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Analysis of students' mathematical communication skills in terms of learning styles

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Abstract

The purpose of this research is to obtain a description of the mathematical communication skills in terms of the learning styles of Grade XI TKR 3 students at SMK Negeri 1 Tanara for the 2023-2024 academic year. This research is qualitative in nature. Six subjects were selected, representing each learning style, from Grade XI TKR 3 students at SMK Negeri 1 Tanara, Tanara District, Serang Regency. The data collection techniques used were observation, interviews, documentation, and tests based on the indicators of mathematical communication skills, namely: (1) the ability to express mathematical symbols through everyday events, (2) the ability to determine the solution set by relating real objects to mathematical ideas, (3) the ability to explain mathematical problems related to elimination, (4) the ability to analyze mathematical problems related to substitution, and (5) the ability to evaluate mathematical thinking and strategies used in problems according to the observed object. The results showed that (1) subjects with a visual learning style have good mathematical concept comprehension on indicators 1, 2, 3, 4, and 5; (2) subjects with an auditory learning style have good mathematical communication on indicators 1, 2, and 5, but performed poorly on indicators 3 and 4; and (3) subjects with a kinesthetic learning style have good mathematical communication skills on indicators 1 and 2, but performed poorly on indicators 3, 4, and 5.

Keywords: Mathematical Communication; Learning Styles; Visual; Auditory; Kinesthetic

1. Introduction

An essential skill that students need to develop in mathematics is mathematical communication ability, which is one of the critical competencies students should possess. Mathematical communication is the ability to connect and explain ideas through mathematical models, including sentences, mathematical equations, graphs, diagrams, and tables. Mathematical communication is a fundamental skill that both students and teachers must have during the learning process. Moreover, the importance of mathematical communication skills in educational programs is aimed at preparing students to articulate and communicate mathematical thoughts clearly and accurately to peers and teachers using mathematical language.

One learning model that has the potential to meet the Process Standards is the learning model developed byJeff Knisley, (2003)namely the Knisley mathematics learning model. The Knisley mathematics learning model (MPMK) is a mathematics learning model developed based on Kolb's learning style theory which is interpreted into four stages of mathematics learning. Each of Knisley's learning stages corresponds to each of Kolb's learning styles. Correspondence between Kolb's learning style and learning activities according to Knisley's interpretation(in Mulyana, 2009)namely, the concrete-reflective learning style corresponds to the student's activities as an allegorizer, the concrete-active learning style corresponds to the student's activities as an integrator, the abstract-reflective learning style corresponds

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to the student's activities as an analyzer, and the active abstract learning style corresponds to the student's activities as a synthesizer.

This makes mathematical communication skills particularly important in mathematics. Nugraha & Pujiastuti, (2019) xplained that there are two reasons why mathematical communication is important. The first reason is that mathematics is not just a tool for thinking, discovering patterns, solving problems, or drawing conclusions; it is also an invaluable tool for communicating various ideas clearly, accurately, and concisely. The second reason is that learning mathematics is a social activity and serves as a medium of interaction between students and between students and teachers.

Mathematical communication skills involve the ability to convey ideas through direct interaction in various forms (discussions, presentations, and others) in a classroom environment (Sofyan & Madio, 2017; Luritawaty 2019). Mathematical communication ability has several indicators, as stated by Hendriana, Sumarmo, & Rohaeti (2013), which include: (1) Describing or representing real objects, images, and diagrams in the form of ideas and/or mathematical symbols; (2) Explaining mathematical ideas, situations, and relations, both orally and in writing, using real objects, images, graphs, and algebraic expressions; (3) Expressing everyday events in mathematical language or symbols or constructing a mathematical model of an event; and (4) Listening, discussing, and writing about mathematics.

Mathematical communication skills are one of the objectives of mathematics learning (Dewi, Sundayana, & Nuraeni, 2020; Syah & Sofyan, 2021). The Ministry of Education and Culture Regulation Number 58 of 2014 states that the objectives of mathematics education include ensuring that students have the ability to (Khairunisa & Basuki, 2021): (1) Understand mathematical concepts and use them flexibly, accurately, efficiently, and precisely in problem-solving; (2) Use patterns as conjectures in problem-solving and make generalizations based on phenomena or existing data; (3) Apply reasoning to properties; (4) Communicate ideas, reasoning, and be able to construct mathematical proofs using complete sentences, symbols, tables, diagrams, or other media to clarify situations or problems; (5) Appreciate the usefulness of mathematics in life, including having curiosity, attention, and interest in learning mathematics, as well as perseverance and confidence in problem-solving.

Furthermore, with mathematical communication skills, students are expected to be able to provide rational reasons in solving problems, transform descriptions into mathematical models, and illustrate mathematical ideas in relevant descriptions. Despite the importance of mathematical communication skills, students have not yet mastered them well (Sumartini, 2019; Putri & Sundayana, 2021). Field evidence shows that students' communication skills are still relatively low (Luritawaty, 2016; Nuraeni & Afriansyah, 2021).

Communication can be done both orally and in writing. The ability to convey ideas, thoughts, or desires in written form is a skill developed through learning or practice. Thus, writing or communicating in written language is a skill that requires learning or training. Based on an interview conducted on September 25, 2023, with the mathematics teacher for Grade XI, it was found that the mathematical communication of students at SMK Negeri 1 Tanara, Tanara District, Serang Regency, is still not optimal. This is due to their lack of curiosity about new things. Many students during the learning process only sit, remain silent, and take notes, with few actively participating in the learning. On average, students are still hesitant and passive in expressing their mathematical ideas. Additionally, the suboptimal mathematical communication skills of students can also be seen from the results of daily tests and semester exams in one class, where only about 40% of the students achieved scores meeting the minimum passing criteria (KKM) related to contextual story problems. Most students are not yet accustomed to writing down what is known and what is asked from a problem before solving it, leading to frequent misinterpretation of the problem's intent.

Based on this, teachers should provide students with the opportunity to learn actively according to their individual learning styles so that students can see and experience the usefulness of mathematics in real life and give them opportunities to construct their knowledge through various activities such as problem-solving, reasoning, and communicating, which lead to critical and creative thinking. According to Wassahua (2016), learning style is key to developing performance in work, school, and interpersonal situations, so learning style will influence how a person absorbs and processes information, affecting the achievement attained. According to Jaenudin et al. (2017), there are three learning style models: visual, auditory, and kinesthetic.

Learning style is the way a person absorbs, organizes, and processes information or learning materials. Some students prefer to respond to information individually, while others prefer to respond to information collectively in a group. Students with an independent learning style try to solve their problems on their own, motivating them to learn better, thus leading to improved learning outcomes (Sartika, 2019). The learning style of each student is crucial for a teacher and greatly influences the classroom learning process. However, identifying each student's learning style is not easy for

teachers because it takes considerable time to understand each student's learning style. Students' learning styles also tend to differ at school and at home, and teachers cannot fully monitor students' learning activities at home. Learning style is a diverse way of learning that each student possesses and is key to success in learning (Rosmaiyadi, 2017).

Learning style is one of the important variables related to how students understand lessons at school, particularly in mathematics. Each student's learning style differs from one another. Because students have different learning styles, it is essential for teachers to analyze their students' learning styles to obtain information that can help teachers be more sensitive to differences in the classroom and implement meaningful learning. Based on the above explanation, there is a relationship between the influence of learning style on students' mathematical communication skills. Although research on this topic has been conducted by several researchers, studies analyzing the influence of learning style on students' mathematical communication skills at the vocational school level are still limited. Therefore, this research will discuss the analysis of students' mathematical communication skills in terms of learning styles at the vocational school level.

2. Material and methods

Based on the research focus presented, the objective of this study is to analyze mathematical communication in terms of students' learning styles in Grade XI TKR at SMK Negeri 1 Tanara in Serang Regency, focusing on the topic of functions. The appropriate research method for this objective is descriptive qualitative research. According to Gay and Diehl (Alwi, 2012), descriptive research requires at least 10% of the research subjects, and the subjects are determined using a questionnaire related to students' learning styles. Qualitative research is a method used to explore and understand the meaning that a number of individuals or groups of people consider to originate from social problems. Bogdan & Taylor define qualitative methodology as a research procedure that produces descriptive data in the form of written or spoken words from the observed people and behavior. In this study, the researcher did not randomly select students to measure mathematical communication ability in terms of learning styles, but instead used the existing classes at the school where the research was conducted. Students who consistently completed the learning style questionnaire were chosen as research subjects according to the visual, auditory, and kinesthetic learning style categories. The classification of students' learning style levels was adapted from Yusuf (2019).

The initial step in this research is the selection of a topic. In qualitative research, it is important to understand the complexity in specifying a topic. The background of the subjects was selected based on initial observations at the research site before the research was conducted. This is necessary to ensure the research is well-targeted. Selecting participants began with field observations and direct dialogues with SMK Negeri 1 Tanara in Serang Regency, involving discussions with the principal or vice principal of curriculum and the Grade XI TKR mathematics teacher who is competent in the research plan, so that the researcher could conduct the research smoothly and easily. The purpose of administering the questionnaire was to obtain information from data sources related to the research process. The preparation of test questions, which serve as research instruments, was aligned with the material chosen by the researcher. Interviews were conducted in this study concerning students' mathematical communication abilities in terms of their learning styles. The final step was analyzing the data obtained from the field, which was then analyzed and processed to obtain results.

The materials and tools used in this research include teaching materials/LKPD (Student Worksheets), lesson plans (RPP), and LTS (Student Task Sheets). The instruments used consist of test and non-test instruments. The test instruments were designed to measure students' mathematical communication abilities. The test instrument in this study is referred to as the students' mathematical ability test. Non-test instruments used include questionnaires, interviews, and observations. The data presented includes the results of the analysis of pre-test data (administered before learning), post-test data (administered after learning), and the results of interviews and observations. These data were analyzed descriptively qualitatively using triangulation methods and techniques.

3. Results and discussion

The results of the learning style classification were obtained by administering a learning style classification questionnaire to the students of Grade XI TKR 3, which consists of 34 students, for the purpose of categorizing their learning styles. This activity was conducted on Friday, May 31, 2024.

Out of the total students, 29 participated in the completion of the learning style classification questionnaire, as 5 students were absent due to illness and permission. Before administering the learning style classification test, the

researcher provided instructions on how to complete the test. After the students finished filling out their respective learning style classification tests, the researcher asked them to submit the completed questionnaires.

The results obtained from the completion of the learning style classification questionnaire were analyzed according to the scoring guidelines of the learning style classification questionnaire. The following data presents the results of the learning style classification test for Grade XI TKR 3 in the table.

Table 1 Learning Style Grouping Questionnaire for Grade 11 TKR3 Class

Learning Style Type			
	Visual	Auditori	Kinestetik
Quantity	9	7	13
Presentation	31.03 %	24.13 %	44.82%

Based on Table 4.1, it was found that 9 students (31.03%) have a visual learning style, 7 students (24.13%) have an auditory learning style, and 13 students (44.82%) have a kinesthetic learning style.

After identifying the students' learning styles, the researcher selected the research subjects at the beginning of the learning process. Two students were chosen from each learning style category, i.e., 2 subjects for the visual learning style, 2 subjects for the auditory learning style, and 2 subjects for the kinesthetic learning style, as these six subjects consistently aligned with the answers in the questionnaire and the conceptual understanding ability test based on the research results. The results of the learning style classification are presented in the following table.

Table 1 Subject Selection Results

No	**Student Code**	**Learning Style**	**Subject Code**
1	P-1	Visual	V-1
2	P-6	Visual	V-2
3	P-12	Auditori	A-1
4	P-19	Auditori	A-2
5	P-22	Kinestetik	K-1
6	P-28	Kinestetik	K-2

The mathematical communication skills test for students was conducted over a 60-minute period. This test was taken by all 29 students in Grade XI TKR 3 and was conducted individually. Before the test began, the teacher asked the students to carefully read the instructions at the top of the test paper.

The results of this mathematical communication skills test will be used by the researcher to assess the students' mathematical communication abilities. These results will later be cross-checked with the findings from interviews with the research subjects, using a technique known as triangulation. The mathematical communication skills of the Grade XI TKR 3 class, as demonstrated in writing, can be considered good, as most of the students have met several indicators of mathematical communication skills, which include: (1) the ability to express and understand mathematical symbols through everyday events, (2) the ability to relate real objects to mathematical ideas, (3) the ability to explain mathematical problems related to elimination, (4) the ability to analyze mathematical problems related to substitution, and (5) the ability to communicate mathematical thinking and strategies used in problem-solving in relation to observed objects.

This can be observed from the students' answers when solving the problems provided by the mathematics teacher on the topic of functions. Most students have written their answers in accordance with the given instructions, solved the problems in a sequential and clear manner, illustrated the appropriate forms corresponding to the questions, and provided conclusions at the end of their work. The following table presents the data from the mathematical

communication skills test based on the 5 indicators of mathematical communication skills, categorized by the learning styles of the students in Grade XI TKR 3.

Table 2 Mathematical Communication Skills Test Results

Learning Style	**Question Items**	**Mathematical Communication Ability Indicators**				
Visual		1	2	3	4	5
	1	√				
	2		√			
	3			√		
	4				√	
	5					√
Auditori		1	2	3	4	5
	1	√				
	2		√			
	3			√		
	4				√	
	5					√
Kinestetik		1	2	3	4	5
	1	√				
	2		√			
	3			√		
	4				√	
	5					√

Based on Table 4.3, it was found that students with a kinesthetic learning style have better mathematical communication skills compared to those with visual and auditory learning styles. The mathematical communication skills in solving problems on the topic of systems of linear equations in two variables (SPLDV) were analyzed in three categories: 1) mathematical communication skills based on the visual learning style, 2) mathematical communication skills based on the auditory learning style, and 3) mathematical communication skills based on the kinesthetic learning style.

Regarding the mathematical communication skills of students with a visual learning style, in this study, the subjects for mathematical communication skills with a visual learning style were V-1 and V-2. The analysis of the mathematical communication skills test results for subjects V-1 and V-2 generally showed that they were able to meet all five indicators of mathematical communication skills, from Indicator 1 through Indicator 5. Based on the above discussion, the mathematical communication skills of students with a visual learning style can be categorized as good. This is because, after conducting trial tests and conceptual understanding tests as well as filling out learning style questionnaires, their answers were consistent. This is due to the fact that students with a visual learning style are able to write mathematical representations in the form of formulas used to solve mathematical problems. From this explanation, it is recommended that teachers, when conducting lessons, always encourage students to be more careful in writing what is known and what is asked. In addition, teachers should also remind students to get into the habit of using mathematical symbols to present mathematical ideas and solve mathematical problems. Below are images of the results of subjects V-1 and V-2 on questions 1 through 5.

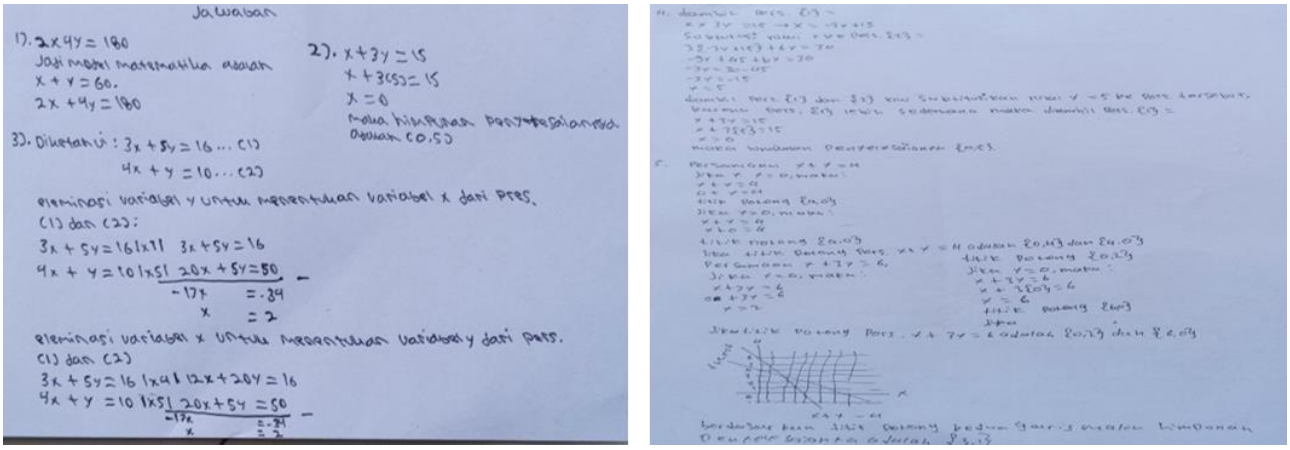

Figure 1 Visuals of Subject V-1 and V-2's Responses to Questions 1-5

Mathematical communication skills based on the auditory learning style were analyzed in this study, with subjects A-1 and A-2 representing this group. The analysis of the results from the mathematical communication skills test and the interviews with subjects A-1 and A-2 showed that they were able to meet Indicators 1-5, which include: expressing mathematical symbols, determining the solution set, explaining using the elimination method, analyzing using the substitution method, and evaluating using the graphical method. However, the auditory learning style subjects struggled with Indicators 3 and 4, specifically using the elimination and substitution methods. Overall, the mathematical communication skills of students with an auditory learning style can be categorized as good. This is because these students were able to understand Indicators 1, 2, and 5. However, their performance on Indicators 3 and 4 was still not optimal. Since they did not fully meet Indicators 3 and 4 (using the elimination and substitution methods), special treatment using appropriate teaching models is needed. From this explanation, it is recommended that teachers, when conducting auditory-oriented lessons, should always focus on ensuring that the auditory understanding is clear. Teachers should also encourage students to be more precise in writing down what is known and what is asked. Additionally, teachers should remind students to get into the habit of using steps or mathematical symbols when solving problems, and they should also remind students to always provide annotations on diagrams. Below are images of the results from subjects A-1 and A-2 on questions 1 through 5.

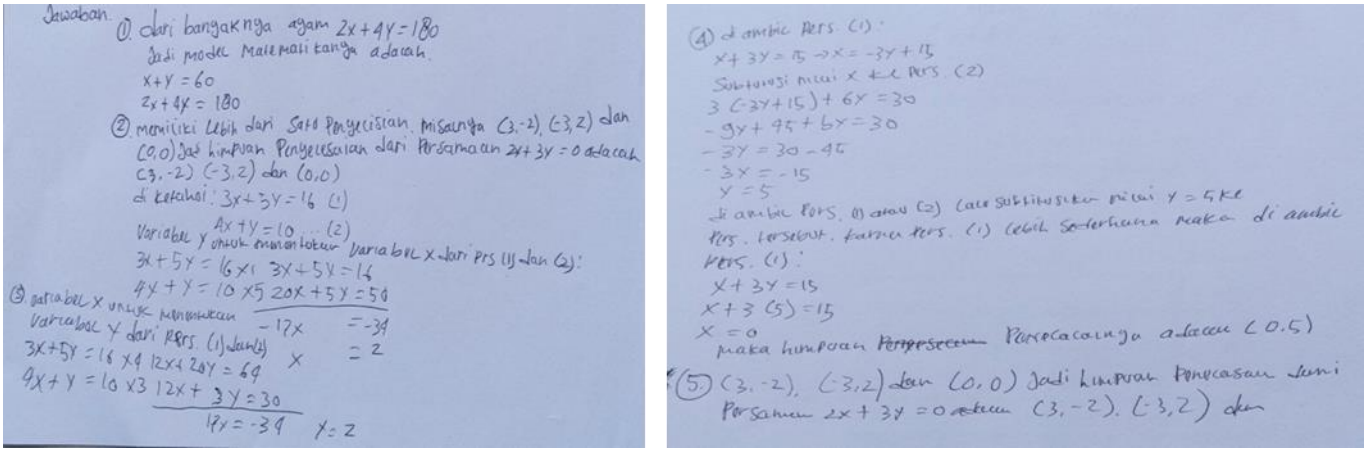

Figure 2 Visuals of Subject A-1 and A-2's Responses to Questions 1-5

The significance value obtained is 0.019> 0.05, so Ha is accepted, soThe normalized gain data for both classes is not homogeneous.Because the data is normal and not homogeneous, the next step taken was to analyze the differences in the means of the two classes using the t-test

Mathematical communication skills based on the kinesthetic learning style were analyzed in this study, with subjects K-1 and K-2 representing this group. The analysis of the results from the mathematical communication skills test and interviews with subjects K-1 and K-2 showed that they were only able to meet Indicators 1 and 2, which include: expressing mathematical symbols and determining the solution set. However, they struggled with Indicators 3 through 5, which involve explaining using the elimination method, analyzing using the substitution method, and evaluating

mathematical thinking using the graphical method. Subjects with a kinesthetic learning style did not adequately meet these indicators. The mathematical communication skills of students with a kinesthetic learning style can be categorized as less satisfactory. This is because students with this learning style were only able to understand Indicators 1 and 2, while they did not yet comprehend Indicators 3 through 5. Therefore, special treatment or intervention is needed to address these issues, such as applying a teaching model that meets the students' learning needs. Based on this, it is recommended that teachers not only provide theoretical instruction but also include hands-on practice so that students can apply what they have learned. Teachers should also encourage students to be more meticulous in solving mathematical problems and in constructing and determining systems of linear equations in two variables. Additionally, teachers should guide students to always make correct conclusions at the end of solving mathematical problems by reminding them during lessons, and if the conclusions are not accurate, teachers should provide corrections and work with students to reach the correct conclusions. Below are images of the results from subjects K-1 and K-2 on questions 1 through 5.

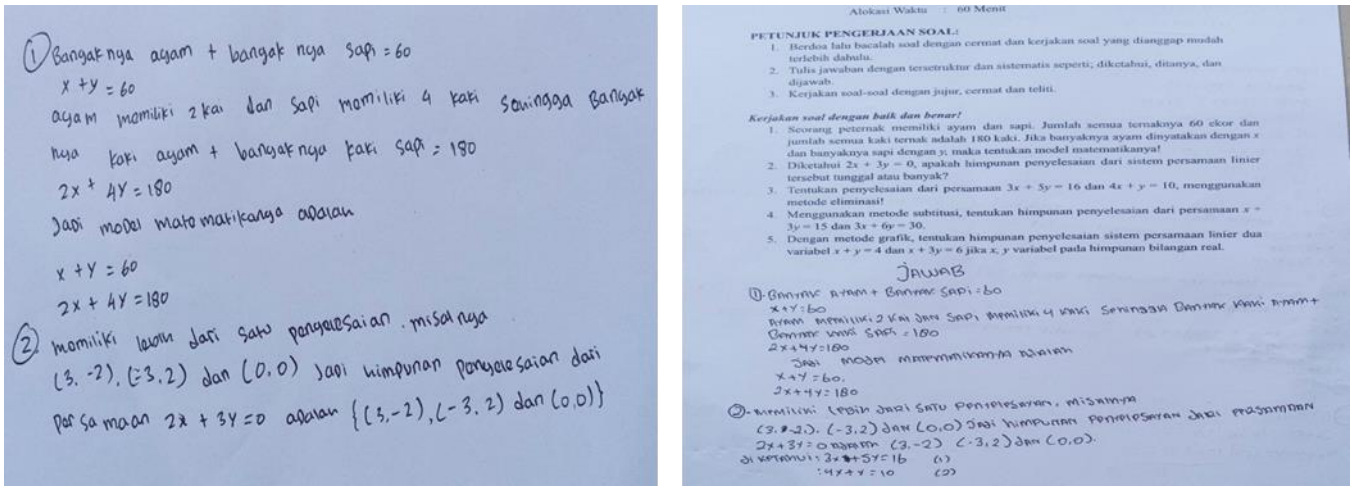

Figure 3 Visuals of Subject K-1 and K-2's Responses to Questions 1-5

Based on this, teachers should not only focus on theoretical instruction but also include practical activities so that students can apply what they have learned. Teachers should also encourage students to be more meticulous in solving mathematical problems and to correctly formulate and determine systems of linear equations in two variables. Additionally, teachers should guide students to consistently make accurate conclusions at the end of solving mathematical problems by reminding them during lessons. If students' conclusions are still incorrect, teachers should provide corrections and work with students to arrive at the correct conclusions. Below is a table summarizing students' learning styles along with the indicators.

Table 6 Summary of Students' Learning Styles

Belajar	Ability to understand mathematical symbols through everyday events.	Ability to relate real objects to mathematical ideas	Ability to explain mathematical problems related to elimination	Ability to analyze mathematical problems related to substitution	Ability to assess mathematical thinking and strategies used in observing a particular object
Visual	v	v	v	v	v
Auditori	v	v			v
Kinestetik	v	v			

In this discussion, the researcher will describe and discuss data and information obtained through tests, observations, and in-depth interviews related to the study of mathematical communication skills. Communication is a process of interaction among people and is an art of conveying information, ideas, and attitudes to others. Schools, as institutions, are no exception to the interactions that occur among their elements. The elements of a school, including individuals

and groups, function as a unity, creating interactions. Communication is a crucial factor in the learning process and supports the success of education in schools, particularly in mathematics. Greenes and Schulman (1996) state that mathematical communication is: 1) a central force for students in formulating mathematical concepts and strategies, 2) a key to students' success in approaches and solutions in mathematical exploration and investigation, and 3) a medium for students to communicate with peers to obtain information, build thoughts and discoveries, brainstorm, evaluate, and refine ideas to persuade others. Additionally, Baroody (1993) mentions five aspects of communication that need to be fulfilled: the ability to present, listen, read or understand, discuss, and write mathematical ideas in mathematical language. Mathematical communication is an integral part of understanding and applying mathematics.

According to Ramdani (2012); Anggraini and Leonard (2015); Martini et al. (2018), mathematical communication involves the use of skills such as writing, reading, listening, understanding, and presenting mathematical problems using real objects, images, graphs, or tables, as well as using mathematical symbols, evaluating mathematical ideas, and articulating arguments in one's own language. Mahmudi (2019); Ariani (2018); Wardhana and Lutfianto (2018) further state that mathematical communication is the ability of students to express their mathematical ideas to others in both verbal and written forms. Verbal communication involves the articulation and explanation of mathematical ideas, while written communication may include the use of words, images, tables, and so forth, reflecting students' thinking processes conducted carefully, analytically, critically, and evaluatively to deepen understanding.

Based on the above description, it can be concluded that mathematical communication skills consist of both verbal and written communication. Verbal mathematical communication is the ability to convey information, ideas, or mathematical concepts clearly and systematically through discussions and presentations. Written mathematical communication is the ability to express mathematical ideas through images, graphs, tables, equations, and writing in the student's own language. Furthermore, mathematical communication skills involve expressing mathematical ideas through language, notations, or symbols so as to understand, interpret, describe relationships, and solve contextual problems in mathematical models and everyday life.

Indicators of mathematical communication are essential to assess students' proficiency in mathematical communication. According to Ansari (2012), the indicators that students should master are: 1) stating mathematical ideas through speaking, writing, demonstrating, and visual representation, 2) understanding, interpreting, and evaluating mathematical ideas presented in written, oral, or visual forms, 3) using language, notation, and mathematical structure to state ideas, illustrate relationships, and create models. Ritonga (2018) proposes indicators of mathematical communication skills as: 1) the ability to translate real objects into mathematical ideas; 2) the ability to express mathematical thoughts in writing and represent daily occurrences with mathematical symbols; 3) the ability to use images to present ideas, everyday conditions, and mathematical relationships in writing; 4) the ability to digest and review mathematical ideas when solving everyday cases in writing; 5) the ability to provide conclusions to everyday questions based on problem-solving results.

Based on the above discussion, the researcher concludes that indicators of mathematical communication skills can be measured through: 1) the ability to state and understand mathematical symbols through everyday events, 2) the ability to relate real objects to mathematical ideas, 3) the ability to explain mathematical problems, 4) the ability to analyze mathematical problems, and 5) the ability to assess mathematical thinking and strategies used in problems based on the observed object.

Visual Learning Style is a learning style where ideas, concepts, data, and other information are presented in the form of images and techniques. In the discussion using the visual learning style, the subjects are two individuals: Visual Subject 1 (V-1) and Visual Subject 2 (V-2). From the tests and interviews, both subjects are capable of stating and understanding mathematical symbols in everyday life, relating real objects to mathematical ideas, explaining mathematical problems, analyzing mathematical problems, and assessing mathematical thinking and strategies used in problems based on the observed object. Therefore, it can be said that visual learning can enhance mathematical communication.

Auditory Learning Style is a learning style where students learn through listening. Students with an auditory learning style rely on their auditory perception for success in learning, so teachers should pay attention to students' listening skills. In the discussion using the auditory learning style, the subjects are two individuals: Auditory Subject 1 (A-1) and Auditory Subject 2 (A-2). From the tests and interviews, both subjects can state and understand mathematical symbols in everyday life, relate real objects to mathematical ideas, and assess mathematical thinking and strategies used in problems based on the observed object. However, for indicators 3 and 4—explaining mathematical problems and analyzing mathematical problems—the subjects have not yet mastered these aspects well. Therefore, it can be said that auditory learning can only enhance mathematical communication for indicators 1, 2, and 5.

Kinesthetic Learning Style is where students learn by doing, touching, feeling, moving, and experiencing. Students with a kinesthetic learning style rely on movement, touch, and action for learning. Such students find it difficult to sit still for long periods because their desire for creativity and exploration is very strong. Students with this learning style learn through movement and touch. Therefore, the required learning approach is more contextual and practical.

From the discussion, it can be said that mathematical communication skills are crucial in mathematics education. Through communication, students can organize and consolidate their mathematical thinking and explore their mathematical ideas. In mathematics education, students are required to develop mathematical language and symbols so they can communicate both verbally and in writing. This significantly affects their mathematical learning outcomes, as in mathematics, learning outcomes are closely related to students' ability to represent what they know and have learned in mathematical language and symbols. Additionally, using visual, auditory, and kinesthetic learning styles can enhance mathematical communication skills in learning. After conducting tests and interviews, Kinesthetic Subject 1 (K-1) and Auditory Subject 2 (K-2) can state and understand mathematical symbols in everyday life and relate real objects to mathematical ideas. However, kinesthetic learning only addresses indicators 1 and 2, and therefore, it cannot yet fully enhance mathematical communication skills.

4. Conclusion

Based on the research results and discussion, it can be concluded that the mathematical communication skills of students using the visual learning style are categorized as good. This is evidenced by meeting all indicators: the ability to state and understand mathematical symbols through everyday events, the ability to relate real objects to mathematical ideas, the ability to explain mathematical problems related to elimination, the ability to analyze mathematical problems related to substitution, and the ability to assess mathematical thinking from the strategies used in observing a particular object. Mathematical communication skills of students with the auditory learning style are also considered good, although they cover only three out of five indicators. These include the ability to state and understand mathematical symbols through everyday events, the ability to relate real objects to mathematical ideas, and the ability to assess mathematical thinking from the strategies used in observing a particular object. On the other hand, mathematical communication skills of students with the kinesthetic learning style are still considered inadequate, as only two of the five indicators are met: the ability to state and understand mathematical symbols through everyday events and the ability to relate real objects to mathematical ideas.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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