Gender Gap in Mathematical Communication: A Case Study on Area Measurement Learning in Elementary School

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Abstract. Mathematical communication plays a crucial role in helping students build concepts and establish connections between abstract ideas and mathematical symbols. This study aims to qualitatively analyze the mathematical communication skills of fourth grade elementary school students on the subject of area measurement, viewed from gender differences. This research employs a descriptive qualitative approach. The research subjects were selected using purposive sampling, consisting of 30 students (14 boys and 16 girls) at an elementary school in Bandung. Data were collected through a 5 item essay test, observation, and interviews, then analyzed using the Miles and Huberman model. The results showed that the students' mathematical communication skills were generally classified as low. Specifically, a significant difference was found based on gender: the average ability of male students was in the Low category (30.7%), while the average ability of female students was in the Medium category (51.3%). Qualitative analysis revealed that female students excelled in accuracy, written expression, and the use of notation, while both genders experienced difficulties in visual representation and reasoning. These findings imply that to bridge this gender gap, teachers must shift from procedural formula memorization to deep conceptual learning by providing gender responsive scaffolding specifically strengthening symbolic precision for male students and fostering spatial reasoning for female students.

Keywords: Area Measurement; Elementary School; Gender; Mathematical Communication Skills.

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INTRODUCTION

21st-century mathematics learning requires more than just conceptual understanding; students also need to develop the ability to communicate mathematical ideas logically, clearly, and effectively, as part of numeracy literacy, which is the main foundation of 21st-century competencies (Cajandig & Ledesma, 2025; Hermawati & Anawati, 2023; Siswantri et al., 2025). This is particularly relevant when students are faced with the challenge of solving contextual problems, formulating quantitative arguments, and explaining their reasoning. In this framework, mathematical communication skills are one of the key aspects in achieving numeracy literacy (Darmastuti et al., 2024; Hidayat et al., 2025). In the current era of rapid technological advancement and information exchange, the ability to communicate mathematical thinking is not only an academic requirement but also a life skill. Students are expected to interpret data, explain quantitative information, and make reasoned decisions in real-life contexts, all of which require strong mathematical communication skills.

Communication plays an important role in helping students develop concepts and establish connections between ideas and abstract language with mathematical symbols (Hariyani et al., 2024; Pramesti et al., 2025; Purnamasari & Afriansyah, 2021); Zaim et al., 2023). Students

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should also be allowed to present their ideas orally, in writing, or by drawing pictures or graphs (Brudny et al., 2023; Siregar & Mardiati, 2020). The development of communication is also one of the objectives of mathematics learning and one of the competency standards for graduates in the field of mathematics. Through mathematics learning, students are expected to be able to communicate ideas using symbols, tables, diagrams, or other media to clarify situations or problems (Arfany & Faradiba, 2022; Suhenda & Munandar, 2023; Zaim et al., 2023).

In general, the word communication comes from the Latin word communicatio, which means notification or exchange of ideas. So, broadly speaking, in a communication process, there must be elements of common meaning in order for an exchange of ideas and understanding to occur between the communicator (message sender) and the communicant (message receiver). Hovland in Mutiarani & Sofyan (2022) states that communication is the process of conveying words that contain certain symbols as stimuli to change a person's behavior. Examples include lectures, sermons, diplomacy, newspaper and magazine reports, radio and television broadcasts, and so on.

The indicators of mathematical communication used by researchers are those described by Sari (2017), namely 1) Expressing mathematical ideas or problems through writing; 2) Expressing mathematical ideas or problems visually in the form of graphs, diagrams, or tables; 3) Using mathematical terms, notation, and symbols in presenting mathematical ideas; 4) Interpreting mathematical ideas or problems in one's own language; 5) Drawing conclusions from mathematical statements.

Various international reports show that the mathematical literacy achievements of students in Southeast Asia, including Indonesia, are still below the global average. Elementary schools in Indonesia scored an average of around 430 out of a maximum of 650 in the Organisation for Economic Co-operation and Development (OECD) World Bank (PISA 2022) international assessment (Mone et al., 2025; Nurhidayah & Heriyana, 2023). Local research reinforces these findings by showing that mathematical communication is one of the weakest indicators in basic learning (Pagiling et al., 2021; Purwati, 2020; Sukirwan & Muhtadi, 2022).

The selection of measurement material is due to the fact that this material not only requires conceptual understanding but also the integration of conceptual knowledge and the ability to convey ideas in writing, describe situations, and explain contextual mathematical solutions. However, research by Nurhidayah & Heriyana (2023) shows that there are systemic obstacles in learning, including the types of questions that require reasoning and argumentation, which limit the space for students to develop mathematical communication. In addition, limited student-teacher interaction in mathematical discussions is a factor that hinders the stimulation of students' communication skills.

Gender related analysis in primary education is gaining attention because the characteristics, motivation, and communication strategies of male and female students are considered significant in determining children's academic and social achievements (Nurhidayah & Heriyana, 2023; Yani & Aulia, 2020). Several studies show that female students tend to excel in visualization and structured mathematical argumentation, while male students tend to be more verbally expressive. This is supported by research by Nurhajarurahmah & Arsyad (2023), which shows that female students have an advantage in mathematical reasoning and communication skills compared to male students.

However, a number of other studies show different results or indicate that gender differences are not always significant. For instance, research by Winggowati et al. (2023) on elementary school students shows that there are no significant differences between boys and girls in mathematical communication skills regarding comparison material. This inconsistency suggests that the influence of gender might be content specific and requires further investigation. Unlike previous studies that focused on general arithmetic or broad geometric concepts, this research specifically targets area measurement a unique domain where spatial reasoning and verbal communication intersect.

Furthermore, while gender differences have been explored, most studies in Indonesia predominantly employ quantitative approaches that focus solely on final learning outcomes (Hanisah & Noordyana, 2022; Nurhidayah & Heriyana, 2023). These studies often overlook the process of how students construct their mathematical understanding. Specifically, research on area measurement material remains very limited. This material is unique as it requires a complex integration of spatial reasoning and verbal communication, which is often a major stumbling block for students. Therefore, a qualitative in-depth analysis is urgently needed to reveal not just who performs better, but why and how male and female students differ in communicating their spatial-mathematical ideas in this specific context. Based on the description of mathematical communication skills and the concept of gender, the author is interested in conducting research entitled Gender Gap in Mathematical Communication: A Case Study on Area Measurement Learning in Elementary School.

METHODOLOGY

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The approach used in this study is a qualitative approach. According to Lichtman (in Suwarsono, 2016), qualitative research is a way for researchers to collect, organize, and interpret information obtained through interviews and/or observations in natural, online, or social situations. Qualitative research requires descriptive data (Subandi, 2011). Therefore, the type of research used is descriptive. According to Arikunto (in Putra, 2015), descriptive research is not intended to test specific hypotheses but only to describe a variable as it is, with the aim of providing a systematic, factual, and accurate description of the facts and characteristics of a particular population.

The subjects in this study were fourth-grade students at an elementary school in Bandung, consisting of 14 male students and 16 female students as the research sample. The research sampling technique was carried out using purposive sampling, which means that the sample was deliberately selected or based on certain considerations to become the object of a study (Sundayana, 2018). This technique was used due to the limited number of research subjects available in the vicinity of the research location.

The data collection techniques used in this study were observation and interviews. The researcher gave a mathematical communication skills test to fourth-grade elementary school students, consisting of five essay questions, to determine the students' mathematical communication skills in the subject of area measurement from a gender perspective. The researcher also documented the results by taking photos of the students' work and photos of the mathematical communication skills test being conducted at the research site. After completing the questions, all research subjects conducted interviews. The students who were interviewed were given various questions to explore data aimed at clarifying the analysis of the answers, namely by trying to look back at the students' mathematical communication skills when completing the test through the statements expressed by the students during the interview.

The research instrument used in this study was a test sheet assessing mathematical communication skills. The questions in this instrument were designed to determine students' mathematical communication skills in the subject of area measurement, viewed from the perspective of gender. Meanwhile, qualitative data analysis is the interpretation of concepts from all available data using analytical strategies that aim to convert or translate raw data into descriptions and explanations of the phenomena being researched and studied (Junaid, 2016). Miles and Huberman (1992:20) describe the process of qualitative research data analysis as follows:

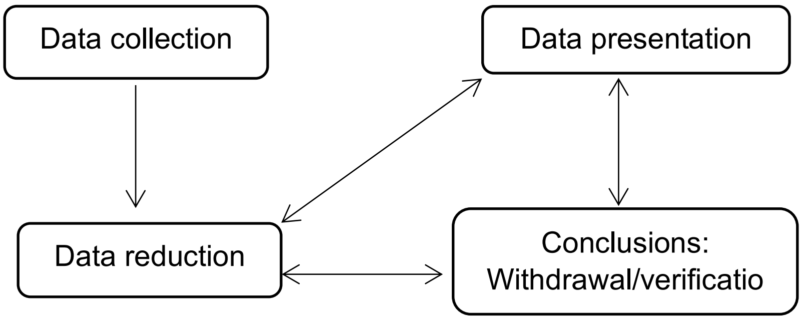

Figure 1. Data Analysis Techniques

Data Reduction: This stage involved selecting, focusing, and simplifying raw data obtained from the field. For Written Tests: Reduction was carried out by assessing the answer sheets of 30 students, assigning raw scores based on mathematical communication skills rubrics, and converting them into percentage scores. The data were then reduced by categorizing students into high, medium, and low ability groups, and segregating data by gender to identify specific response patterns. For Interviews: Reduction involved transcribing recordings from selected subjects. The researcher selected student statements relevant to the five indicators of mathematical communication (such as reasons for symbol errors or students' reasoning processes). Irrelevant or repetitive information was discarded to sharpen the focus on students' epistemological obstacles.

Data Display: Reduced data were presented in the form of descriptive statistical tables to provide a general overview. Subsequently, qualitative data were displayed as narrative text supported by visual evidence (photos of student work) and direct interview excerpts to deeply describe the profile of mathematical communication skills.

Conclusion Drawing/Verification: Conclusions were drawn by identifying patterns between written test results and interviews, as well as comparing findings across genders. Preliminary conclusions were re-verified against raw data to ensure the validity of the findings before finalizing the conclusion. this study, the categories of students' mathematical communication skills according to Sumarmo (in Wijayanto et a., 2018) are:

Table 1. Categories of Mathematical Communication Skills

Achievement of Mathematical Communication Skills	*x*	Category
X ≤ 33 %	0 - 6	Low
X > 33 %	7 - 13	Medium

X > 66 %	14 - 20	High

Sumarmo (in Wijayanto et a., 2018)

RESULTS AND DISCUSSION

RESULTS

From the research and analysis that has been conducted, the results show the mathematical communication skills of male and female students individually, as well as the mathematical communication skills of male and female students as a whole. Below is an overview of the research results presented in tabular form, while a complete explanation will be described in the following discussion.

Table 2. Individual analysis of the mathematical communication skills of male students

Subject	Total Score	Max Score	Percentage	Category
S-L1	6	20	30%	Low
S-L2	7	20	35%	Medium
S-L3	5	20	25%	Low
S-L4	6	20	30%	Low
S-L5	8	20	40%	Medium
S-L6	4	20	20%	Low
S-L7	7	20	35%	Medium
S-L8	6	20	30%	Low
S-L9	5	20	25%	Low
S-L10	7	20	35%	Medium
S-L11	6	20	30%	Low
S-L12	6	20	30%	Low
S-L13	5	20	25%	Low
S-L14	8	20	40%	Medium
Total	**86**	**280**	**30.7%**	**Low**

Based on the data in Table 2, it is evident that the mathematical communication skills of male students tend to be heterogeneous but are dominated by unsatisfactory achievements. Out of a total of 14 male students, 10 students (71.4%) fall into the Low category with score percentages below 33%, while only 4 students (28.6%) managed to reach the Medium category. Notably, no male student achieved the High category. The lowest score was obtained by subject S-L6 with a percentage of 20%, while the highest score only reached 40%, achieved by subjects S-L5 and S-L14. Cumulatively, the average mathematical communication ability of the male student group stands at 30.7%, indicating that the majority of male students experience significant obstacles in communicating their mathematical ideas regarding area measurement, particularly in written aspects.

Table 3. Individual analysis of female students' mathematical communication skills

Subject	Total Score	Max Score	Percentage	Category
S-P1	10	20	50	Medium
S-P2	11	20	55	Medium
S-P3	9	20	45	Medium
S-P4	12	20	60	Medium
S-P5	8	20	40	Medium
S-P6	10	20	50	Medium
S-P7	11	20	55	Medium
S-P8	13	20	65	Medium
S-P9	9	20	45	Medium
S-P10	10	20	50	Medium
S-P11	12	20	60	Medium
S-P12	8	20	40	Medium
S-P13	11	20	55	Medium
S-P14	9	20	45	Medium
S-P15	10	20	50	Medium
S-P16	11	20	55	Medium
Total	**164**	**280**	**51.3%**	**Medium**

In contrast, the data presented in Table 3 reveals a more consistent and stable ability profile within the female student group. Unlike the male group, all female students (16 students) are evenly distributed within the 'Medium' category, with score percentages ranging from 40% to 65%. The highest achievement was attained by subject S-P8 with a score of 13 (65%), which nearly touches the threshold for the high category. Meanwhile, the lowest score in this group was 40% (obtained by S-P5 and S-P12); interestingly, the lowest female score is equivalent to the highest score achieved by the male group. Overall, the average mathematical communication skill of female students was recorded at 51.3%, demonstrating better mastery in accuracy and idea delivery compared to their male counterparts.

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Based on the results of data analysis, the difference in mathematical communication skills between male and female students can be clearly seen in Figure 2. The diagram shows that the average ability of male students is 30.7%, which places them in the Low category. In contrast, female students show superior achievement with an average score of 51.3%, which falls into the Medium category. This visualization confirms that there's a significant achievement gap between the two genders, where female students have better mathematical communication performance than male students in this area of measurement.

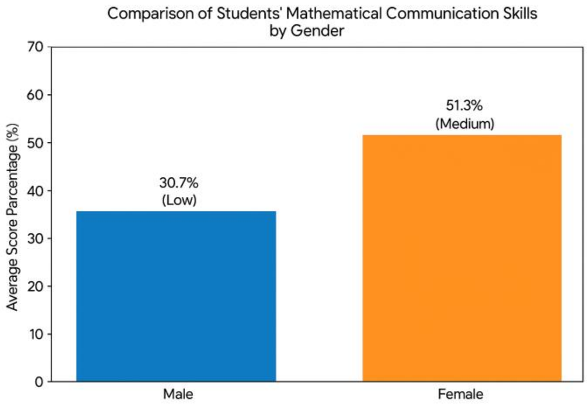
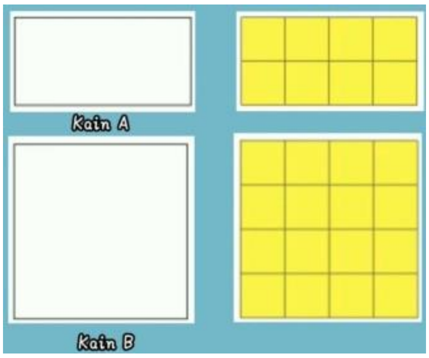


Figure 2. Comparison of Students' Average Mathematical Communication Skills Based on Gender

Based on the analysis of written test and interview data, it was found that students' mathematical communication skills were generally in the Low and Moderate categories. The data from the written test and interview observations will be discussed in depth for one research subject representing the Low category, namely S-L1 (Male Student 1). The description of S-L1's results based on the 5 test questions is as follows:

Question (1): Look at the following picture!



There are fabrics A and B used to filter square shaped tofu of the same size. Based on the picture, determine: a. How do you calculate the area of fabric A and fabric B using square shaped tofu? b. Which fabric has a larger area, fabric A or fabric B? Explain your reasoning!

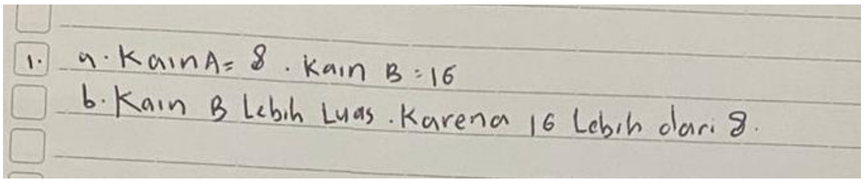

1. a. Kain A = 8 . kain B = 16
b. Kain B Lebih Luas . Karena 16 Lebih dari 8.

Figure 3. Question 1

a. Fabric A = 8. Fabric B = 16.

b. Fabric B is larger. Because 16 is greater than 8.

Solution:

Based on Figure 3, in question (a), S-L1 did not explain how to calculate the area as requested. The subject directly gave the final answer (8 and 16) without explaining the process (for example: counting all the squares or counting the sides and bottom and then multiplying). In question (b), the subject was able to determine the correct answer (Fabric B), but the reason given (Because 16 is more than 8) was very minimal and did not provide a complete explanation, even though the answer was technically correct. During the interview, S-L1 made the following statement:

P: In question 1a, you were asked to explain how. Why did you just write the numbers 8 and 16 in your answer?

S-L1: I counted the boxes, ma'am. There are 8 in A and 16 in B.

P: Did you just count them one by one? Was there no other way?

S-L1: No, ma'am, I just counted them all.

P: Then in question 1b, your reason was because 16 is more than 8. Can you explain more clearly?

S-L1: Yes... fabric B has 16 squares, so it is larger than fabric A, which has 8 squares.

Based on the written answers and interview results, S-L1 can calculate but fails to communicate the process (question 1a indicator). S-L1's explanation is very ineffective and inaccurate in answering the instructions.

Question (2): Consider the following statement! A notebook is rectangular in shape, with a length of 20 cm and a width of 15 cm. a. Write down the definition of area. b. Explain how you calculate the area using standard and non-standard units, then state the result.

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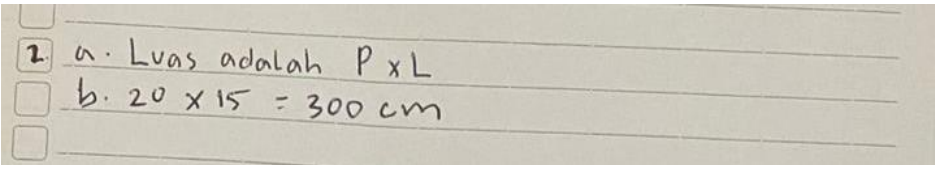

Figure 4. Question 2

a. Area is L x W.

b. 20 x 15 = 300 cm.

Solution:

In Figure 4, S-L1 shows a fundamental conceptual error. In question (a), the subject defines “area” as the area formula (L x W), rather than as a concept (the size of a surface). In question (b), the subject was able to perform the calculation using standard units (20 x 15 = 300), but made a mistake in writing the symbol, namely 300 cm when it should have been 300 cm2. The subject also completely ignored the instruction to explain the calculation using non-standard units. During the interview, S-L1 made the following statements:

P: Question 2a asks about the ‘definition of area’. Why did you write the formula?

S-L1: Area is length times width, ma'am.

P: That's the formula. But what is area?

S-L1: (Silence)... I don't know, ma'am.

P: In question 2b, you were asked to calculate using standard and non-standard units. Your answer is 300 cm. Where is the non-standard unit?

S-L1: I don't understand what you mean by non-standard unit, ma'am.

P: Your answer is 300 cm, are you sure the unit is cm?

S-L1: Yes, ma'am, because the question is in cm. Oh... there should be a square, right, ma'am? I forgot.

From the above discussion, it is concluded that S-L1 is in the low category for this indicator. S-L1 is unable to explain the concept of area and is very careless in using symbols (units).

Question (3): A student estimates that the area of the blackboard is 50 sheets of HVS paper. After measuring, the blackboard is 200 cm x 100 cm. The size of one sheet of HVS paper is 20 cm x 25 cm. Is the student's estimate close to the correct answer? Explain your reasoning!

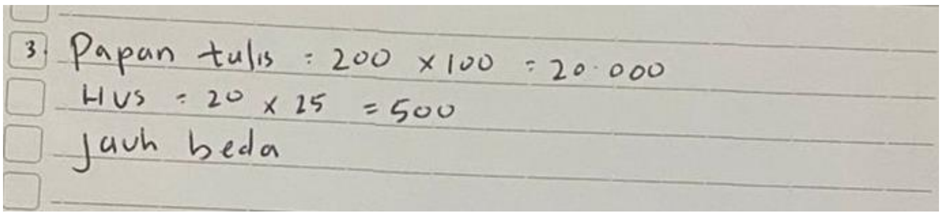

Figure 5. Question 3

Blackboard = 200 x 100 = 20,000

HVS = 20 x 25 = 500 Far off.

Solution:

Based on Figure 5, S-L1 can identify the correct steps (calculating the area of the blackboard and the area of the HVS paper). The subject successfully calculated both areas correctly (20,000 and 500). However, the subject failed to proceed to the next step (dividing 20,000 by 500) to find the actual number of HVS sheets (40 sheets). The subject immediately drew the conclusion Far away by comparing 500 (area of HVS) with 50 (estimate), which shows a failure to understand the problem. During the interview, S-L1 made the following statement:

T: You calculated the area of the blackboard as 20,000 and the area of the HVS as 500. That is correct. Then your conclusion was Far. What did you mean by that?

S-L1: The HVS is 500, but the estimate is 50. Far.

T: What is 500 in relation to the HVS?

S-L1: The area.

T: What is the estimated 50 in relation to?

S-L1: (Silence)... The number of sheets, ma'am?

T: Yes. What should be done with 20,000 and 500?

S-L1: Oh... divide them? I didn't think of that.

From this analysis, it can be concluded that S-L1 failed to construct a mathematical argument. Although the calculation was accurate, the explanation was ineffective because the subject failed to connect the data to answer the question.

Question (4): Danu estimated the area of the field to be 400 steps, with 1 step = 1 m2. After measuring with a tape measure, the results are 40 m long and 10 m wide. Is Danu's estimate close to the actual measurement results? Explain your reasoning with simple calculations.

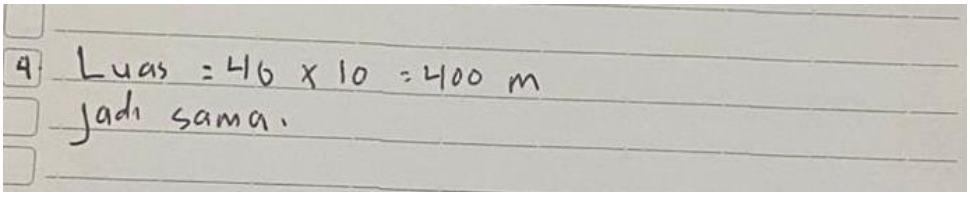

Figure 6. Question 4

Area = 40 x 10 = 400 m.

So it's the same.

Solution :

In Figure 6, S-L1 was able to perform simple calculations using standard units (40 x 10 = 400). The subject also successfully compared it with the estimate (400 steps) and drew the correct

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conclusion (So it's the same). However, the explanation of the reasoning is very brief and does not explicitly state the unit (400 m²) in the calculation result, even though this is the question that S-L1 performed best on. During the interview, S-L1 made the following statement:

P: Your answer is So it's the same.What does that mean?

S-L1: The area is 400 meters, and the steps are also 400. So it's the same.

P: So what about Danu's estimate?

S-L1: It's correct, ma'am. It's close.

From the above description, S-L1 can construct a simple argument. The subject uses mathematical language somewhat effectively to explain the conclusion.

Question (5): Consider the following statement! There are two ways to measure the area of a classroom floor with tiles: The first way is to count the tiles one by one. The second way is to count the number of tiles on the long side and the short side, then multiply them. 30 Write: a. Which method do you think is more efficient? b. Your reason for choosing that method. c. How you would explain your opinion clearly.

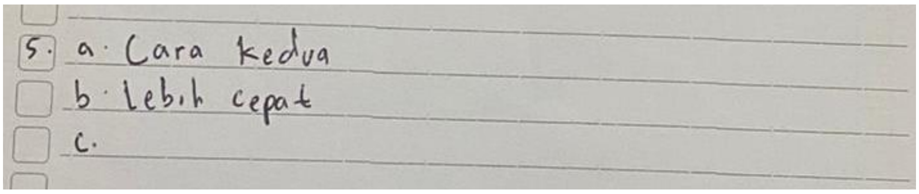

Figure 7. Question 5

a. The second method.

b. It is faster.

c. (Blank)

Solution:

In Figure 7, S-L1 was able to choose the correct strategy (the second method). The reason given in (b) (It is faster) is also correct, although it is very brief. However, the subject completely failed on question (c), where actual mathematical communication skills are tested. The subject was unable to provide an example or personal explanation (such as If the length is 10 tiles and the width is 8 tiles, 10 x 8 = 80. That's faster than counting 80 tiles one by one). During the interview, S-L1 made the following statement:

T: You chose the second method because it is faster. That is correct. Why did you leave part (c) blank?

S-L1: I was confused about how to explain it.

T: Try to explain it to me now. Why is L x W more efficient?

S-L1: Well... you just multiply. If you count them one by one, it takes a long time and is tiring.

P: Is that all?

S-L1: Yes, ma'am.

From the above description, S-L1 is in the low category for this indicator. The subject can choose answers but cannot participate in mathematical discussions by providing adequate explanations or justifications.

Based on the analysis of these five questions, it can be concluded that S-L1's mathematical communication skills are consistently in the low category. The subject demonstrated proficiency in basic procedural calculations (multiplication), but failed significantly in core communication aspects, such as explaining processes, defining concepts, constructing arguments, and providing written justifications.

Discussion

The results of this study show alarming findings: the mathematical communication skills of both male and female students are generally still at a suboptimal level, with achievements classified as low and moderate. These low skills indicate that students are still focused on memorizing formulas rather than conceptual understanding. In the subject of area measurement, students are not only required to calculate (P X L), but also to be able to communicate their understanding of the conceptual meaning of area it self. These findings are in line with broader research that identifies that students' mathematical communication skills are generally still low, often because learning still focuses on procedural computation and lacks training in Higher-Order Thinking Skills (HOTS), of which communication is an essential part (Kholidah & Qohar, 2020; Rachmawati et al., 2021).

In addition, this condition also reflects that classroom learning practices have not yet fully integrated activities that encourage students to explain, argue, and represent mathematical ideas in multiple forms. Teachers tend to emphasize correct final answers rather than the processes of thinking and communicating reasoning. As a result, students are less accustomed to articulating their understanding, both orally and in written form, which ultimately weakens their mathematical communication skills.

The most striking differences between the moderate (female) and low (male) categories were seen in indicators (1) expressing ideas through writing and (3) using terms, notation, and symbols. Female students demonstrate slightly better mathematical communication skills, which can be attributed to their superiority in terms of accuracy and verbal expression.

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Qualitative analysis shows that male students make more minor mistakes, such as incorrectly writing units of area (e.g., cm instead of cm2) or neglecting to use the correct mathematical notation.

This finding also suggests that accuracy in mathematical communication is closely related to students' attention to detail and their familiarity with formal mathematical conventions. Students who are rarely trained to write complete solutions—including units, symbols, and explanations tend to overlook these important aspects, even when they understand the basic concept.

However, a novel finding of this study is the specific identification of the cognitive block faced by male students in the context of area measurement. Unlike previous studies which generally state that boys are less careful, this study specifically found that male students struggle with the visual to symbolic translation. While they could grasp the visual concept (counting squares), they failed to abstract this spatial understanding into precise symbolic representation (formulas and units). This specific insight contributes to the existing body of knowledge by highlighting that for male students, the main barrier in area measurement is not calculation logic, but the rigorous translation of spatial models into written mathematical symbols.

This indicates the need for instructional strategies that explicitly bridge visual representations and symbolic forms, such as using guided questioning, scaffolding, and step-by-step modeling. By consistently connecting visual models (e.g., grids) with mathematical symbols and language, students can gradually develop stronger representational fluency.

This is consistent with studies finding that female students tend to be more meticulous and systematic in presenting written answers (Awaliyah et al., 2022; Brudny et al., 2023; Satriani et al., 2025). In addition, recent meta-analyses also note a small but consistent advantage for girls in verbal abilities, which are crucial for written expression in mathematics (Adilia et al., 2025; Naja et al., 2021; Setiawati et al., 2024).

Nevertheless, it is important to emphasize that these differences are not deterministic, but rather influenced by learning experiences and classroom environments. With appropriate instructional support, both male and female students can develop equally strong mathematical communication skills.

The challenges faced by both genders are clearly evident in indicators (2) expressing ideas visually (diagrams/tables) and (4) interpreting ideas in their own words. In the area measurement material, this means that students have difficulty translating picture stories into representative grid models, or conversely, difficulty explaining the meaning of a rectangular area image using their own words. Students can calculate 5 x 4 = 20, but they fail to interpret that ‘20’ means there are 20 square units covering the surface. Failure to translate between modes of representation (from visual to verbal/symbolic) is a core obstacle in mathematics learning and problem solving in elementary school (Jitendra & Woodward, 2019).

This limitation suggests that students’ representational competence is still underdeveloped. Effective mathematics learning should involve multiple representations visual, symbolic, and verbal and explicitly guide students to move flexibly between them. Without this ability, students’ understanding remains fragmented and procedural.

Furthermore, the low achievement on indicator (5) drawing conclusions from mathematical statements is the most concerning, as this is purely in the realm of Higher-Order Thinking Skills (HOTS). In the context of area measurement, students were able to calculate the area of two different rooms, but they failed when asked to draw conclusions about which room was larger and justify those conclusions. This shows that learning in grade 4 has not yet reached the stage of analysis or evaluation. This low ability reflects the students' lack of exposure to non-routine problems that encourage justification and reasoning, which are the foundations of mathematical communication (Putra et al., 2022).

This finding reinforces the importance of incorporating HOTS-oriented tasks into daily instruction. Students need to be regularly exposed to open-ended problems, reasoning-based questions, and opportunities to justify their answers. Such practices can gradually foster critical thinking and strengthen their ability to communicate mathematical ideas meaningfully.

Overall, the findings that students' mathematical communication skills in area measurement are not yet optimal indicate that the low level of students' mathematical communication skills in area measurement is not a gender issue, but rather a teaching method issue. Learning in 4th grade still focuses on formulas (procedural) and neglects meaning (conceptual). Students are not trained to communicate their ideas. This should serve as a reminder that memorizing formulas is not the same as understanding. True understanding is reflected in students' ability to communicate.

Therefore, future instructional practices should shift toward student-centered learning approaches that emphasize discussion, explanation, and reflection. Teachers are encouraged

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to create a classroom environment where students feel confident expressing their ideas, making mistakes, and learning through communication. By doing so, mathematical communication skills can be developed as an integral part of conceptual understanding, not merely as an additional competency.

CONCLUSION

Based on the description and analysis of the research results, it is concluded that the mathematical communication skills of fourth-grade students on the subject of area measurement are generally low. These findings can be further detailed based on gender differences: male students (N=14) obtained an average percentage of 31.8% (Low category), while female students (N=16) obtained an average percentage of 50% (Moderate category). Thus, there is a disparity in ability, with female students performing better than male students.

In light of these findings, it is recommended that teachers shift their focus from purely procedural learning (memorizing formulas) to deep conceptual understanding. Practically, teachers need to explicitly emphasize the cognitive transition from visual representations (such as using grid papers or concrete models) to symbolic abstractions (formulas). This scaffolding is crucial to prevent students, particularly male students, from becoming trapped in rote calculation without grasping the underlying spatial concepts. Furthermore, gender responsive interventions are suggested: teachers should provide targeted guidance for male students to improve their accuracy in written mathematical expression (units and symbols), while simultaneously challenging female students with open-ended problems to strengthen their reasoning skills. For future researchers, it is recommended to conduct experimental research to test the effectiveness of specific learning models in improving these communication skills.

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