UJMER 10 (2) (2021) 202 - 210

Unnes Journal of Mathematics Education Research

http://journal.unnes.ac.id/sju/index.php/ujmer

Mathematical Communication Ability in terms of Student Learning Styles in Inquiry Based Learning Assisted by Module

Fita Kurniawati [1]✉, Hardi Suyitno[2], Mulyono Mulyono[2]

[1] MI Muhammadiyah Jatikulon Kudus, Indonesia
[2] Universitas Negeri Semarang, Indonesia

Article Info

Article History:
Received :
10 August 2021
Accepted:
10 September 2021
Published:
30 December 2021

Keywords:
Mathematical Communication Skills, Learning Styles, Inquiry Based Learning assisted by Module

Abstract

The purpose of this study is to describe mathematical communication ability in terms of student learning styles in module-assisted Inquiry Based Learning. This study uses a combination method of concurrent embedded design with a population of class VIII students of SMP Negeri 1 Jati Kudus and the research sample is based on cluster random sampling. Data collection techniques in this study were observation, mathematical communication ability tests, learning style questionnaires and interviews. The results showed (1) students with visual learning styles were able to write mathematical ideas into mathematical models, compose and explain completion procedures, (2) students with auditory learning styles were able to express everyday events in mathematical language or symbols, write mathematical ideas into in mathematical models, compiling and explaining completion procedures and (3) students with kinesthetic learning styles are able to write mathematical ideas into mathematical models and develop completion procedures.

✉Correspondence:
Desa Bulung Kulon RT 02 RW 03 Kec. Jekulo Kab. Kudus
E-mail: fita.kurniawati33@gmail.com

p-ISSN 2252-6455
e-ISSN 2502-4507

INTRODUCTION

The success of education is caused by several factors, one of which is the teaching and learning process in the classroom (Ulva & Suri, 2019). An appropriate teaching strategy is needed in creating a good learning atmosphere. According to Irawan et al., (2018) Teaching strategy is an approach taken by teachers to support learning activities so that students can be actively involved in the learning process. A middle school math teachers need to emphasize will be the importance of communication in the learning of mathematics, both orally and in writing (Pourdavood c & Wachira, 2015). According to NCTM (2000), the general goal of learning mathematics is to have (1) the ability to solve, (2) the ability to reason, (3) the ability to communicate, (4) the ability to make connections, and (5) the ability to represent. Of the five abilities, communication skills have a very important role in learning mathematics (Sari & Suyitno, 2019). This agrees with Sapto et al., (2015) that communication skills are also one of the abilities that students must have.

Communication is a process that takes place, is dynamic, produces change to achieve results, involves mutual interaction, and involves a group. In communicating, one must think about how to make the message conveyed by someone can be understood by others (Wijayanto et al., 2018). However, inappropriate learning innovations in the classroom have an impact on students' weak mathematical communication skills (Syaiful et al., 2019). The lack of communication skills in learning mathematics is an inhibiting factor for the continuity of learning (Ardani & Purwaningsih, 2018). According to Ramadhan & Minarti, (2018) the cause of students not having good mathematical communication skills is that students consider writing what is known and asked to be unimportant. The low mathematical communication skills of students result in difficulties in learning mathematics, both in understanding concepts and in solving problems (Lestari et al., 2019).

The results of observations conducted by researchers pointed to k 's that learning in the classroom carried out conventionally, namely learning is dominated by teachers. Learning that is more one-way in nature causes student involvement in the learning process to be very small. Students are taught theory through notification, then students are given and discussed examples, then given practice questions that are like examples. This situation does not provide opportunities for students to develop their potential. According to Heryan, (2018) one of the factors that results in low student mathematical communication is because students tend not to have the opportunity to communicate to ask questions and respond to problems, both to the teacher and to other students.

The results of an interview with one of the mathematics teachers at SMP Negeri 1 Jati Kudus stated that the problem that is often experienced by class VIII students is in communicating the tasks that have been given by the teacher with the language of mathematics or it can be said that students' mathematical communication is still low. This was confirmed when a preliminary study was conducted on the flat material. Students do not understand math problems related to everyday life so that they have difficulty solving problems into mathematical models. This is in line with the results of research from Triana et al., (2019) which showed that some students made the wrong mathematical model. By thus, the students do not understand the material that has been presented by the teacher so that student learning outcomes have not yet reached complete learn. Therefore, teachers need to pay attention to the quality of mathematics learning so that it is easier for students to learn mathematics.

The thing that deserves attention in the learning process is the sensitivity of the teacher to recognize the tendency of students' learning styles. Student learning errors that are still patterned with learning styles that rely on memorization and the application of formulas will result in low mathematics learning outcomes (Triwibowo et al., 2017). Learning style is a person's way of receiving, absorbing, and processing information in response to the learning he receives (Nuraini, 2013). Based on the opinion of Bandler & Grinder (in DePorter, 2002) which states that almost everyone tends to have one learning style that plays a role in learning, processing, and communication. By knowing the different learning styles of students, teachers can make changes in learning and look for strategies that are suitable and in accordance with students' learning styles

(Agustrianita et al., 2019). Teachers as facilitators must be able to create effective teaching and learning conditions, so that the teaching and learning process can develop students' mathematical communication. The results of Sari's research, (2017) show that the results of the mathematical communication ability test are different for each student with different learning styles. This is supported by the research results of Bire et al., (2014) which shows that visual learning styles, auditory learning styles, and kinesthetic learning styles have a positive relationship with student achievement.

There are many models of learning that gives students the opportunity to actively participate in the learning process, one of which is a learning model of inquiry (Inquiry-Based Learning). Inquiry-Based Learning (IBL) is a learning that can involve children directly into real life by conducting its own investigation, the meaning and purpose of a teaching materials (Nurjanah, 2017). According to Sefalianti, (2014) with inquiry learning, students will get better communication ability about mathematics and will be more interested in mathematics because they are actively involved in making their own discoveries. Based on research by Smallhorn et al., (2015) showed an increase in student interaction and encourage students to be more independent in learning. This is in line with the findings made by Chong et al., (2017) showing that students participate actively in IBL learning, so that they can improve their ability to solve mathematical problems.

The availability of books in accordance with scientific principles as expected in the 2013 curriculum is very important. Therefore, researchers compiled modules that were in accordance with the 2013 curriculum. According to Tjiptiany et al., (2016) modules are teaching materials that are systematically and attractively arranged which include material content, methods, and evaluations that can be used independently. In the research of Purnomo et al., (2013) the mathematics module aims to develop students' mathematical abilities. The learning module that will be made by the researcher is equipped with questions that can develop students' mathematical communication ability.

The problem of this research is How mathematical communication ability in terms of students' learning styles in Inquiry Based Learning assisted by module.

METHOD

This research uses a combination of quantitative-qualitative research (mixed method) with a concurrent embedded design. The population in this study was grade VIII SMP Negeri 1 Jati Kudus in the 2017/2018 academic year. From the existing VIII class, two classes were selected as the research sample and one class as the trial class. Determination of the research sample based on cluster random sampling. The first class as an experimental class that applies the Inquiry Based-Learning learning model with the help of a module, the second class as a control class uses conventional learning. In the experimental class, students' learning styles were categorized (visual, auditory, and kinesthetic) by giving a learning style questionnaire. Each category of student learning style is taken by 2 students to serve as the subject of qualitative research.

The data to be explored in this study are data about the results of students' mathematical communication skills, data about the results of student learning style questionnaires in learning and data about inquiry-based learning with the help of modules. While sumber of data in this research is responden (students of class VIII in SMP Negeri 1 Kudus in the 2017/2018 academic year) and the informant (teacher of mathematics courses in SMP Negeri 1 Jati Kudus).

Data collection techniques in this research consisted of quantitative data collection techniques and qualitative data collection techniques. Quantitative data collection techniques in this study are tests and questionnaires. The test given is the Mathematical Communication Ability Test (TKKM). TKKM was carried out twice, namely the initial TKKM (pretest) before being given treatment and the second TKKM (posttest) after being given treatment. The questionnaire used in this study is a questionnaire based on student learning styles (learning style inventory). Qualitative data collection techniques used in this study were observation, interviews, and documentation.

In quantitative analysis, analysis initial data as a prerequisite test in this study consisted of normality test, homogeneity, and median equality test described as follows. Then the final data analysis carried out includes classical completeness test, average difference test and completeness proportion test. In the analysis of qualitative data in this study using the Miles and Huberman model. Data analysis was carried out during data collection, and after completion of data collection within a certain period. Then in this study, credibility test was used to test the validity of the data. Test the credibility of the data is done by triangulation.

RESULTS AND DISCUSSIONS

The grouping of students based on learning styles in this study used a learning style questionnaire that had been validated by an expert validator first. The learning style questionnaire is grouped into 3 categories, namely Visual Learners, Auditory Learners, and Kinesthetic Learners. The results of grouping students in terms of learning styles are presented in table 1 below.

Table 1. Grouping of Students in terms of Learning Style

Category Learning Style	Many Students	Percentage
Visual Learners	9	27.3%
Auditory Learners	10	30.3%
Kinesthetic Learners	14	42.4%
Amount	33	100%

Based on table 1, the selection of research subjects in each category was selected by two students to analyze their mathematical communication ability in depth during the learning process. Determination of this subject by selecting one student whose questionnaire results have the highest score and the other is the student who has an average score in each learning style category. This subject selection was carried out with the aim of showing significant differences between the three categories of learning styles in solving problems. Each selected research subject is coded to facilitate the presentation of mathematical communication ability data. The coding of the research subjects can be seen in table 2.

Table 2. Research Subject Codes

Category Learning Style	Research Subject Codes
Visual Learners	VL-1 VL-2
Auditory Learners	AL-1 AL-2
Kinesthetic Learners	KL-1 KL-2

Homogeneity test was conducted to determine whether the final TKKM data between the experimental class and the control class had the same variance. *The output of* the calculation of the homogeneity test between the experimental class and the control class can be seen in table 3 below.

Table 3. Final Homogeneity Test SPSS *Output*

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
Nilai TKKM Akhir	3.307	1	64	.074

Based homogeneity test with SPSS using *Levene Statistic Test* with significance level of 5% significance obtained values are 0,074 = 7,4%> 5%, then H_0 accepted. This shows that the experimental class variance is the same as the control class variance (homogeneous variance).

From the calculation of the classical completeness test using the z formula, the z value is 2,961. Furthermore, these results are compared with the z-value table. With a significance level of 5% obtained $z_\alpha = z_{0,05} = 1,64$. Visible value $z_{hitung} = z_{tabel}$ or 2,961 > 1,64. Thus H_0 is rejected or H_1 receiving means that the proportion of students who are taught by a model *Inquiry-Based Learning* with the help of modules that achieve mastery KKM has exceeded 75% of the total number of students. It can be concluded that learning mathematics with the *Inquiry Based-Learning* model with the help of modules meets the criteria for classical learning completeness.

Different test average is used to Determine the difference in average ability mathematical communication students who are taught using a model of *Inquiry-Based Learning* assisted by module (experimental class) with students who are taught by teaching the conventional (control class), and roomates is better between the average mathematical communication ability of students in the experimental class or the control class. The data used to test the average difference in mathematical communication skills is the TKKM posttest data from the two groups. From the calculation results obtained s^2 is 63,64, so the value of $s = \sqrt{63,64} = 7,98$. After calculating the average difference obtained t test value of 5,555 with a degree of freedom (df) = 64. The test with significance level of 5% was obtained $t_{tabel} = t_{(64,0,05)} = 1,669$ shows that the value $t_{hitung} > t_{tabel}$ or 5,555 > 1,669. It is thus H_0 rejected, which means the average ability of mathematical communication in the experiment class more than the ability of mathematical communication in the control class.

The mastery proportion test was used to determine the difference in the number of students who achieved complete mathematical communication ability in the experimental class and the control class. From the calculation of the completeness proportion test using the z formula, the z value is 4,023. Furthermore, these results are compared with the z-value table. With a significance level of 5% obtained $z_\alpha = z_{0,05} = 1,64$. Visible value $z_{hitung} = z_{tabel}$ or 4,023 > 1,64. Thus H_0 is rejected or receiving H_1 means the mastery proportion of students' mathematical communication skills experimental group over the control class.

Assessment of the implementation of learning is carried out through observation sheets of teacher activities in *Inquiry Based Learning with* module assisted. The observers who observed the teacher's activities during the study were the mathematics teacher of SMP Negeri 1 Jati Kudus (O1) and students of the Master of Mathematics Education study program, Semarang State University (O2). The results of observations of the learning process carried out by teachers can be seen in Table 4.

Table 4. Results of Observation of the Learning Process

No	Learning	O1	O2	Average	Category
1	Meet-1	3.889	3.963	3.926	Well
2	Meet-2	4.148	4.074	4.111	Well
3	Meet-3	4.222	4.259	4.241	Very Good
	Total average			4.093	Well

From table 4, it is obtained that the average total observation of the learning process is 4.093 (included in the good category). It can be concluded that *Inquiry Based Learning* process with the module-assisted carried out by the teacher is going well.

Quality learning is a series of activities that can improve the achievement of student competencies. The quality of learning in this study was measured in 3 stages, namely 1) planning the learning process with a minimum criterion of good, 2) the implementation of the learning process in a minimum of good criteria, and 3) assessment of effective learning outcomes.

At the learning planning stage, the researchers compiled learning tools in the form of syllabus, lesson plans, modules, and TKKM. The learning tools are validated by expert validators. From the results of the validator's assessment, the average value for each device is included in the good category. Trial questions that have been tested previously, have been analyzed for each item and obtained five of the eight questions that can be used as TKKM.

At the implementation stage, the measurement of the quality of the implementation of learning is carried out in three meetings by observing or observing the teacher's activities during learning. Observations of the quality of learning were carried out by 2 observers, namely the mathematics teacher of SMP Negeri 1 Jati Kudus and students of the Master of Mathematics Education study program, State University of Semarang. Observations on the quality of this learning obtained results in the good category. It can be concluded that the teacher's activity during the *Inquiry Based-Learning* assisted by the module is good.

The final assessment of the quality of learning is the assessment stage. Learning assessment is said to be effective if 1) students complete classically, (2) the mathematical communication skills of the class that conducts *Inquiry Based-Learning with* module-assisted is better than the class that carries out conventional learning. The results of the mathematical communication ability test with the KKM in this study were 70 stating that more than 75% of the experimental class students completed classically. Tests for normality and homogeneity must be carried out first as a prerequisite test in the average difference test. The results obtained are 1) The mathematical communication ability test data comes from a normally distributed population; 2) The mathematical representation ability test data comes from a homogeneous population. After that, the results of the average difference test with the number of students in each class of 33 students obtained the average mathematical communication ability of the experimental class more than the average mathematical communication ability of the control class.

Based on the stages of planning, implementation, and assessment of learning described above, *Inquiry-Based Learning* with module-assisted can be said to be of high quality. This is in accordance with the research of Farda et al., (2017) which shows that the mathematical communication ability of the experimental class students is higher than the mathematical communication ability of the control class students. Likewise, research from Anintya (2017) which states that students' mathematical communication ability with *resource-based learning* models achieve classical mastery. The results in the study of Fitriana et al., (2018) also showed that the students' mathematical communication with Project Based Learning model (*Project Based Learning*) achieve mastery learning criterion. Likewise, another study from Arini (2017) stated that the *Inquiry Based Learning* model could be implemented well and could improve student learning outcomes. The results of the research of Pujiastuti et al., (2019) also proved that the inquiry learning model had a positive effect on students' mathematical critical thinking skills.

In this study, students' mathematical communication ability was analyzed based on students' learning styles, where students' learning styles were divided into three namely visual, auditory, and kinesthetic. Students' mathematical communication ability refer to the mathematical communication indicators of Sufis. The discussion related to the results of research on students' mathematical communication ability is described as follows.

The mathematical communication ability of students with visual learning styles can be categorized as good. Students with visual learning styles are still less precise in expressing everyday events in language or symbols by assuming mathematical symbols. They can show the writing of mathematical ideas in the form of mathematical models that are suitable for everyday problems. They can also write down the steps of completion so that they can explain the solution of a daily problem correctly and correctly.

From this explanation, the teacher should always encourage students to better understand the information in the questions. In addition, teachers need to remind students to get used to writing down what is known and asked to make it easier to develop steps to solve a mathematical problem. Teachers must also guide students to always make the right conclusions at the end of solving mathematical problems during learning. If the conclusion is still not right, the teacher must correct it together with the students so that they can make the correct conclusion.

The mathematical communication ability of students with auditory learning styles can be categorized as good. This is because students with auditory learning styles can express everyday events in language or symbols by assuming everyday events using mathematical symbols. Subjects with auditory learning styles are also able to write mathematical ideas into the form of mathematical models that are suitable for mathematical problems. They can also arrange the steps of completion in a coherent manner so that they can explain the solution of a daily problem clearly and correctly.

From this explanation, the teacher should always encourage students to better understand the information contained in the questions. Teachers need to remind students to get used to writing conclusions or solving mathematical problems in everyday life. If the conclusions made by students are still inaccurate, the teacher needs to provide corrections together with students to make the correct conclusions.

The mathematical communication ability of students with kinesthetic learning styles can be categorized as poor. This is because students with kinesthetic learning styles have not been able to express everyday events in language or symbols. However, they can show the writing of mathematical ideas into the form of mathematical models that are suitable for everyday problems even though they are not precise. They can also write down the steps for the solution. However, they have not been able to explain the solution of a daily problem, namely by writing a conclusion.

From this explanation, it is better if the teacher in carrying out learning emphasizes using mathematical symbols. The teacher must also always encourage students to pay more attention to and understand the information in the questions. In addition, teachers need to remind students to get used to writing down what is known and asked to make it easier to develop steps to solve a mathematical problem. The teacher must also remind students to get used to writing conclusions at the end of solving mathematical problems. If the conclusions made by students are still not right, the teacher needs to provide corrections with students to make the correct conclusions.

CONCLUSION

Based on the research findings and the discussion data presented in this study, the following conclusions can be drawn: (1) students' mathematical communication ability with visual learning styles are able to write mathematical ideas into mathematical models, develop settlement procedures, and explain the solution of a daily problem systematically, (2) Students' mathematical communication ability with auditory learning style are able to express everyday events in mathematical language or symbols, write mathematical ideas into mathematical models, develop settlement procedures, and explain the solution of a daily problem with coherent and systematic, (3) The mathematical communication ability of students with kinesthetic learning styles is only able to write mathematical ideas into mathematical models and develop settlement procedures.

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