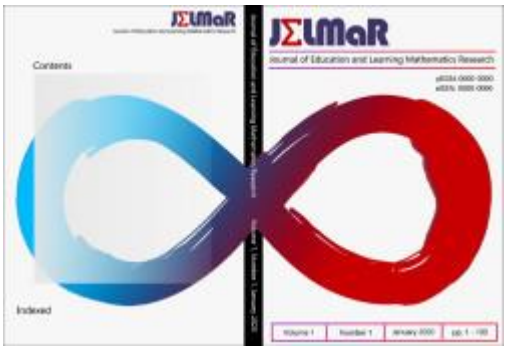

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High Schools' Students Mathematics Communication Ability: Learning Style Perspective

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***Abstract**: Students' mathematical communication is a mutual method of various mathematical inspirations that are learned and clarified through understanding. Communication of mathematical ideas can be used as objects of reflection, and can be replaced, can be improved, and can be discussed. This study intends to identify students' communication ability in terms of visual, auditory, and kinesthetic learning styles. This qualitative descriptive study involved 25 students of class VIII-C in SMP 17 August 1945 Surabaya. The instruments used in this study include a learning style questionnaire, mathematical communication test, and interviews. The result is that students' mathematical communication ability in terms of auditory learning styles are capable of indicators express known information and asked information, using mathematical icon, drawing shape, and planning get solution. Likewise, students' mathematical communication ability in terms of visual learning styles can be in indicators express known information and asked information, then planning get solution. On the other hand, students' mathematical communication ability in terms of kinesthetic learning styles are capable of indicators express known information, planning get solution, and conclude.*

Keywords: mathematical, communication ability, visual, auditory, and kinesthetic.

INTRODUCTION

Merriam-Webster describes communication as altering personal data to another person through a system of similar icons, features, or attitudes. Communication is the dissemination of information, ideas as actions or emotions from one person to another through symbols. Mathematical communication ability is communication that arises in learning mathematics (Fay, 2018), so it can be said that it covers cognitive abilities. Communication can occur through the process of reflection, organization of perspective, and expression of thoughts through words. This is where students learn to make assumptions, take into account the process, connect, confirm, and equate ideas. This interaction involves mathematical vocabulary to help strengthen students' understanding, not only from words, but also from mathematical ideas and words conveyed (Erawati & Putri, 2019).

Students' mathematical communication is influenced by their respective learning styles and according to their needs. DePorter & Hernacki (2002) distinguish learning styles into 3 major groups, namely visual, auditory, and kinesthetic learning styles (Erawati & Putri, 2019). Visual learning style is a learning style with the method of looking, observing, looking, and the like (Falah & Fatimah, 2019). The sense of sight is the strongest position in this learning style. The eye is a very sensitive tool to form each sign or stimulus learning. The auditory learning style is a learning style using the listening method (Haryono & Tanujaya, 2018). Students with this learning style are more dominant in using the sense of hearing to carry out teaching and learning activities. Kinesthetic learning style is a learning style by moving, working, and touching. This means learning that prioritizes the sense of taste and body movements. (Erawati & Putri, 2019).

Based on the pre-research at SMP 17 August 1945 Surabaya in the 2021/2022 academic year. Researchers conducted discussions with tutors and class VIII-C teachers. It was found that category VIII-C students have mathematical communication and diverse learning styles to identify students who have visual, auditory and kinesthetic learning styles. Not only that, it was also found that students did not master symbols, notes and communicated in mathematical form. After that the lack of student learning styles to absorb, process and organize mathematical information. Based on that review, the researchers formulated the problem High Schools' Students Mathematics Communication Ability on Learning Style Perspective.

METHOD

This research is a qualitative descriptive which was conducted at SMP 17 August 1945 Surabaya. 25 students of class VIII-C in the 2021/2022 academic year were involved in this research. The selected subject is a subject whose type of learning style is known. The instruments used in this research are learning style questionnaires, mathematical communication tests, and questions and answers.

The information used for research is the result of student learning style questionnaires, mathematical communication ability test results and the results of questions and answers. The mathematical communication question and answer ability test is intended to measure students' mathematical communication ability. The learning style questionnaire aims to divide students into 3 groups, namely the visual learning style group, the auditory learning style group and the kinesthetic learning style group.

The information collection method is a questionnaire method containing questions that students want to answer in order to identify the extent to which students understand their respective visual, audiovisual and kinesthetic learning styles. After that using the test method and a question and answer test about students' mathematical communication ability. If each has known the results, then the results of the replies received can be corrected according to the answer sheet and the results of the questions and answers can be recorded in order to minimize errors while finding accurate information.

The steps that were tried in the planning step were conducting preliminary research at SMP 17 August 1945 Surabaya, organizing research concepts, making research instruments in the form of mathematical communication ability test questions, learning style questionnaires, other answer options and evaluating test questions, carrying out research instrument validation, revise research instruments based on the results of validation, conduct trials of research instruments, analyze the results of information and trials, revise research instruments based on experimental results.

The steps that are tried in the implementation step are distributing learning style questionnaire questions to students, distributing numbers on the answers to the research point test, analyzing learning style questionnaires, dividing students into 3 groups, students who have visual, auditory, and kinesthetic learning styles. As well as interviewing students about students' mathematical communication ability. The steps that are tried in the step of making research information, are collecting learning style questionnaires and mathematics communication interviews, carrying out analysis of learning style questionnaires and mathematics interviews, making conclusions and organizing research information. On the other hand, the steps that are tried in the step of making research information are collecting learning style questionnaires and mathematical communication questions and answers, carrying out analysis of learning style questionnaires and mathematical questions and answers, making conclusions and organizing research information.

In qualitative research, to establish the validity of information, a triangulation method is needed. In this case, observers use triangulation methods to re-examine information from similar sources but use note-taking, questionnaire and question-and-answer methods. It is hoped that the information that has been analyzed is correct.

RESULT AND DISCUSSION

Completion of questionnaires by class VIII-C students at SMP 17 August 1945 Surabaya for grouping students' learning styles. The activity was carried out on Saturday, December 11, 2021 by means of online loading via a google form. This is because teaching and research activities at the school are being recommended to be done online and active school days are used to increase learning hours as an exercise before the Final Semester Exams. Participants who included a learning style questionnaire for 18 students were caused by 7 other students exploring extracurricular activities at school. Until, the 7 students were asked to submit a questionnaire on Saturday, December 18, 2021. The information obtained from filling out the learning style questionnaire was analyzed according to the principles of evaluating the learning style questionnaire. Furthermore, information on the results of the VIII-C student learning style questionnaire was presented below.

Table 1. Results Quistionnaries of learning styles

Learning styles	Number
Visual	14
Auditory	5
Kinesthetic	6

Source: Processed data (2022)

Based on the table 1 above, it is found that there are students who have each learning style according to Deporter and Hernacki (2002). Students who have a visual learning style are 14 students (56%), students who have an audiotorial learning style are 5 students (20%), and students who have a kinesthetic learning style are 6 students (24%). From those we know that the most students learning style at SMP 17 Agustus 1945 are visual learning style and Table 1 can presented figure below

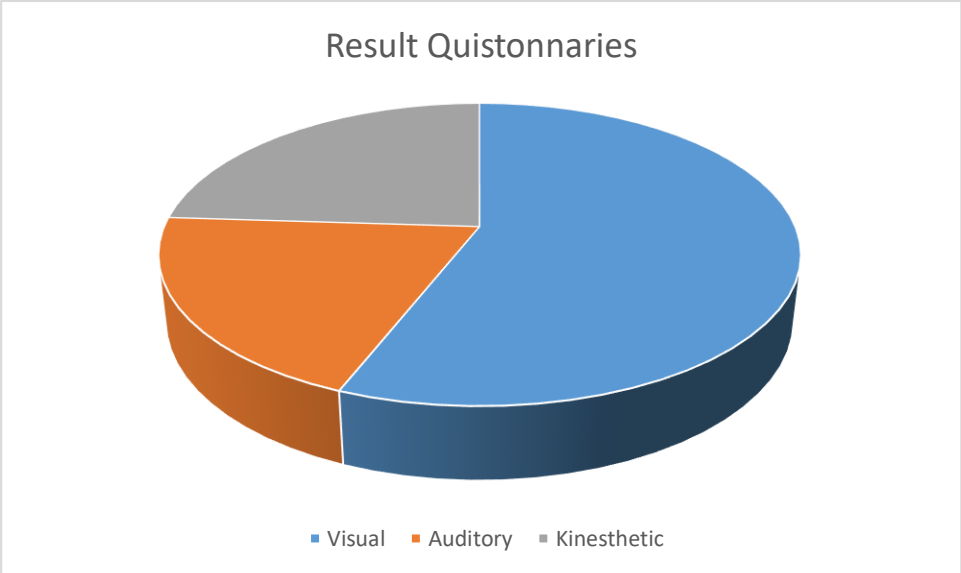

Figure 1. Comparison results quistionnaries of learning styles

After identifying the student's learning style, the researcher determines the research subject. 24% of the total subjects selected were 2 visual learning style subjects, 2

audiotorial learning style subjects, and 2 kinesthetic learning style subjects. Based on the results of grouping learning styles, the results are similar to those in table 2

Table 2. Subject coding

Code	Learning Style	Code
C-5	Visual	V-1
C-10	Visual	V-2
C-19	Audiotorial	A-1
C-4	Audiotorial	A-2
C-12	Kinestetik	K-1
C-20	Kinestetik	K-2

The research activity was carried out on December 1, 2021 to February 10, 2022. The research schedule can be seen in the following table below.

Table 3. Implementation of research activities

Date	Activities
December, 11th, 2021	Quistionnaries learning styles
January, 13th, 2021	Give a test of mathematical ability
January, 14th, 2021	Interview
January, 18th, 2021	Interview

The test of students' mathematical communication ability was carried out for 60 minutes. This test was taken by all students of class VIII-C in SMP 17 August 1945 totaling 25 students. Mathematics communication ability test is done individually. Before carrying out the test, the researcher first reads the instructions for working on the questions located at the top of the test questions.

Interviews were conducted to obtain data on mathematical communication ability in class VIII-C students in SMP 17 August 1945. Interview activities were carried out on Friday, January 14, 2022 and on Tuesday, January 18, 2022 when class hours were over. This matter is tried so as not to disturb the learning activities. Subjects V-1, A-1, and K-1 will be held on Friday, January 14, 2022, while V-2, A-2 and K-2 will be held on Tuesday, January 18, 2022.

Based on the research results, we get a summary of the analysis of students' mathematical communication ability from 6 subjects consisting of visual learning styles for subjects V-1 and V-2, audiotorial learning styles for subjects A-1 and A-2, and kinesthetic learning styles for subjects K-1 and K-2 as follows**.**

Table 4. Mathematical communication ability analysis

Subject Code's	Indicators				
	1	2	3	4	5
V-1	Able	Able	Able	Able	Able
V-2	Able	Able	Poor	Able	Poor
A-1	Able	Able	Able	Able	Poor
A-2	Able	Able	Able	Able	Able
K-1	Able	Poor	Able	Able	Able
K-2	Able	Able	Poor	Able	Able

Source: Processed data (2022)

The results of the analysis of students' mathematical communication ability in terms of learning styles match the results of the research. The first thing to be reviewed is the students' mathematical communication ability in terms of visual learning styles, the second is students' mathematical communication ability in terms of audiotorial learning styles. And the last one is students' mathematical communication ability in terms of kinesthetic learning style.

Visual learning styles

Further reviews students' mathematical communication ability in terms of visual learning styles will be presented at Figure 2 and 3 as follows.

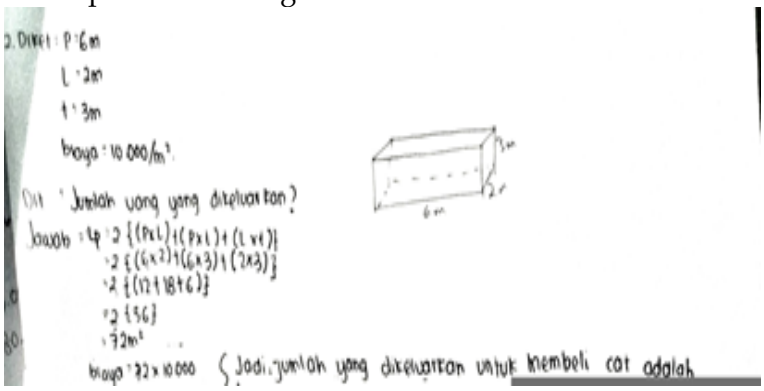

Figure 2. Subject V-1

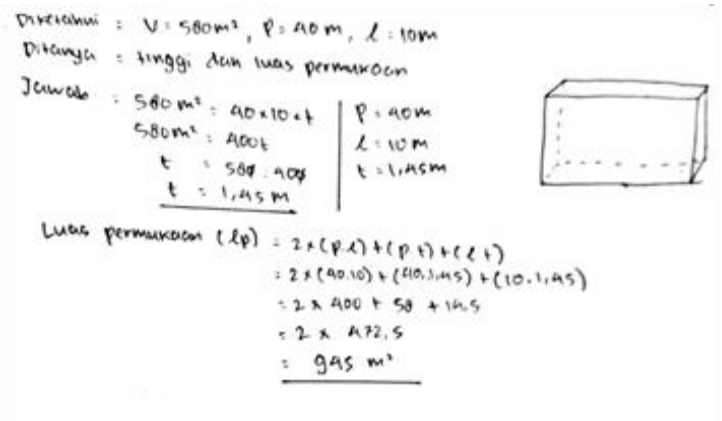

Figure 3. Subject V-2

Mathematical communication ability of visual learning styles obtained in indicators 1 and 2 can express information that is known and asked completely. In indicator 3, both the subject can describe the shape according to the sample questions along with their size. Subject V-1 can describe the shape with its size according to the case submitted, then subject V-2 has described the shape according to the problem that has been submitted but does not contain the size. Indicator 4, both subject express the methods used to solve the existing problems and can write down the steps used to solve the cases accompanied by the correct and appropriate calculation results. In indicator 5, both subjects can formulate cases that have been completed. Subject V-1 was able to formulate the submitted case but subject V-2 did not conclude the case that had been submitted. This is because the subject of visual learning styles is less able to formulate a conclusion.

In this research, the subject of interviewing students' communication ability with visual learning styles of subjects V-1 and V-2 can fulfill 3 indicators of mathematical communication ability. Three indicators students' communication ability, i.e indicator 1, 2, and 4. But both subjects didn't meet indicator 3 and 5 students' communication ability.

Visual learning style subjects can be briefly linking real objects and pictures into mathematical ideas, as well as draw conclusions from mathematical statements. But the subject hasn't can maximally explain ideas, situations, and mathematical relations verbally or writing with real objects, pictures, and algebra, and cannot be maximized in expressing everyday events in mathematical language or symbols. This is contradict with Auliana et al. (2017) and Wijayanti et al. (2019) that students who are visual learning tends

to communicate questions with short answers through the process of answering questions with answers that go to the points only.

Auditory learning styles

Students' mathematical communication ability in terms of auditory learning styles will be presented at Figure 4 and 5 as follows.

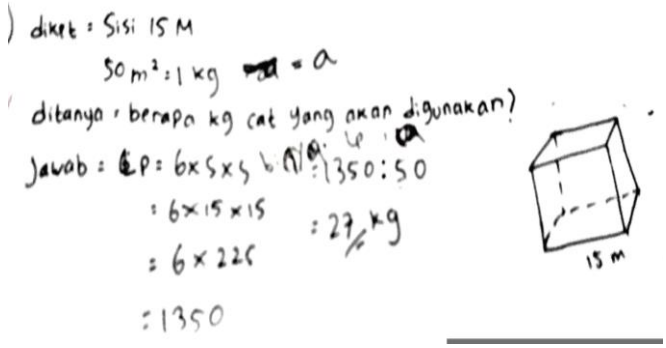

Figure 4. Subject A-1

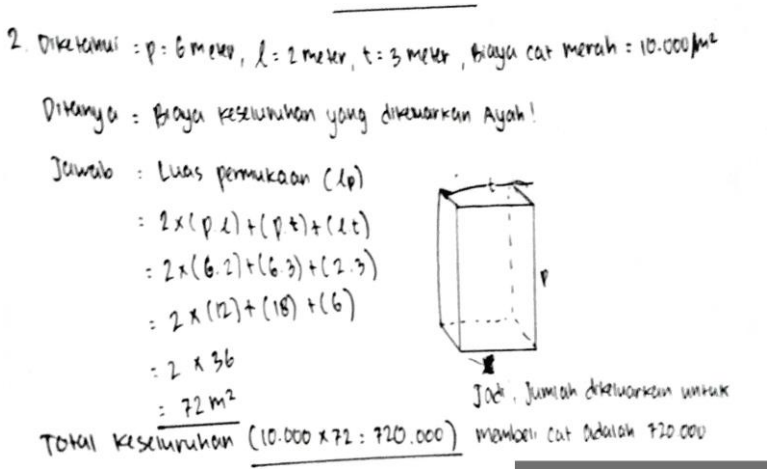

Figure 5. Subject A-2

Mathematical communication ability in terms of auditory learning styles obtained in indicator 1 are able to write known and asked data completely. Both subjects can use math icons in writing known and asked data in problem-solving (indicator 2). In indicator 3, the subjects can describe the shape according to the scribbles of the question and its size. Then they write down the methods used to solve the existing cases and can write down the steps used to solve the cases accompanied by the correct and appropriate calculation results (indicator 4). Indicator 5, subjects are able to formulate cases that have been completed. Subject A-2 is able to formulate the submitted case but subject A-1 does not write down the conclusion of the case that has been submitted. This is because the subject of the audiotorial learning style is wrong in formulating the problem**.** In this research, the subjects of can normally meet 4 indicators of mathematical communication ability, are indicator 1, 2, 3 and 4.

Subjects can turn sentences into mathematical ideas; can explain mathematical ideas (formulas); turn pictures of everyday events into mathematical symbols; explain the problem solving process; and can do drawing conclusions, but has not been able to explain mathematical ideas in image form. This is different from the research of Syarifah, et al (2017) which provide results that students with auditory learning styles tend to be

less capable in representing mathematical ideas into mathematical or written models, describe mathematical ideas visually, and are less able to use symbols, notations, and mathematical equations completely and correctly. But result this study in line with Wijayanti et al (2019) that subject do better using their ideas in mathematical symbol, explain, then concluded.

Kinesthetic learning styles

Students' mathematical communication ability in terms of kinesthetic learning styles will be presented at Figure 6 and 7 as follows.

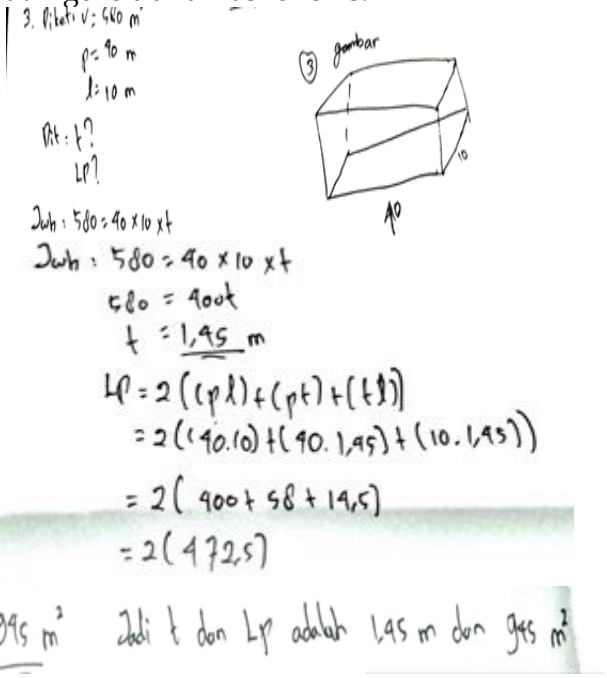

Figure 6. Subject K-1

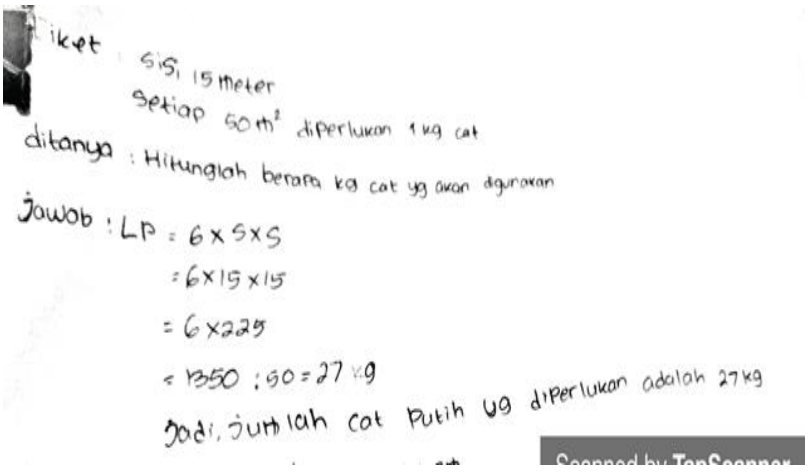

Figure 7. Subject K-2

Mathematical communication ability in terms of kinesthetic learning styles are obtained in indicator 1 of mathematical communication ability. Subjects with kinesthetic learning styles can write down known information and be asked in full with the method of being reminded the umpteenth way. In indicator 2 of mathematical communication ability, both subjects can use mathematical icons in writing known and asked information in solving the problem. Subject K-1 is lacking in writing methods to find the size of bars,

which should be the method or symbol is t = v (height equals volume) or (p×l) (length cross width) but the subject only writes without loading icons or methods appropriately. On the other hand, subject K-2 can write information and symbols well and correctly. As a result, the subject of kinesthetic learning styles can use mathematical icons in writing information according to the case in a recorded way.

On the other hand, indicator the subject is able to describe the shape according to the illustration of the question along with its size. Subjects K-1 can describe the shape according to the scribble of the question with its size. However, subject K-2 does not contain a painting with dimensions that match the scribble of the question. As a result, subjects with a kinesthetic learning style are able to convey inspiration, mathematical closeness, everyday situations by recording them with paintings. In indicator 4, students' mathematical communication ability with kinesthetic learning styles can write down the method used to solve the existing case and can write down the steps used to solve the case accompanied by the correct and appropriate calculation results. In indicator 5 students' mathematical communication ability with kinesthetic learning styles are able to formulate cases that have been completed. In this research, both the subject K-1 and K-2 can normally fulfill 3 indicators of mathematical communication ability. These indicator are indicator 1, 4, and 5. But the subject of mathematical communication ability is kinesthetic learning style unable to fulfill indicator 2 and 3.

Subjects can turn sentences into mathematical ideas; explain the idea mathematics in the form of pictures and formulas; and change the event image everyday life into mathematical symbols, but has not been able to explain the process solving the problems and drawing conclusions. This contradict to research by Auliana, et al (2017) and Wijayanti et al. (2019) that students with kinesthetic learning styles tend not to pay attention to mathematical symbols, do not write mathematical symbols in communicating the answer and also no draw conclusions. So, this research in line with Lauren & Hunting (1999) that the communication process that occurs will help students to start thinking mathematically, correctly establish mathematical relationships, and "go" beyond memorizing rules that have little or no meaning for them". Important for teachers to train mathematical communication ability for improving their problem-solving ability (Riyadi & Pujiastuti, 2014; Wulandari et al., 2014).

CONCLUSION

Based on the results of research and discussion above, can be concluded students with visual learning styles are able to indicators 1), 2) and 4). The auditory learning style can be in indicators 1), 2), 3) and 4). And students with kinesthetic learning style abilities are able to indicators 1), 4) and 5). Based on the reviews, students' mathematical communication ability in terms of student learning styles are recommended to readers that further research can be tried to discuss efforts to improve students' mathematical communication ability using various equipment so that they can complete research better.

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