e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

International Journal of Geometry and Applied Mathematics
TESSERACT
Vol. 4, No. 1, March 2026 Pp. 32-49
Journal Page is available to http://ekalaya.nindikayla.com/index.php/home

EXPLORING ORAL AND WRITTEN MATHEMATICAL COMMUNICATION SKILLS IN GEOMETRY PROBLEMS

Darto[1]
[1]Universitas Negeri Sultan Syarif Kasim Riau, Pendidikan Matematika, Indonesia
Email: darto2@uin-suska.ac.id

ABSTRACT

A problem in mathematics learning is that students' mathematical communication skills remain low, both in oral and written mathematical communication regarding geometry problems. Mathematical communication skills in geometry problems require students to explore these problems during the mathematics learning process. Students still face difficulties in solving geometry problems, particularly in accurately expressing mathematical ideas, and they struggle to communicate their mathematical thoughts to peers and teachers. Students' oral and written mathematical communication skills are integral to 21st-century mathematics competencies. Mathematics instruction in the classroom should be designed around plane geometry content so that learning is more focused on achieving learning objectives. It is necessary to explore students' abilities in solving oral and written mathematical communication problems through discussion, argumentation, explaining answers, and writing down mathematical ideas—whether in the form of symbols, graphs, or tables. The objective of this study is to explore oral and written mathematical communication skills in geometry problems among junior high school students in Riau Province. This study employed a qualitative, descriptive-exploratory research method. The research subjects consisted of 25 students. The study was conducted in the 7th-grade class at SMP Negeri 3 Pangkalan Kuras in Pelalawan Regency, Riau Province, Indonesia. The results of this study revealed that students' mathematical abilities related to oral and written mathematical communication in geometry problems in the 7th grade were categorized as "good.".

Keywords: Mathematical exploration, oral and written mathematical communication, Geometry Problems.

INTRODUCTION

Students' oral and written mathematical communication skills are essential for learning mathematics. Through mathematics learning activities, students are encouraged to discuss and write about the topics they are studying; they are given the opportunity to present their arguments both orally and in writing. This means that understanding mathematical concepts requires both written and oral explanations (Sa'dijah et al. 2022). Given the importance of reasoning and justification in solving mathematical problems, a process is required to arrive at an answer and explain what students have written on their answer sheets; this impacts students' oral and written mathematical communication skills. Mathematical communication skills can be defined as the ability to share ideas and clarify understanding through reflection, revision, and modification. In the mathematics

learning process, students should be given the opportunity to express their ideas, reasons, and opinions regarding the solutions to the math problems they work on. In 21st-century mathematics education, skills to enhance mathematical communication abilities—both oral and written—are developed through mathematical exploration, contextual applications, discussion, and reflection (Sembiring, Hadi, and Dolk 200AD). Activities in the mathematics learning process that foster students' mathematical communication skills can be facilitated through discussion and writing (Hidayat and Iksan 2015). Oral mathematical communication needs to be fostered in classroom mathematics learning, such as through presentations, discussions, and explaining concepts during class discussions. Discussion activities in mathematics learning enable students to build an understanding of mathematical concepts through discussions, presentations, and explaining in their own words (Prendergast et al. 2018). However, in practice, students are often not given sufficient opportunities to express their opinions when solving math problems, and teachers do not provide enough opportunities for students to discuss or voice their ideas; consequently, this situation can result in low levels of students' oral and written mathematical communication skills (Wijaya and Doorman 2021).

In the mathematics learning process, the teacher's role as a facilitator is to understand and adapt to students in developing reasoning and to help students construct arguments related to the problems they face while working on math problems (Teledahl 2017). Thus, mathematics learning can be meaningful and enjoyable, and students' engagement in the context of their daily lives can be enhanced. Students' mathematical communication skills are largely limited to brief verbal responses prompted by the teacher and symbolic questions in written exercises (Fauzan, Plomp, and Gravemeijer 2013). However, students do not yet understand the process of arriving at answers in terms of both oral and written mathematical communication skills. This can affect students' communication abilities in mathematics learning, including both their oral and written mathematical communication.

Mathematical communication, both oral and written, can play a central role in professional teaching standards because teaching, at its core, is communication (Olteanu 2014). Regarding mathematical communication skills, students need to focus on the linguistic aspects of mathematics to develop ideas, where language acts as a representation of meaning and the meaning of communication (Dullas and Soliven 2021). By adhering to this principle, students need to be accustomed to communicating and engaging in mathematical reasoning with others about information based on interpretation, while others can evaluate and provide feedback on their interpretations (Maulita and Marzuki 2020). Such activities will provide students with a deeper understanding of what they have done, such as solving context-related numeracy problems (Agussuryani et al. 2022). Additionally, teachers need to foster students' ability to communicate in every lesson (Drijvers et al. 2010). Real-world observations indicate that limitations in teachers' knowledge and students' learning habits in the classroom—which rely on conventional methods—prevent students' mathematical communication skills from developing optimally (Indah Nartani, Aliim Hidayat, and Sumiyati 2015).

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

Mathematics is a symbolic language that can also be described as a formal mathematical language (Ziadat and Sakarneh 2022). If mathematics instruction focuses solely on memorizing terms rather than communicating ideas and arguments—such as through discussions, writing, and explaining concepts in their own words—it falls short (Adi, Irianto, and Sukarmin 2022). This approach provides a solution for students who struggle to understand mathematical concepts during the learning process, particularly regarding oral and written mathematical communication. Students are encouraged to identify specific aspects of mathematical communication. They are engaged in providing explanations and ideas when solving math problems so that their answers reflect a meaningful understanding (Nurhasanah et al. 2021). Mathematical communication skills are essential because they are used in teaching mathematical concepts (Nurhasanah et al., 2021). Students who write to explain or describe solution strategies experience an improvement in their problem-solving skills (Kosko and Wilkins, 2010).

Creating a mathematical context is essential for students to develop mathematical communication skills (Panaoura 2012). The objectives of mathematics instruction are to help students accelerate their understanding, solve problems using their informal knowledge, provide opportunities for students to demonstrate their abilities, and motivate students to apply their mathematical communication skills in problem-solving (Sedaghatjou 2018). Mathematical communication is a way of sharing ideas, clarifying understanding, and communicating ideas through reflection, revision, and modification (Oktiningrum, Zulkardi, and Hartono 2016). When a student receives information in the form of mathematical concepts from a teacher or reading material, a mathematical transformation occurs from the information source to the student. The student then responds based on their interpretation of that information.

A common problem is when students' responses indicate that the information they received does not meet expectations (Panjaitan and Simamora 2021). This can occur due to the nature of mathematics: students may solve math problems correctly but fail to understand what they have done. Simply put, mathematics learning in mathematics education is like the iceberg phenomenon. The tip of the iceberg is visible above the surface of the water and requires a solid foundation (Shahbari 2018). This means that students can master abstract and deductive mathematical concepts and principles. Equipping students with various experiences related to their real-world context is essential (Sanjaya and Hidayat 2022). These learning experiences will serve as that foundation, guiding students to the tip of the iceberg.

Mathematics education serves as a communication tool to aid in thinking, identifying patterns, solving problems, or formulating conclusions to convey various ideas clearly, accurately, and precisely (Darto 2021). In mathematics instruction, students must be encouraged to communicate their ideas, arguments, and explanations regarding their answers when solving math problems, so that they can understand the context of the problem (Angriani, Darto, and Zein 2021). However, in practice, students are often not given sufficient opportunities to express their opinions when solving math problems, a situation that can result in low levels of students' oral and written mathematical communication skills. In the mathematics learning process, teachers should be able to understand and adapt to

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

students' needs in developing reasoning and help students construct their own thinking (Oonk, Verloop, and Gravemeijer 2019).

The term "exploratory" is defined in the Kamus Besar Bahasa Indonesia as "having an exploratory nature; involving investigation, probing, or exploration." The term "exploratory" is more commonly interpreted as an investigative activity or field exploration aimed at acquiring more knowledge. Exploration is typically associated with the investigation, probing, or discovery of natural resources found in a particular location. Based on the explanation above, the exploratory strategy in this paper is defined as a learning strategy in which students primarily engage in discovery through activities such as finding, searching, and investigating, while the teacher's role is to provide guidance and challenges to students in the form of problems they must explore so that they are motivated to work and ultimately discover concepts (Palinussa, Molle, and Gaspersz 2021). "Exploratory" is a term that conveys the meaning of discovering, searching for, or investigating freely.

The term "exploratory" is more commonly known as "exploration," a term used in the field of geology. Geologists searching for locations where natural resources are found are typically said to be conducting exploration. Today, the term "exploratory" is also frequently used in education, particularly in mathematics instruction that adheres to constructivism. According to the constructivist perspective, learning is a process in which students construct their knowledge through reflection and abstraction (Öztürk, Akkan, and Kaplan 2020). In constructing knowledge, active cognitive structures must be continuously trained and developed through observation, activities, and structured and informal experiences.

These three activities must be carried out intentionally through challenging tasks. Learning activities place greater emphasis on the importance of building a learning community so that students have the opportunity to choose and construct their own knowledge through specific activities based on their interests and needs, ultimately leading to the integration of students' physical, emotional, social, linguistic, aesthetic, and cognitive development (Adi, Irianto, and Sukarmin 2022). A learning process grounded in constructivist theory expects teachers to establish connections between facts and concepts to encourage students to discover new understandings (Shahbari 2018). The guidance provided should elicit student responses and encourage students to analyze, interpret, and predict information (Zeynivandnezhad and Bates 2018).

Communication is a means of sharing ideas and clarifying understanding; through communication, ideas are reflected upon, refined, discussed, and modified. A key 21st-century skill students must possess is communication. Mathematical communication can take place both orally and in writing; oral communication includes explaining, describing, listening, asking questions, and collaborating (Sa'id et al. 2021). According to Sriwardhani, mathematics as a communication tool is a language that symbolizes a series of meanings from the statements intended to be conveyed; mathematical symbols are "artificial," meaning they only acquire meaning once a specific interpretation is assigned to them. In mathematics learning, when a student receives information in the form of mathematical concepts—whether presented by an instructor or obtained from reading materials—a

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

transformation of mathematical information occurs from the source to the student. Consequently, students will respond based on their interpretation of that information. A common problem is that students' responses to the information they receive do not align with expectations. This may occur because of the nature of mathematics, where students may be able to solve mathematical problems correctly but do not understand what they are actually doing.

The aspect of mathematical communication in mathematics learning related to higher-order thinking in mathematics is the ability to connect real objects, pictures, and diagrams to mathematical ideas; and to explain mathematical ideas, situations, and relationships orally or in writing. Observing mathematical activities through the context of students' daily lives using real objects, pictures, graphs, and algebra; and expressing everyday events in the language of mathematical symbols can facilitate students' mathematical communication skills (Azhari and Fajri 2021). Students' ability to listen, discuss, and write about mathematics; engage with and understand a written mathematical presentation, formulate conjectures, construct arguments, define concepts, and generalize; and explain and ask questions about the mathematics they have learned (Sosa-Moguel and Aparicio-Landa 2021).

Furthermore, students are said to possess both oral and written mathematical communication skills when they have mastered the following indicators of mathematical communication: (1) able to express mathematical ideas orally, in writing, through demonstrations, and in visual forms; (2) able to understand, interpret, and evaluate mathematical ideas presented orally, in writing, or visually; (3) able to use mathematical language, notation, and structures to present ideas, describe relationships, and create models. Thus, mathematics instruction must focus on students' ability to communicate their thoughts and ideas in understanding concepts and procedures, solving problems, or engaging in reasoning—both orally and in writing (Hidayati, Fauzan, and Hakim 2019).

Mathematics instruction that emphasizes mathematical communication—both oral and written—should be prioritized for students as a communication tool to aid in thinking, identifying patterns, solving problems, or describing and communicating various ideas clearly, accurately, and precisely (Yunianto, Indra Prahmana, and Crisan 2021).

THEORETICAL BACKGROUND

Communication is a way of sharing ideas and clarifying understanding; through communication, ideas are reflected upon, refined, discussed, and modified. Communication skills are essential for 21st-century students. Mathematical communication can take place both orally and in writing; oral communication includes explaining, describing, listening, asking questions, and collaborating (Sa'id et al. 2021). Consequently, students will respond based on their interpretation of the information. A common problem is that students' responses to the information they receive do not align with expectations. This may occur because of the nature of mathematics, where students may be able to solve math problems effectively but do not understand what they are actually doing.

The aspect of mathematical communication in mathematics learning related to higher-order thinking in mathematics is the ability to connect real objects, pictures,

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

and diagrams to mathematical ideas; and to explain mathematical ideas, situations, and relationships orally or in writing. Observing mathematical activities through the context of students' daily lives using real objects, pictures, graphs, and algebra; and expressing everyday events in the language of mathematical symbols can facilitate students' mathematical communication skills (Azhari and Fajri 2021). Students' ability to listen, discuss, and write about mathematics; engage with and understand a written mathematical presentation, formulate conjectures, construct arguments, define concepts, and generalize; explain and ask questions about the mathematics they have learned (Sosa-Moguel and Aparicio-Landa 2021).

Furthermore, students are considered to have developed both oral and written mathematical communication skills when they have mastered the following indicators of mathematical communication: (1) able to express mathematical ideas orally, in writing, through demonstrations, and in visual forms; (2) able to understand, interpret, and evaluate mathematical ideas presented orally, in writing, or in visual forms; (3) able to use mathematical language, notation, and structures to present ideas, describe relationships, and create models. Thus, mathematics instruction must focus on students' ability to communicate their thoughts and ideas in understanding concepts and procedures, solving problems, or engaging in reasoning—both orally and in writing (Hidayati, Fauzan, and Hakim 2019).

METHOD

This study used an exploratory qualitative approach for data collection to explore the oral and written mathematical communication skills of junior high school students in solving problems involving quadrilaterals. This study focuses on the oral and written mathematical communication of junior high school students regarding quadrilateral geometric shapes. The subject was selected based on indicators of students' oral and written mathematical communication skills that emerge in contextual problem-solving activities, in line with the discourse on learning mathematics through context. Oral and written communication problems were given to 25 seventh-grade students at SMP Negeri 3 Pangkalan Kuras in Pelalawan Regency, Riau Province. Qualitative research is research conducted in a natural setting with the aim of analyzing phenomena as they occur, utilizing various available methods. The type of research employed in this study is exploratory qualitative research, which is a research procedure that generates data in the form of words or spoken language from individuals and observed behaviors. The reason for using an exploratory qualitative approach is that the researcher wanted to conduct the study under natural conditions experienced by the research subjects in order to determine whether there is a relationship between the variables under study and, if so, the nature of that relationship. The data collection techniques or procedures used in this study included questionnaires, tests, and interviews.

RESULTS AND ANALYSIS

The work of 25 junior high school students revealed several similarities in their problem-solving processes. The solutions to these geometry problems—which involved both oral and written mathematical communication—were classified into

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

three categories. There were 8 students in the first category (Subject 1), 11 students in the second category (Subject 2), and 6 students in the third category (Subject 3). Next, one student was selected from each category to represent their group as a research subject. Subject 1 represents Category 1 and is referred to as S1; Subject 2 represents Category 2 and is referred to as S2; and Subject 3 represents Category 3 and is referred to as S3. The categories related to students' oral and written mathematical communication are illustrated in the following table :

Tabel 2. Indikator Komunikasi Matematis Lisan

Characteristics	Indicator
1. Presentation	Students can state the given information and the question, and explain their answers to their groupmates in their own words during class discussions.
2. Discussion	Students can explain the reasoning behind their solutions to problems and can correctly identify the given information, the question, and the notation, symbols, graphs, and tables in mathematics lessons during class discussions, and correctly state the final answer to the problem
3. Explanation	Students can provide reasons and arguments related to the problem based on the given information and the questions asked, and clearly present conclusions regarding the final solution to their group members during discussions.

Table 2 shows that, by subject category, Subject 1 students were able to provide answers during the discussion, write down what was given in the problem, formulate questions based on the problem, and explain in their own words how to correctly solve the problem within their respective groups. Category 1 accounted for 32%, Category 2 for 44%, and Category 3 for 24%. In general, oral and written mathematical communication was rated as good. This indicates that exploring mathematical learning in terms of oral and written communication is crucial in the classroom mathematics learning process. To foster oral mathematical communication skills through discussion and mathematics learning activities, it is important to provide explanations regarding the concepts involved in mathematics learning. In mathematics learning, when a student receives information in the form of mathematical concepts—whether presented by the instructor or obtained from reading materials—a transformation of mathematical information occurs from the source to the student. Consequently, the student will respond based on their

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

interpretation of that information. A common issue is that the student's response to the information received does not align with expectations. This may occur because of the nature of mathematics, where a student may be able to solve mathematical problems well but does not understand what they are actually doing. Communication in mathematics—or mathematical communication—connects real-world objects, images, and diagrams to mathematical ideas; explains mathematical ideas, situations, and relationships verbally or in writing using real-world objects, images, graphs, and algebra; expressing everyday events in the language of mathematical symbols; listening to, discussing, and writing about mathematics; engaging with a written mathematical presentation to develop understanding, forming conjectures, constructing arguments, formulating definitions and generalizations; and explaining and asking questions about the mathematics that has been studied.

Table 3. Indicators of Written Mathematical Communication

Characteristics	Indicator
1. Writing answers	Apply their ideas and thinking to solve problems by writing down the given information and the question, and correctly describing the problem-solving process in writing.
2. Drawing	Use representations—such as notation, symbols, or diagrams—to correctly solve math problems in writing.
3. Expressing ideas	Write out the solution to the problem correctly and provide a conclusion using mathematical terms and notation appropriately to present their ideas in solving the problem in writing. The final answer or solution is written using the phrase "so…"

Furthermore, students are said to possess mathematical communication skills when they have mastered the following recommended indicators: (1) the ability to express mathematical ideas orally, in writing, through demonstration, and in visual form; (2) the ability to understand, interpret, and evaluate mathematical ideas presented orally, in writing, or in visual form; (3) can use mathematical language, notation, and structures to present ideas and describe relationships through modeling (Dullas and Soliven 2021). Thus, mathematics instruction must focus on students' ability to communicate their thoughts and ideas regarding the understanding of concepts and procedures, problem-solving, or reasoning—both orally and in writing (Agussuryani et al. 2022). Mathematics learning serves as a communication tool to aid in thinking, identifying patterns, solving problems, or illustrating conclusions to convey various ideas clearly, accurately, and precisely. In mathematics instruction,

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

students must be encouraged to communicate their ideas, arguments, and explanations for their answers when solving math problems, so that they can understand the context of the problem (Ziadat and Sakarneh 2022).

Geometry Problem

1. Mr. Karto has a square plot of vacant land with a side length of 25 meters. Mr. Karto plans to build a rectangular fish pond that is 10 meters long and 5 meters wide. What is the area of Mr. Karto's remaining land? Explain your answer!

The students' answers to this problem are as follows;

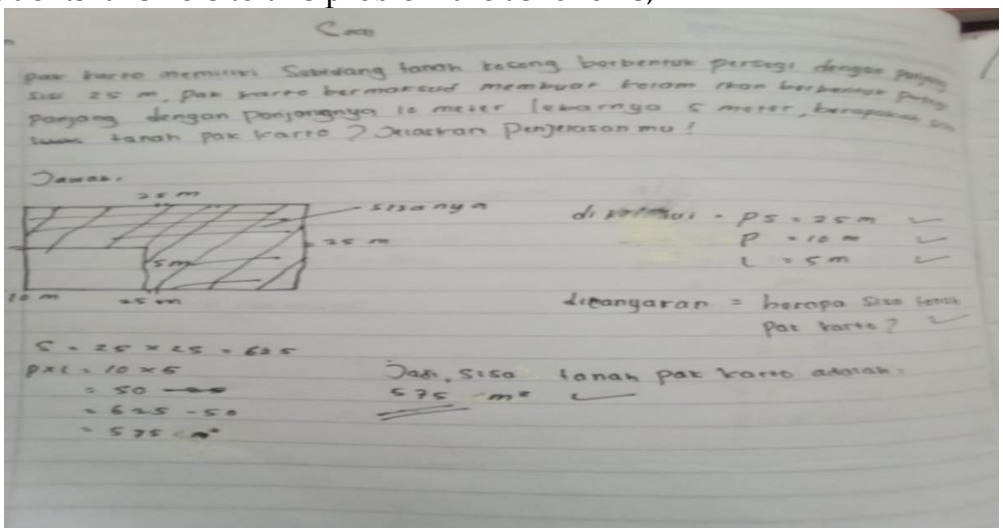


Figure 1.1. Examples of students' responses regarding written mathematical communication

The students' answers to the geometry problems were correct; for each problem, they were able to list the given information and the question asked, and illustrate the problem with their own drawings. This demonstrated that the students understood the geometry problems. Furthermore, they were able to write a conclusion in the final solution to each problem; this is important for students to understand that they have successfully found the solution to the problem they were seeking in the geometry problem. The mathematics learning process related to mathematical communication—both oral and written—needs to be emphasized so that students can solve problems in the context of their daily lives. In mathematics instruction related to plane figures, students should be given the opportunity to express their ideas and opinions in solving geometry problems using their own words. This is important for fostering students' motivation to learn and building their self-confidence, thereby improving their mathematics learning outcomes.

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

2.Soal Geometri

2. Harga sebuah dari sepotong cokelat dengan ukuran seperti yang tampak, pada gambar di bawah ini adalah Rp.12.000,00 Tentukanlah harga tiap potong cokelat yang besarnya seperti ditunjukkan pada gambar berikut

a. 

b. 

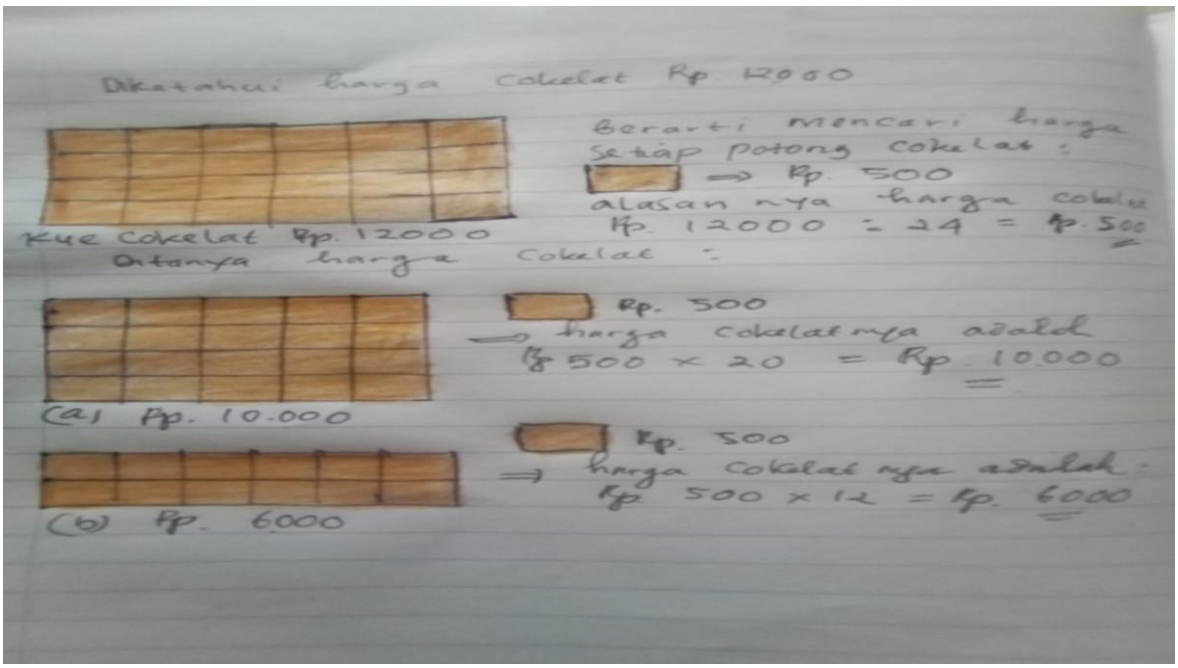
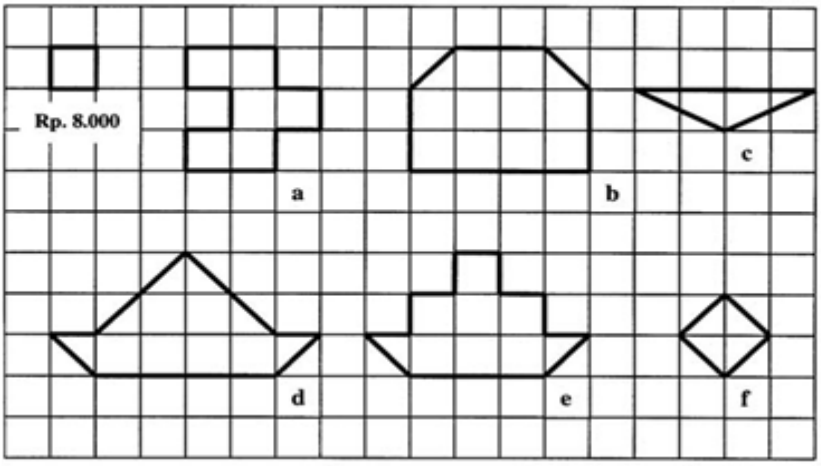


Figure 2.1. Example of a student's response regarding written mathematical communication

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

3. Geometry Problem

Below is a picture of tiles of various shapes. If a small square tile costs Rp. 8,000, determine the price of the other tiles. Explain how you arrived at each answer.



e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

Figure 2.3. A student explains a geometry problem in the context of oral mathematical communication

Regarding oral mathematical communication skills in mathematics learning, students need to articulate their reasoning and ideas in their own words when solving geometry problems. In discussion and presentation activities, as shown in Figure 2.3, students explain to their peers how to solve geometry problems, starting with the given information in the problem and what the problem is asking. They may also draw diagrams to illustrate the problem in greater detail to better understand it; subsequently, students are asked to draw conclusions based on the results of their discussion.

This is important for developing oral mathematical communication skills. When writing out their solutions to geometry problems, students are asked to provide reasons and ideas related to their answers; in this way, mathematics learning becomes meaningful..

Table 3. Results of the Oral Mathematical Communication Test Based on Interviews with Undergraduate Students

Indicators of Oral Mathematical Communication Skills	Data on Oral Mathematical Communication Test Results	Interview Results Data: Oral Mathematical Communication Skills
Presentation	Subject S1 clearly articulated what was known and what was being asked in the problem.	Subject S1 can state what is known and understand what is being asked.
Discussion	Subject S1 was able to formulate a mathematical model corresponding to the geometric problem presented.	Subject S1 explains the mathematical model in a geometry problem and is able to understand the meaning of each symbol in the answer.
Explanation	Subject S1 employed	Subject S1 is able to provide

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

	appropriate strategies in solving the problem. Furthermore, Subject S1 solved the problem in a logical, step-by-step manner with accurate calculations, resulting in a correct answer.	sound reasoning for the strategies he or she uses.

Table 4. Results of the Oral Mathematical Communication Test Based on Interviews with Master's Degree Students

Indicators of Oral Mathematical Communication Skills	Data on Oral Mathematical Communication Skills Test Results	Interview Data: Oral Mathematical Communication Skills
Presentation	Subject S2 was able to write down what was given and what was asked, although the written response regarding the given information was incomplete.	Master's students can identify what is given and what is asked in a problem.
Discussion	The subject wrote down the area of the plane figure for question 1, but for question 2, the subject did not write down the final answer	Master's students are able to understand the symbols written on the answer sheet.
Explanation	The strategies used by subject S2 were appropriate and correct.	Master's students are able to determine the method or formula used to solve a problem correctly.

Table 5. Results of the Oral Mathematical Communication Test Based on Interviews with Doctoral Students

Indicators of Oral Mathematical Communication Skills	Data on Oral Mathematical Communication Test Results	Interview Data: Oral Mathematical Communication Skills
Presentation	Subject S3 was deficient in the aspect of writing down the problem. However, the subject wrote down what they knew, although not completely.	Subject S3 realized that some information in the problem had not been written on the answer sheet.
Discussion	The subject did not write down the geometric	Subject S3 hesitated when explaining the symbols they

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

	pattern, but subject N wrote down mathematical symbols on their answer sheet.	had written and when determining the area.
Explanation	The strategy used by subject S3 was inappropriate, and the result obtained was also incorrect.	Subject S3 was not yet able to develop an appropriate strategy to solve the problem because they did not yet understand the concept of quadrilaterals.

DISCUSSION

Oral mathematical communication in mathematics learning can be observed through discussion activities and explanations of contextual problems (Parada Rico, Velasco Mèndez, and Fiallo 2023). Mathematics instruction that explores oral and written mathematical communication can be achieved through contextual problems, such as problems 1 and 2, which relate to contexts in the students' immediate surroundings that are familiar to their daily lives. Students understand the context of the oil palm plantations in Pelalawan Regency, Indonesia, specifically in Surya Indah Village, which is known for its oil palm plantations. Mathematics learning activities should include opportunities to explore oral and written mathematical communication; this can help students develop ideas and arguments regarding the importance of context-based learning (Yunianto, Indra Prahmana, and Crisan 2021).

One of the roles and responsibilities of teachers in mathematics education—both now and in the future—is to facilitate students' intellectual activities in the classroom, such as discussions and communication (Tong, Uyen, and Quoc 2021). Students must develop and possess mathematical communication skills (Öztürk, Akkan, and Kaplan 2020). The Indonesian government, through the Ministry of National Education, states that one of the general objectives of mathematics education in schools is to prepare students to use mathematics as a communication tool. Various ideas, issues, or problems can be communicated practically and systematically using the language of mathematics, presented in mathematical models such as diagrams, equations, graphs, or tables. There are two important reasons why communication in mathematics learning needs to be fostered among students. First, "mathematics as a language"—meaning that mathematics is not merely a tool to aid thinking, a means to discover patterns, solve problems, or draw conclusions, but also a valuable tool for communicating a variety of ideas clearly, precisely, and succinctly. Second, "mathematics learning as a social activity"—meaning that, as a social activity in mathematics education, mathematics also serves as a vehicle for interaction among students and for communication between teachers and students. This is an important part of nurturing children's mathematical potential.

CONCLUSIONS

Results of the exploration of students' oral and written mathematical communication skills in the topic of quadrilaterals. In general, students' oral and

written mathematical communication skills were rated as good. Mathematics instruction focused on students' oral and written mathematical communication skills should include mathematical communication problems presented both in written and oral formats. Students' mathematical communication skills—both oral and written—can help them understand mathematical concepts and expand their mathematical knowledge. Oral mathematical communication skills in mathematics instruction can be developed through exploration, contextual activities, discussion, and reflection. Meanwhile, written mathematical communication skills in mathematics instruction can be assessed through contextual problems, where students write down the given information, the question asked, and the solution to the problem, and then draw conclusions.

Oral mathematical communication in classroom mathematics instruction can take the form of group discussions, presentations, and explaining the obtained answers to peers or other groups. This provides students with the opportunity to explore ideas and concepts related to the mathematical context being studied. Motivation and guidance from the teacher will impact students' understanding of mathematical concepts and make learning mathematics truly enjoyable. Difficulties and obstacles in learning mathematics can be more effectively overcome through an enjoyable learning process, so the teacher's role in mathematics education is that of a facilitator. Mathematics learning that connects to real-world contexts is, in principle, designed to help students learn about the environment in which they live. This means that mathematics can be learned through the natural world around them (nature itself serves as a teacher), and students' potential needs to be explored through context-based mathematics learning.

REFERENCES

Adi, Banu Setyo, Djoko Pekik Irianto, and Yustinus Sukarmin. 2022. "Teachers' Perspectives in Motor Learning with Traditional Game Approach for Early Childhood." *Cakrawala Pendidikan* 41(1): 1–11.

Agussuryani, Qori et al. 2022. "STEM Literacy in Growing Vocational School Student HOTS in Science Learning : A Meta-Analysis." 11(1).

Angriani, V., Darto, and M. Zein. 2021. "The Effect of Using Group Investigation Learning Model and Prior Knowledge toward Student Problem Solving Skills on Mathematics Subject at Junior High School." *Journal of Physics: Conference Series* 1806(1).

Azhari, Budi, and Iwan Fajri. 2021. "International Journal of Mathematical Education in Distance Learning during the COVID-19 Pandemic : School Closure in Indonesia Distance Learning during the COVID-19 Pandemic : School." https://doi.org/10.1080/0020739X.2021.1875072.

Darto. 2021. "The Effect of Learning Realistic Mathematics Education (RME) Approach to Improve Students' Mathematical Communication." *Journal of Physics: Conference Series* 1776(1): 0–7.

Drijvers, P et al. 2010. "The Teacher and the Tool: Instrumental Orchestrations in the Technology-Rich Mathematics Classroom." *Educational Studies in ….* https://link.springer.com/article/10.1007/s10649-010-9254-5.

Dullas, Lany D, and Samuel R Soliven. 2021. "High School Mathematics Teachers '

Competence on the Contents of a Quantitative Research Paper." 10(4): 1202–12.

Fauzan, A, T Plomp, and K Gravemeijer. 2013. "The Development of an Rme-Based Geometry Course for Indonesian Primary Schools." *Educational design research …*. https://research.tue.nl/files/3900348/23590380570408.pdf.

Hidayat, Riyan, and Zanaton H Iksan. 2015. "The Effect of Realistic Mathematic Education on Students' Conceptual Understanding of Linear Progamming." *Creative Education* 06(22): 2438–45.

Hidayati, R, A Fauzan, and R Hakim. 2019. "Implementation of Think Talk Write (TTW) Strategy to Improve Understanding of Concept and Communication of Mathematics." *1st International Conference on …*. https://www.atlantis-press.com/proceedings/icoie-18/55912868.

Indah Nartani, C, Rosidah Aliim Hidayat, and Yohana Sumiyati. 2015. "Communication in Mathematics Contextual." *International Journal of Innovation and Research in Educational Sciences* 2(4): 2349–5219.

Kosko, Karl W., and Jesse L.M. Wilkins. 2010. "Mathematical Communication and Its Relation to the Frequency of Manipulative Use." *International Electronic Journal of Mathematics Education* 5(2): 79–90.

Maulita, S R, and A Marzuki. 2020. "Developing Mathematical Reasoning Problems Type Two-Tier Multiple Choice for Junior High School Students Based on Ethnomathematics of Jember Fashion Carnaval Developing Mathematical Reasoning Problems Type Two-Tier Multiple Choice for Junior High School S."

Nurhasanah, Rizki Ahid, St Budi Waluya, Iqbal Kharisudin, and Universitas Negeri Semarang. 2021. "Mathematical Communication Ability from The Perspective of Math Anxiety in 10 Th Grade Student." 10(2): 115–21.

Oktiningrum, Wuli, Zulkardi, and Yusuf Hartono. 2016. "Developing PISA-like Mathematics Task with Indonesia Natural and Cultural Heritage as Context to Assess Students' Mathematical Literacy." *Journal on Mathematics Education* 7(1): 1–8.

Olteanu, Lucian. 2014. "Effective Communication, Critical Aspects and Compositionality in Algebra." *International Journal of Mathematical Education in Science and Technology* 45(7): 1021–33.

Oonk, W, N Verloop, and K P E Gravemeijer. 2019. "Analyzing Student Teachers' Use of Theory in Their Reflections on Mathematics Teaching Practice." *Mathematics Education Research …*. https://link.springer.com/content/pdf/10.1007/s13394-019-00269-y.pdf.

Öztürk, Mesut, Yaşar Akkan, and Abdullah Kaplan. 2020. "Reading Comprehension, Mathematics Self-Efficacy Perception, and Mathematics Attitude as Correlates of Students' Non-Routine Mathematics Problem-Solving Skills in Turkey." *International Journal of Mathematical Education in Science and Technology* 51(7): 1042–58.

Palinussa, Anderson Leonardo, Juliana Selvina Molle, and Magy Gaspersz. 2021. "Realistic Mathematics Education: Mathematical Reasoning and Communication Skills in Rural Contexts." *International Journal of Evaluation and Research in Education* 10(2): 522–34.

Panaoura, Areti. 2012. "Computers in Human Behavior Improving Problem Solving Ability in Mathematics by Using a Mathematical Model : A Computerized

Approach." *Computers in Human Behavior* 28(6): 2291–97.

Panjaitan, Agustina Hariani, and Elmanani Simamora. 2021. "The Effect of Learning Model and Early Mathematical Ability on Mathematical Critical Thinking Skill of Students." 05(01): 36–47.

Parada Rico, Sandra Evely, Angèlica Mayerly Velasco Mèndez, and Jorge Fiallo. 2023. "Communication Skills Enabled in a Pre-Calculus Course Using Dynamic Geometry Software." *Eurasia Journal of Mathematics, Science and Technology Education* 19(3): em2235.

Prendergast, Mark et al. 2018. "International Journal of Mathematical Education in Investigating Secondary Students Beliefs about Mathematical Problem-Solving." 5211. https://doi.org/10.1080/0020739X.2018.1440325.

Sa'dijah, Cholis, Sri Rahayuningsih, Sukoriyanto Sukoriyanto, and Abd. Qohar. 2022. "Exploration on Students' Understanding Layers in Solving Arithmagon Problems." *Jurnal Cakrawala Pendidikan* 41(1): 170–85.

Sa'id, I. A. et al. 2021. "Development of Mathematics Learning Tools with Realistic Mathematics Education-Jumping Task (RME-JT) and Its Effect on the Mathematic Communication Skills." *Journal of Physics: Conference Series* 1839(1).

Sanjaya, Budi, and Wahyu Hidayat. 2022. "Student Speaking Skill Assessment : Techniques and Results." 11(4).

Sedaghatjou, Mina. 2018. "Advanced Mathematics Communication beyond Modality of Sight." *International Journal of Mathematical Education in Science and Technology* 49(1): 46–65. http://dx.doi.org/10.1080/0020739X.2017.1339132.

Sembiring, Robert K., Sutarto Hadi, and Maarten Dolk. 200AD. "Reforming Mathematics Learning in Indonesian Classrooms through RME." *ZDM - International Journal on Mathematics Education* 40(6): 927–39.

Shahbari, Juhaina Awawdeh. 2018. "Mathematics Teachers' Conceptions about Modelling Activities and Its Reflection on Their Beliefs about Mathematics." *International Journal of Mathematical Education in Science and Technology* 49(5): 721–42. https://doi.org/10.1080/0020739X.2017.1404650.

Sosa-Moguel, Landy, and Eddie Aparicio-Landa. 2021. "Secondary School Mathematics Teachers' Perceptions about Inductive Reasoning and Their Interpretation in Teaching." *Journal on Mathematics Education* 12(2): 239–56.

Teledahl, Anna. 2017. "How Young Students Communicate Their Mathematical Problem Solving in Writing." *International Journal of Mathematical Education in Science and Technology* 48(4): 555–72. http://dx.doi.org/10.1080/0020739X.2016.1256447.

Tong, Duong Huu, Bui Phuong Uyen, and Ngo Van Anh Quoc. 2021. "The Improvement of 10th Students' Mathematical Communication Skills through Learning Ellipse Topics." *Heliyon* 7(11): e08282. https://doi.org/10.1016/j.heliyon.2021.e08282.

Wijaya, Ariyadi, and Michiel Doorman. 2021. "A LEARNING TRAJECTORY FOR PROBABILITY : A CASE OF GAME-BASED LEARNING." 12(1): 1–16.

Yunianto, Wahid, Rully Charitas Indra Prahmana, and Cosette Crisan. 2021. "Indonesian Mathematics Teachers' Knowledge of Content and Students of Area and Perimeter of Rectangle." *Journal on Mathematics Education* 12(2): 223–38.

e-ISSN: 2986-8076
DOI: 10.57254/tess.v4i1.52

Zeynivandnezhad, Fereshteh, and Rachel Bates. 2018. "Explicating Mathematical Thinking in Differential Equations Using a Computer Algebra System." *International Journal of Mathematical Education in Science and Technology* 49(5): 680–704. https://doi.org/10.1080/0020739X.2017.1409368.

Ziadat, Ayed Hanna, and Mohammad Abed Sakarneh. 2022. "Academic Achievement and Self-Regulated Learning from Parent ' s Perspective of Student with Learning Difficulties." 11(3): 1028–39.