysis and Discussion about Students' Mathematical Communication Ability during Discussion

In learning activity using Reciprocal Peer Tutoring Strategy on permutation and combination, students were grouped into small groups that consist of two students in each group. Observation was made on three groups where the first group considered of SP1 and SP3, the second group considered of SP2 and SP5 and the third group considered of SP4 and SP6. This grouping is based on differences in the mathematics ability that the students have.

Observation was doing when students in discussion activity. In this activity, students explained their own answer about the question in LKPD to the other student in the group. The answer from one of the research subject presented in Figure 1 and the analysis of its data present bellow the figure.

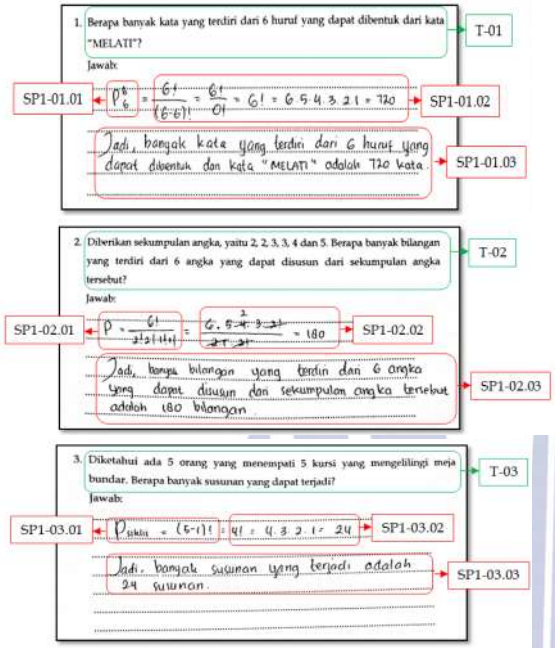

Figure 1. The answer of LKPD 1 by SP1

In discussion activity, SP1 can explain the answer of question 1 (SP1-01.01, SP1-01.02 and SP1-01.03) without any error in pronunciation the notation. SP1 can explain the answer of question 2 (SP1-02.01, SP1-02.02 and SP1-02.03) without any error in pronunciation the notation. SP1 can explain the answer of question 3 (SP1-03.01, SP1-03.02 and SP1-03.03) without any error in pronunciation the notation. It proved that SP1 can explain the answer of the question to the other student in group correctly.

SP1 always concerned about the explanation of SP3 related to the answer in LKPD. When SP3 explained the answer of question 3, SP1 interrupted by saying "Why are you using $_5P_5$ as the formula to answer the question?" It proved that SP1was listening the explanation of SP3 and SP1 was cropped the explanation with relevant thing.

SP1 always gave comment about the explanation of SP3 related to the answer of question by saying the explanation was wrong or correct with the reason. It proved that SP1 was providing feedback on the explanation from SP3.

SP1 always provided feedback on the explanation from SP3. SP1 was dominating discussion on qustion number 3. It proved that SP1 was active in group and dominating on question during discussion.

After analyzing the data, researcher presented the result of the aspect that fulfilled by research subjects in table. The result of observation of students' mathematical communication ability during discussion in learning using Reciprocal Peer Tutoring Strategy related to permutation can be seen in Table 6.

Table 6. The Result of Observation of Students' Mathematical Communication Ability during Discussion related Permutation

Code	Aspect																Total	Category
	I				II				III				IV					
	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1		
SP1	√					√			√					√			14	Very Good
SP2	√					√			√					√			14	Very Good
SP3		√				√				√			√				13	Very Good
SP4		√				√				√				√			12	Good
SP5			√			√					√					√	7	Not Good
SP6			√		√						√					√	8	Not Good

. While, the result of observation of students' mathematical communication ability during discussion in learning using Reciprocal Peer Tutoring Strategy related to combination can be seen in Table 7.

Table 7. The Result of Observation of Students' Mathematical Communication Ability during Discussion related Combination

Code	Aspect																Total	Category
	I				II				III				IV					
	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1		
SP1	√					√			√					√			15	Very Good
SP2	√				√				√					√			16	Very Good
SP3	√				√				√					√			16	Very Good
SP4	√					√			√					√			15	Very Good
SP5	√				√					√						√	12	Good
SP6			√			√				√						√	9	Not Good

Based on Table 6 and 7, the researcher resumed the result of observation of students' mathematical communication during discussion in Table 8.

Table 8. The Resume of Observation of Students' Mathematical Communication Ability during Discussion for Each Subject

Code	Aspect		The Average	Category
	First Meeting	Second Meeting		
SP1	14	15	14,5	Very Good
SP2	14	16	15	Very Good
SP3	13	16	14,5	Very Good
SP4	12	15	13,5	Very Good
SP5	7	12	9,5	Good
SP6	8	9	8,5	Good

Based on the Table 8, there are four research subjects have good category. So, It presented that students' mathematical communication ability during discussion categorized very good. The achievements of students characterized by student explained the answer of the question, student appreciated the other student in the group when explaining the answer of the question, student gave feedback to the other student's explanation and the effectiveness of student during discussion.

Fulfillment of the aspects in the observation sheet indicates that learning with Reciprocal Peer Tutoring Strategy can be said to be effective. It is corresponding with explanation of Brendefur & Frykholm (2000), Reciprocal Peer Tutoring Strategy is learning strategy that can be used to make learning more effective.

2. Data Analysis and Discussion about Students' Mathematical Communication Ability on Writing

Mathematical Communication Ability Test used to know students' mathematical communication ability on writing. This test was doing twice. The first was doing after learning using Reciprocal Peer Tutoring Strategy related to permutation and the second was doing after learning using Reciprocal Peer Tutoring Strategy related to combination. The answer from one of the research subject presented in Figure 2 and 3 and the analysis of data presented bellow the each figure.

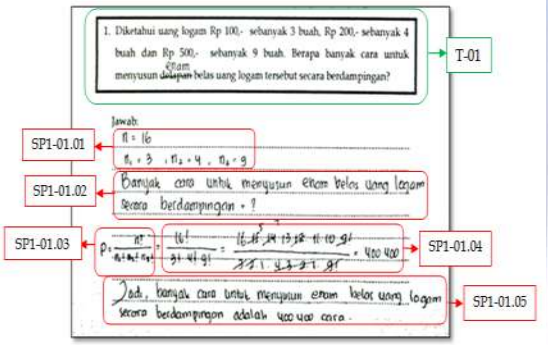

Figure 2. The answer of Question 1 in TKKMT 1 by SP1

SP1 was writing "*n=16, n1=3, n2=4* and *n4=9"* as the thing had known from the question (SP1-01.01). SP1 was writing *"Banyak cara untuk menyusun enam belas uang logam secara berdampingan=?"* as the thing that had asked from the question (SP1-01.02). It proved that SP1wrote the relevant things from the question.

SP1 used formula on SP1-01.03 as the formula used to answer the question. This formula was relevant to the question.

The calculation that had been writing by SP1 is correct (SP1-01.04). So, the answer of the question was correct. SP1 was writing the conclusion also (SP1-01.05).

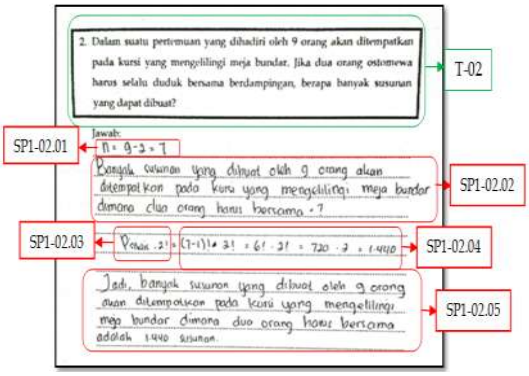

Figure 3. The answer of Question 2 in TKKMT 1 by SP1

SP1 was writing "*n=9-2=7"* as the thing had known from the question (SP1-02.01). SP1 was writing *"Banyak susunan yang dibuat oleh oleh 9 orang akan ditempatkan pada kursi yang mengelilingi meja bundar dimana dua orang harus bersama?"* as the thing that had asked from the question (SP1-02.02). It proved that SP1wrote the relevant things from the question.

SP1 used formula on SP1-02.03 as the formula used to answer the question. This formula was relevant to the question.

The calculation that had been writing by SP1 is correct (SP1-02.04). So, the answer of the question was correct. SP1 was writing the conclusion also (SP1-02.05).

After analyzing the data, researcher presented the result of the indicators that fulfilled by research subjects in table. The result of students' indicators analysis about TKKMT 1 on learning with Reciprocal Peer Tutoring Strategy can be seen in Table 9.

Table 9. The Result of Students' Indicators Analysis about TKKMT 1

			Indicator		
			Writing relevant statements to the question	Writing formula or requirement relevant to the question	Writing calculation corresponding to the formula
Research Subject	SP1	Question 1	√	√	√
		Question 2	√	√	√
	SP2	Question 1	√	√	√
		Question 2	√	√	√
	SP3	Question 1	√	√	√
		Question 2	-	-	-
	SP4	Question 1	√	√	√
		Question 2	-	√	√
	SP5	Question 1	-	-	-
		Question 2	-	-	-
	SP6	Question 1	-	√	√
		Question 2	-	-	-

Based on Table 9, mathematical communication ability on writing in learning with Reciprocal Peer Tutoring

Strategy related to permutation shows the indicators that most students achieve are indicator 2 about writing formula or requirement that relevant to the question and indicator 3 about writing calculation related to the formula. The reason about why students do not fulfill indicator 1 about writing relevant statement related to question is because some students do not know how to write it.

The result of students' indicators analysis about TKKMT 2 on learning with Reciprocal Peer Tutoring Strategy can be seen in Table 10.

Table 5. The Result of Students' Indicators Analysis about TKKMT 2

			Indicator		
			Writing relevant statements to the question	Writing formula or requirement relevant to the question	Writing calculation corresponding to the formula
Research Subject	SP1	Question 1	√	√	√
		Question 2	√	√	√
	SP2	Question 1	√	√	√
		Question 2	√	√	√
	SP3	Question 1	√	√	√
		Question 2	√	√	√
	SP4	Question 1	√	√	√
		Question 2	√	-	-
	SP5	Question 1	-	√	√
		Question 2	-	-	-
	SP6	Question 1	-	√	-
		Question 2	-	-	-

Based on Table 10, mathematical communication ability on writing in learning with Reciprocal Peer Tutoring Strategy related to combination shows the indicators that most students achieve are indicator 2 about writing formula or requirement that relevant to the question and indicator 3 about writing calculation related to the formula. The reason about why students do not fulfill indicator 1 about writing relevant statement related to question is because some students do not know how to write it.

3. Data Analysis and Discussion about Students' Oral Mathematical Communication Ability

Students' Oral Mathematical Communication Ability was doing twice. The first was doing after learning using Reciprocal Peer Tutoring Strategy related to permutation and the second was doing after learning using Reciprocal Peer Tutoring Strategy related to combination.

The result of students' indicators analysis about interview 1 on learning with Reciprocal Peer Tutoring Strategy can be seen in Table 11.

Table 11. The Result of Students' Indicators Analysis about Interview 1

			Indicator		
			Accurateness	Completenss	Fluency
Research Subject	SP1	Question 1	√	√	√
		Question 2	√	√	√
	SP2	Question 1	√	√	√
		Question 2	√	√	√
	SP3	Question 1	√	√	√
		Question 2	-	-	√
	SP4	Question 1	√	√	√
		Question 2	√	-	√
	SP5	Question 1	-	-	-
		Question 2	-	-	√
	SP6	Question 1	-	-	-
		Question 2	-	-	√

Based on Table 11, oral mathematical communication ability in learning with Reciprocal Peer Tutoring Strategy related to permutation shows the indicators that most students achieve are indicator 1 about student explains the answer of equation accuratelly and indicator 3 about student explains the answer of equation fluency. In this case, the most students do not achieve indicator 2 because students are not convey the complete information, espesially on matters relevant to the question.

The result of students' indicators analysis about interview 2 on learning with Reciprocal Peer Tutoring Strategy can be seen in Table 12.

Table 12. The Result of Students' Indicators Analysis about Interview 2

			Indicator		
			Accurateness	Completeness	Fluency
Research Subject	SP1	Question 1	√	√	√
		Question 2	√	√	√
	SP2	Question 1	√	√	√
		Question 2	√	√	√
	SP3	Question 1	√	√	√
		Question 2	√	√	√
	SP4	Question 1	√	√	√
		Question 2	-	-	√
	SP5	Question 1	√	√	√
		Question 2	-	-	√
	SP6	Question 1	√	-	√
		Question 2	-	-	√

Based on the Table 7, oral mathematical communication ability in learning with Reciprocal Peer Tutoring Strategy related to combination shows the indicators that most students achieve are indicator 1 about student explains the answer of equation accuratelly and indicator 3 about student explains the answer of equation fluency.

In this case, the most students do not achieve indicator 2 because students are not convey the complete information, especially on matters relevant to the question. It seems with

the indicators that students achieve in the oral mathematical communication ability in learning with Reciprocal Peer Tutoring Strategy related to permutation.

CLOSURE

Conclusion

Based on the result of data analysis and discussion that elaborated above, then obtained the following conclusion.

1. Profile of students' mathematical communication ability during discussion in learning with Reciprocal Peer Tutoring Strategy included excellent category. It characterized by student explained the answer of the question, student appreciated the otjer student in the group when explaining the answer of the question, student gave respond to the other student's explanation and the effectiveness of student during discussion. Fulfillment of the aspects in the observation sheet indicated that learning with Reciprocal Peer Tutoring Strategy could be said to be effective.
2. Profile of mathematical communication ability on writing in learning with Reciprocal Peer Tutoring Strategy showed the indicators that most students achieve were indicator 2 about writing formula or requirement that relevant to the question and indicator 3 about writing calculation related to the formula.
   The reason about why students did not fulfill indicator 1 about writing relevant statement related to question was because some students do not know how to write it.
3. Profile of students oral mathematical communication ability in learning with Reciprocal Peer Tutoring Strategy showed the indicators that most students achieve were indicator 1 about students explained the answer of question accurateness and indicator 3 about students explained the answer of question fluency.

Suggestion

Based on the result of this research, we have suggestion as follows:

1. Providing more practice is needed by teacher so that the students' mathematical communication ability more trained.
2. The complexity of the question used in LKPD must be improved so that it can train students' mathematical communication ability more.
3. Interview questions used must be datailed so that it can measure the oralmathematical communication ability more specifically.

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