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The 5th International Conference on Mathematics and Science Education (ICoMSE) 2021

Science and Mathematics Education Research: Current Challenges and Opportunities

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Editors • Habiddin Habiddin and Nani Farida

ICoMSE 2021

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Preface: The 5th International Conference on Mathematics and Science Education (ICoMSE) 2021

ICoMSE has been held annually by the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia, since 2017. The conference has proven to be worth considering since its first event was evinced by the high number of participants from several countries, successful, engaging event, and numerous articles published in its proceedings after two-step blind review.

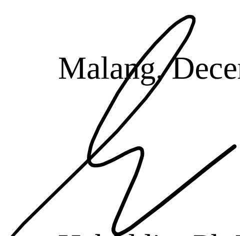
This year, the 5th ICoMSE's theme of "Science and Mathematics Education Research: Current Challenges and Opportunities" was held virtually due to the high spreading of COVID-19. Nonetheless, the enthusiasm of the researchers and academicians to contribute never recedes. 287 talks in six fields (Biology Education, Chemistry Education, Mathematics Education, Physics Education, Science Education & educational technology, and Science) have been delivered in this conference creating interesting discussion which accommodated them to share their experiences, offer their insights, point the challenges up, and suggest new solutions in the fields. Amongst those hundreds of abstracts submitted to the committee, 151 qualified papers were accepted to publish in this proceeding. We do hope that the ideas shared in this proceeding will stimulate the dissemination of valuable knowledge in the relevant area.

For this success, please allow me to thank all the participants for putting their best ideas into this conference and the committees for their hard work. In particular, I would like to express my highest appreciation and gratitude to the keynote speakers:

- Professor Vicente A Talanquer, Ph.D from University of Arizona, USA
- Professor Dr. Mustafa Sozbilir from Atatürk University, Turkey
- Professor Dr. Zaidatun binti Tasir from Universiti Teknologi Malaysia, Malaysia
- Dr. Marianne Achiam, M.Sc. from University of Copenhagen, Denmark
- Dr. Sentot Kusairi, S.Pd., M.Si. from Universitas Negeri Malang, Indonesia
- Dr. I Gusti Darmawan, M.Sc. from Adelaide University, Australia.

I believe that this conference will catalyze sharing experiences and knowledge in mathematics and science education and build networking between academicians, practitioners, and researchers. This conference has been a chance to promote and share our research results and valuable ideas so everyone who shares common interests can discuss and even adopt them.

Malang, December 2021



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Profile of mathematical communication skills of prospective mathematics teachers

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Profile of Mathematical Communication Skills of Prospective Mathematics Teachers

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Abstract. Mathematical communication ability is an important ability for prospective mathematics teacher students to have. The purpose of this study was to describe the profile of mathematical communication skills of prospective mathematics teachers when working on high school problems on derivatives and integrals, trigonometry, and geometry topics. This type of research is qualitative descriptive research. The subjects of this study were 36 prospective mathematics teacher students who took a high school mathematics learning design course at the mathematics education study program at Sanata Dharma University, Yogyakarta. The data collection technique is using a mathematical communication ability test. The test result data was analyzed by adding up the student scores and determining the category, besides that the percentage of each indicator of mathematical communication ability was also analyzed. The qualitative data analysis process is done according to Miles & Huberman's analysis techniques namely data reduction, data display, and drawing conclusion. The results showed that the average student communication ability was 47.82 in the moderate category. There are 94% of students in the moderate category and 16% in the low category. The average achievement of mathematical communication indicators is 49.19%, in the moderate category. The best indicator is "use math language to express mathematical ideas appropriately" with 66.67% achievement, while the indicator that needs to be improved is "organizing and consolidating mathematical thinking through communication" with 31.94% achievement.

INTRODUCTION

The main purpose of education is to give birth to a competent generation through various academic activities to be able to compete in the future. One of the subjects taught at every level of education in mathematics. It shows the importance of mathematics in the development of quality human resources. National Council of Teachers of Mathematics (1), stated that the process skills that must be mastered by learners through mathematics learning are problem-solving, communication skills, connection skills, reasoning skills, and representation skills. Through mathematics learning can train the ability of participants in logical, systematic, creative, critical, rational, and meticulous (2).

Mathematics is not only oriented about numbers, but also understands a problem in determining its solution and draws conclusions by thinking logically and systematically, critically, and creatively. In line with the nature and development of the times that have reached the 21st century, learners are required to master 6 competencies (6C) or also referred to as ability 21st century, as described by Miller and Fulan (3). Ability consists of critical thinking, collaboration, communication, creativity, citizenship/ culture, and character education/connectivity (3).

Based on the description above, it appears that one of the abilities that must be mastered by students based on NCTM and 21st century capabilities is communication skills. Mathematical communication skills become an important thing and must be possessed by learners. According to Zahri (4), mathematical communication can be interpreted as the process of delivering messages containing mathematical content. Mathematical communication skills are the ability to use mathematical ideas in solving mathematical problems orally and in writing. Mathematical forms are of communication orally such as discussing and explaining, while communication mathematics in writing such as

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expressing mathematical ideas through images or graphs, tables, equations, or in their language.

Based on interviews conducted with several lecturers of the mathematics education study program in Sanata Dharma University, students' mathematical communication skills still need to be developed. In written communication, most students cannot write answers coherently and correctly when working on mathematical problem solving problems. In oral communication, some students have difficulty expressing ideas during group discussions or class discussions. Students have ideas, but do not dare to express them, or sometimes express ideas but in language that is rather difficult to understand. Thus students' mathematical communication skills need to be improved.

Based on principles and standards for school mathematics (1) presents mathematical communication standards in students in terms of 1) Organizing and consolidating mathematical thinking through communication,2) Expressing mathematical ideas coherently and clearly to other students, teachers, and others,3) Analyzing or evaluating mathematics and mathematics Strategies of others, 4) Use mathematical language to express mathematical ideas appropriately. A teacher's ability to communicate mathematically can influence students' learning activities. This was demonstrated by research from Astuti &Leonard (5). The higher the mathematical communication skills of learners, the higher the achievement of learning mathematics learners. In addition, the teacher's ability to convey information mathematically will affect the understanding of learners. If a teacher has low mathematical communication skills then the learner will find it difficult to understand the material delivered by the educator. Thus, in carrying out its duties, a math teacher is required to be able to convey a message in the form of concepts or ways of solving mathematical problems related to certain theories and problems in daily life so that the message conveyed can be understood by students. Communication is the best means of establishing relationships between teachers and students in the classroom. Thus, communication skills must be possessed by the math teacher for the learners to understand the material delivered.

Based on the exposure, researchers are interested in describing “Profile of Mathematical Communication Skills of Prospective Mathematics Teachers on Derivatives and Integrals, Trigonometry, and Geometry Topics”.

METHOD

The type of research conducted is qualitative descriptive research. This research was conducted online on June 8, 2021. The subjects in this study were 36 students of the Mathematics Education Study Program of Sanata Dharma University class of 2018. The sampling technique used is purposive sampling. In this technique, the selection of samples is based on specific purposes such as which subjects provide information that is rich, most interesting, or considered to have the information that researchers expect (6-8). The research subject was chosen because the subject is studying High School Mathematics’ Learning Design courses and this course is relevant to the topic to be studied, namely mathematical communication skills to solve math problems at the high school level.

The data collection technique used in this study is mathematical communication test. According to Arikunto (9) the subjective test is a test in the form of essays and requires answers in the form of descriptions of words. The main instrument in this researcher is the researcher himself. This is by qualitative research characteristics expressed by Merriam (10) and Fraenkel &Wallen (6). In addition to researchers as the main instrument, this study also used supporting instruments in the form of test questions to help the data retrieval process. The test consists of 3 question points used to measure the subject's mathematical communication skills on the topic of derivative and integral, trigonometry, and geometry. Each question item is organized based on NCTM mathematical communication capability indicators. The test questions used in this study were validated by 2 lecturers of the Mathematics Education Study Program.

The data obtained from the test results will be analyzed qualitatively and quantitatively. The qualitative data analysis process is done according to Miles & Huberman's analysis techniques. There are at least 3 procedures that must be done, namely data reduction (data reduction), presentation of data (data display), and conclusion drawing/ verification. In this technique, researchers also need to focus on things that are considered foreign and do not yet have a pattern (11). The quantitative data analysis process is carried out using mathematical communication ability indicators namely:1) Organizing and consolidating mathematical thinking through communication;2) Expressing mathematical ideas as coherent and clear to other students, teachers, and others;3) Analyzing or evaluating other people's mathematical thoughts and strategies; and 4) Using mathematical language to mathematical ideas appropriately (1).

In order to classified subject’s communication skill, in this research we’ll use Azwar’s data categorization (12-14) which is presented in Table 1.

TABLE 1. Score Categorize

Criteria	Students' Mark	Mathematical Communication Indicators (%)	Category
$X \leq \mu + \sigma$	$X \leq 66{,}67$	$X \leq 66{,}67$	High
$\mu - \sigma \leq X < \mu + \sigma$	$33{,}33 \leq X < 66{,}67$	$33{,}33 \leq X < 66{,}67$	Moderate
$X < \mu - \sigma$	$X < 33{,}33$	$X < 33{,}33$	Low

RESULT AND DISCUSSION

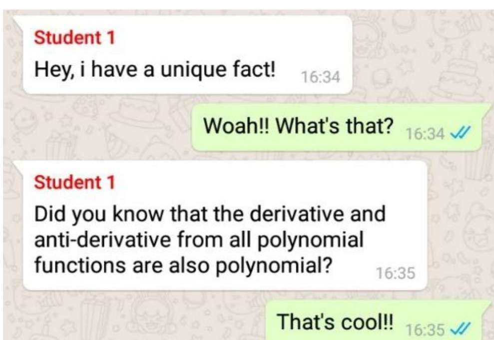
As previously presented, the test questions used are prepared based on mathematical communication capability indicators. Details of the corresponding indicators and question items can be observed in Table 2. Furthermore, a detailed description of the question used can be observed in Table 2.

TABLE 2. Details of Mathematical Communication Indicators of each Problem Item

Item Number Problem	Mathematical Communication Indicators
1	Organizing and consolidating mathematical thinking through communication; Analyze or evaluate the mathematical thinking and strategies of others
2	Express math ideas coherently and clearly to other students, teachers, and others; Analyze or evaluate the mathematical thinking and strategies of others
3	Express math ideas coherently and clearly to other students, teachers, and others; Use math language to express mathematical ideas appropriately

Table 3 is a list of questions given to students.

TABLE 3. Problem Description

<table>
<tr><th>Item Number Problem</th><th>Problem Description</th></tr>
<tr><td>1</td><td>Take a look at the following dialog!


Do you agree with Student 1's opinion? Give me your reasons!</td></tr>
<tr><td>2</td><td>Lee Min Ho and Song Jong Ki are observing the top of a building. They have two opinions:
<table>
<tr><td>Opinions of Lee Min Ho</td><td>Song Jong Ki's Opinion</td></tr>
<tr><td>If Lee Min Ho's distance to the building becomes twice as far as his original position, his elevation angle will be twice as small, vice versa.</td><td>If Song Jong Ki's distance to the building changes, then the angle of elevation will surely always change.</td></tr>
</table>
Do you think Lee Min Ho and Song Jong Ki's opinion is correct? Explain your reasons!
Description: vice versa = and vice versa</td></tr>
<tr><td>3</td><td>A craftsman would make a can of crackers made of metal plates consisting of sized beams and tubes $25\ cm \times 25\ cm \times 30\ cm$ as the lid was the size of a radius and $7\ cm$height. $4\ cm$ The can will be glassed on one side of the sized salah. $20\ cm \times 25\ cm$
Illustrate the problem in the form of an image.
Based on illustration a, calculate how wide a metal plate is needed to make 1 can of crackers.
If you're given a rectangular-sized metal plate, $100\ cm \times 42\ cm$ is it enough and how do you cut out parts of the cracker can on the metal plate? Draw the sketch.</td></tr>
</table>

Table 4 are the results of the student's mathematical communication ability test.

TABLE 4. The Results of the Student's Mathematical Communication Ability

student	No 1 (calculus)		No 2 (trigonometry)		No 3 (geometry)		Score total	Mark	Category
	Indicator1	Indicator3	Indicator2	Indicator3	Indicator2	Indicator4			
	max score 3								
s1	1	3	2	1	1	2	10	55.56	Moderate
s2	2	3	1	1	1	2	10	55.56	Moderate
s3	1	3	2	1	0.5	2	9.5	52.78	Moderate
s4	0	0	0	0	2.5	2	4.5	25.00	Low
s5	1	1	1	1	0.5	2	6.5	36.11	Moderate
s6	2	3	1	1	1	2	10	55.56	Moderate
s7	0.5	2	2	1	2	2	9.5	52.78	Moderate
s8	0.5	1	2	1	1	2	7.5	41.67	Moderate
s9	0.5	2	1	1	0.5	2	7	38.89	Moderate
s10	0.5	0.5	2	1	2.5	2	8.5	47.22	Moderate
s11	0.5	0.5	1	1	1.5	2	6.5	36.11	Moderate
s12	1	3	2	1	1.5	2	10.5	58.33	Moderate
s13	1	3	1	1	1.5	2	9.5	52.78	Moderate
s14	1	3	1	1	1.5	2	9.5	52.78	Moderate
s15	1	3	2	1	2.5	2	11.5	63.89	Moderate
s16	2	3	1	1	1.5	2	10.5	58.33	Moderate
s17	1	3	1	1	0.5	2	8.5	47.22	Moderate
s18	1	1	1	1	1	2	7	38.89	Moderate
s19	2	3	1	1	1	2	10	55.56	Moderate
s20	1	3	1	1	2.5	2	10.5	58.33	Moderate
s21	1	3	2	1	2.5	2	11.5	63.89	Moderate
s22	0.5	0.5	1	1	1.5	2	6.5	36.11	Moderate
s23	1	3	1	1	1	2	9	50.00	Moderate
s24	1	3	1	1	1	2	9	50.00	Moderate
s25	1	3	1	1	0.5	2	8.5	47.22	Moderate
s26	1	1	1	1	2.5	2	8.5	47.22	Moderate
s27	0	0	0	0	2.5	2	4.5	25.00	Low
s28	1	3	2	1	1.5	2	10.5	58.33	Moderate
s29	1	3	1	1	2.5	2	10.5	58.33	Moderate
s30	1	3	1	1	1.5	2	9.5	52.78	Moderate
s31	0.5	0.5	1	1	1.5	2	6.5	36.11	Moderate
s32	1	3	1	1	1.5	2	9.5	52.78	Moderate
s33	1	0.5	2	1	1	2	7.5	41.67	Moderate
s34	1	3	1	1	2.5	2	10.5	58.33	Moderate
s35	1	3	2	1	1	2	10	55.56	Moderate
s36	1	3	1	1	1.5	2	9.5	52.78	Moderate
	Mean							49.15	Moderate

From the table it is known that the average student score is 49.15 and is in the moderate category. From the 36 students who took the test, 34 of them were in the moderate category, while the rest were in the low category.Table 5 are the results of the analysis of mathematical communication ability indicators.

TABLE 5. Mathematical Communication Indicators

Number	Mathematical Communication Indicators	Reach
1	Organizing and consolidating mathematical thinking through communication	31,94%
2	Expressing mathematical ideas coherently and clearly to other students, teachers, and others	45,60%
3	Analyze or evaluate the mathematical thinking and strategies of others	52,55%
4	Use math language to express mathematical ideas appropriately	66,67%
	Average	49,19%

Based on the results of the study, obtained the achievement of each mathematical communication indicator of the subjects as in Table 3. The average achievement of each indicator of the three questions given is 49.19%. That is, the mathematical communication skills of the subject are at a moderate level (12-14). Further, will be discussed communication analysis mathematics subject on each item of the question.

Problem Number 1

Problem number 1 contains two indicators, namely indicator 1 and indicator 3. Indicator 1 focuses on problem-solving strategies, while indicator 3 focuses on evaluating the given statement. The percentage of achievement of indicator 1 in question point number 1 is 31.94%, while the percentage of achievement of indicator 3 pada point number 1 is 73.61%. The following will be discussed one by one the results of the subject's work on each indicator.

The first question relates to evaluating the statement on the question (indicator 3). Based on the results of the study, obtained information which are 23 from 37 subjects stated that derivatives and integrals of a polynomial function are also polynomial functions. In addition, found some subjects that have different opinions. One of the subjects revealed that "integral [of a polynomial function] is a polynomial function, while the derivative [of a polynomial function] is not necessarily a polynomial function ". Some subjects do not evaluate the given statement. One of the things that may cause differences in evaluation on the subject is the strategy used to evaluate the statement on the question.

The strategy given by the subject in question point number 1 relates to indicator 1. Diverse completion strategies will result in different evaluations. There are at least 3'types' of strategies presented by the subject to solve this problem. These strategies include:

Proving by Example

One of the settlement strategies used by some subjects is to prove by example. Figure 1 is presented the answer of one of the subjects that use this strategy.

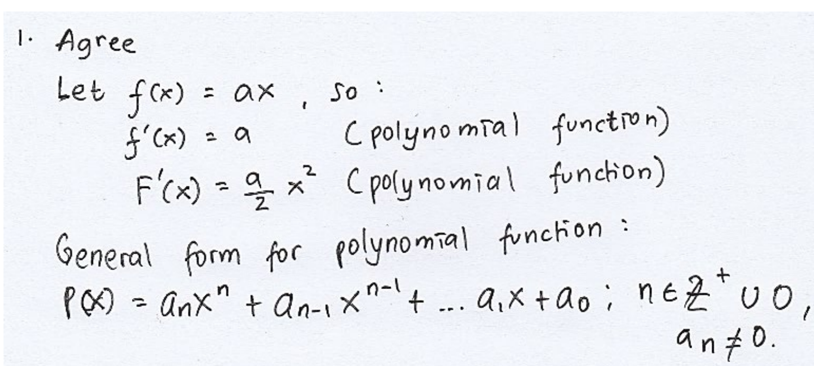
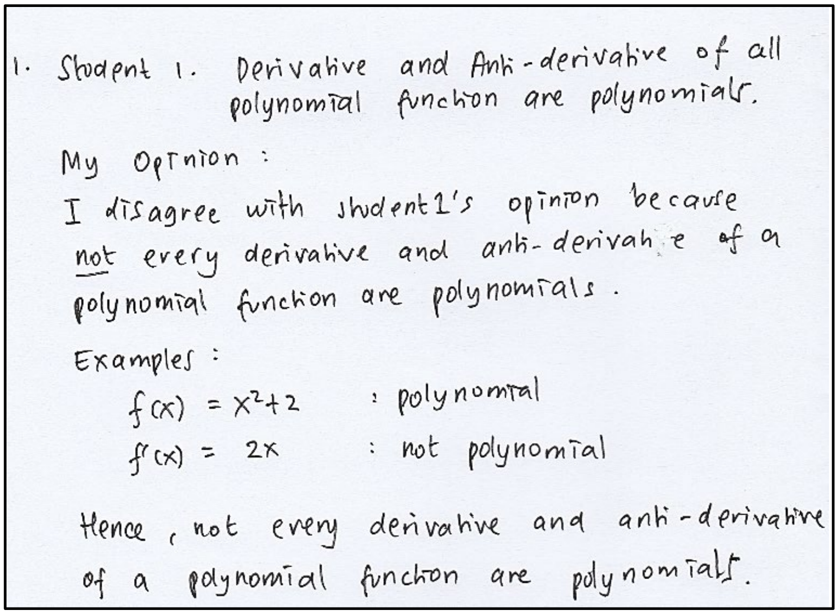


FIGURE 1. Proof with Example

Based on the results of the work, it is shown that the subject has degraded and integrated the function f(x)=ax appropriately. In addition, the subject has also described the constant function and the quadratic function as linear functions. The procedure written by the subject on this strategy is not wrong, but the chosen strategy is not appropriate. When proving by example, we cannot guarantee that the evidenced statement also applies to other objects (in this case functions) that are not used as examples. That is, the process of proofing and using examples cannot be categorized as the right steps/strategies.

Refute Statements with a Counterexample


1. Student 1. Derivative and Anti-derivative of all polynomial function are polynomials.

My Opinion :

I disagree with student1's opinion because not every derivative and anti-derivative of a polynomial function are polynomials.

Examples :

$f(x) = x^2+2$: polynomial

$f'(x) = 2x$: not polynomial

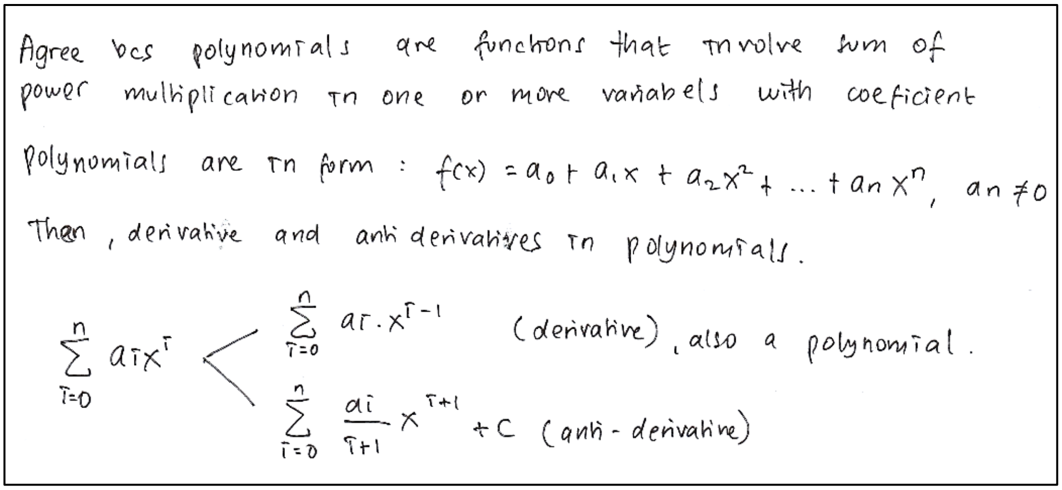
Hence, not every derivative and anti-derivative of a polynomial function are polynomials.

FIGURE 2. Subject Answer Results Related to Denial with a Counterexample

Based on figure 2, the counterexample is one way to intercept a statement by showing an example/condition that does not meet the statement (15,16). At least7 subjects chose to use counterexamples to help evaluate the given statement. The procedure that the subject performs in using counterexample is not wrong. An error in the evaluation result occurs when the subject interprets a function. In the image 2, it appears that there are still subjects that consider that linear functions are not f'(x)=2x polynomial functions. In addition, some subjects consider that quadratic functions and constant functions are not polynomial functions. When we associate it with the general form of polynomial functions, it can be concluded that the linear function is a polynomial function of magnitude 1, the quadratic function is a polynomial function of 2 degrees, and the constant function is a polynomial function of 0. This misconception of the concept causes the evaluation results of the subject to be precise.

Using Common Definitions/Forms of Derivatives and Integrals

Not a few subjects use this strategy in solving problems in point number 1. Figure 3 and 4 are presented as the answer to one of the subjects that use this strategy.

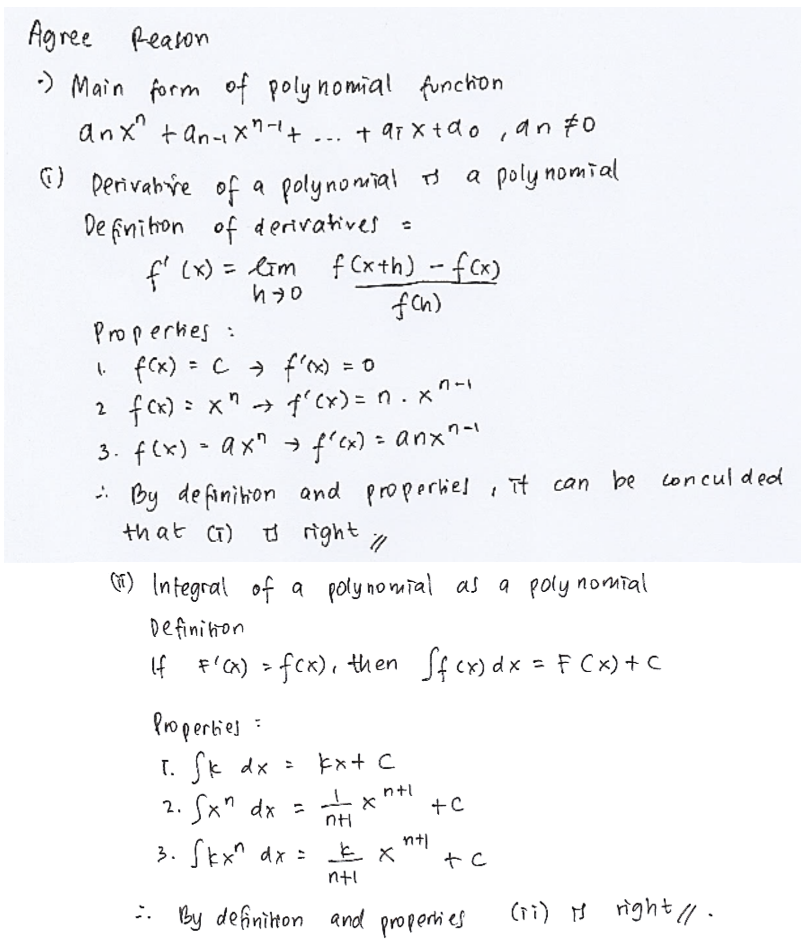

Agree bcs polynomials are functions that involve sum of power multiplication in one or more variabels with coeficient

Polynomials are in form : $f(x) = a_0 + a_1 x + a_2 x^2 + \dots + a_n x^n$, $a_n \neq 0$

Then, derivative and anti derivatives in polynomials.

$\sum_{i=0}^{n} a_i x^i$ < $\sum_{i=0}^{n} a_i \cdot x^{i-1}$ (derivative), also a polynomial. / $\sum_{i=0}^{n} \frac{a_i}{i+1} x^{i+1} + C$ (anti-derivative)

FIGURE 3. Subject Answers Use Common Definitions/Forms of Derivatives and Integrals


Agree Reason

·) Main form of polynomial function

$a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$, $a_n \neq 0$

(i) Derivative of a polynomial is a polynomial

Definition of derivatives =

$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{f(h)}$

Properties :

1. $f(x) = C \rightarrow f'(x) = 0$
2. $f(x) = x^n \rightarrow f'(x) = n \cdot x^{n-1}$
3. $f(x) = ax^n \rightarrow f'(x) = anx^{n-1}$

∴ By definition and properties, it can be conculded that (i) is right //

(ii) Integral of a polynomial as a polynomial

Definition

If $F'(x) = f(x)$, then $\int f(x)\,dx = F(x) + C$

Properties :

1. $\int k \, dx = kx + C$
2. $\int x^n \, dx = \frac{1}{n+1} x^{n+1} + C$
3. $\int kx^n \, dx = \frac{k}{n+1} x^{n+1} + C$

∴ By definition and properties (ii) is right //.

FIGURE 4. Alternative Strategies Using Common Definitions/Forms

When observed further, the strategy given by the subject is not precise/incomplete. Almost all subjects using this strategy only present derivative/integral definitions of algebraic functions. However, the subject does not provide evidence or other relevant arguments to support the chosen strategy. As a result, the process and results of the evaluation of the subject using this strategy became less precise.

Problem Number 2

In question number 2 combines two indicators, namely indicator 2 and indicator 3. Indicator 2 focuses on the ability to express mathematical ideas coherently and clearly to convey solutions to a problem. On the other hand, indicator 3 deals with the ability to analyze and evaluate mathematical thoughts or ideas presented. From the results of the analysis that has been done, it was obtained that the percentage of achievement of indicator 2 in question point number 2 is 41.67%. Meanwhile, the percentage of achievement of indicator 3 there is a point of question number 2 of 31.48%.

Based on the research conducted, it was obtained that the difference seen in the delivery of answers by the subject is the selection of strategies used. In this case, there are three strategy groups, as follows:

Delivery by utilizing illustrations/models from an angle of view through distance and angle

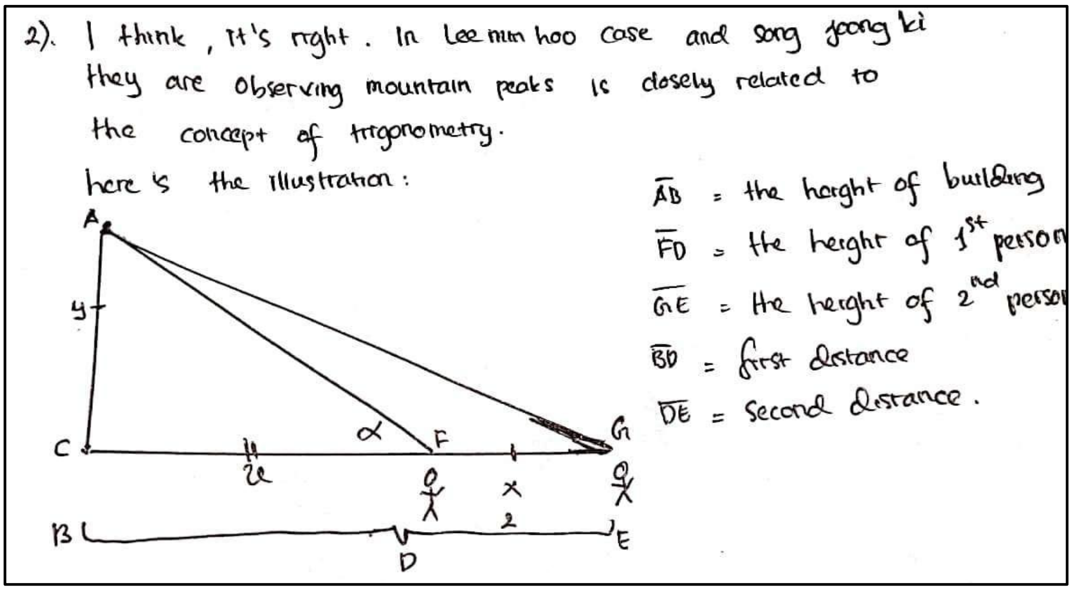


FIGURE 5. Delivery by utilizing illustrations/models from an angle of view through distance

Based on Figure 5, in strategy groups that apply illustrations or models from a distance point of view, it is pretty much applied by the subject. However, when viewed carefully the answers presented by the subject are not precise and complete. Where the understanding obtained from the analysis of the statement in the question experienced a misunderstanding, resulting in errors in the evaluation process. Not only that, but the subject also applies a strategy by utilizing illustrations/models from an angle-related point of view. as in the image of one of the answers given by the following subject.

Based on Figure 6, the statement or answer given by the subject, it appears that the subject provides evidence in the form of illustrations and the results of his analysis using the concept of angles from the illustrations he composed. Based on Figure 7, the same error also occurred, the subject is less in interpreting the statement given so that in the process of analysis and evaluation is still not appropriate. However, at the end of the conclusion given the majority of subjects answered one of the statements given is worth wrong. Some subjects answer with the same strategy.

Submission using sentences

Not a few subjects are just describing their opinions in the form of sentences without providing mathematical evidence. From one of the answers given by the subject, it is shown that the subject provides an incorrect understanding. The subject tends to do analysis just to investigate the given statement without trying to show the truth of the evidentiary results. If further examined, the subject experiences the same error that is the error in understanding the given statement. Of all the subjects that answered with this strategy, no subject was found to give the right answer or proof.

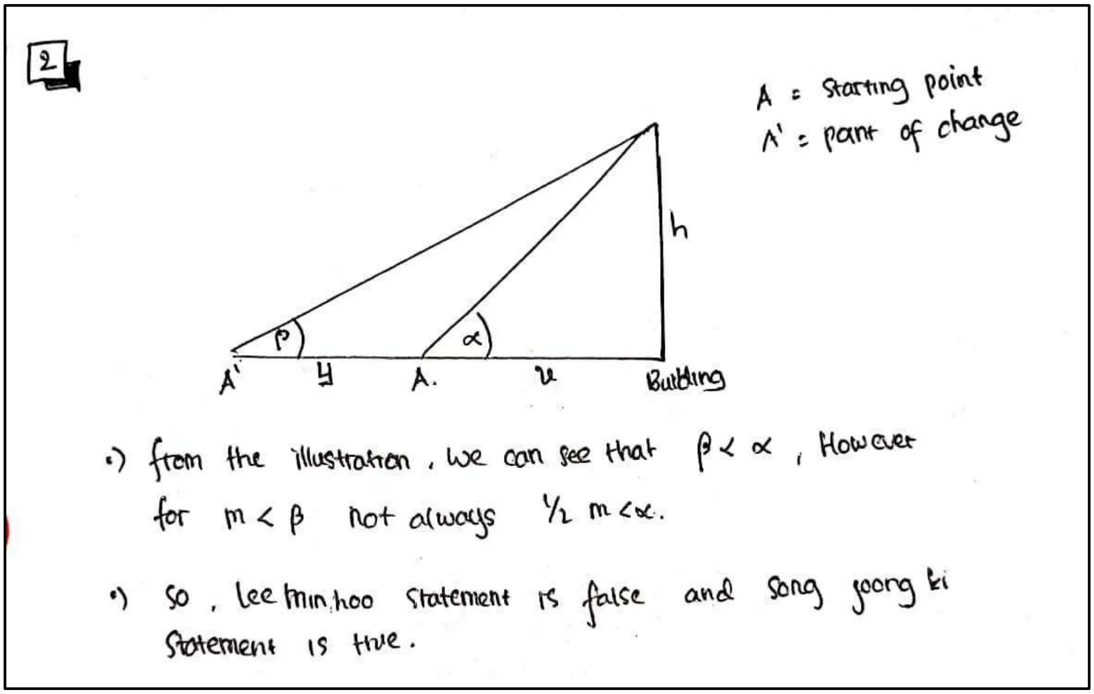


FIGURE 6. Delivery by utilizing illustrations/models from an angle of view

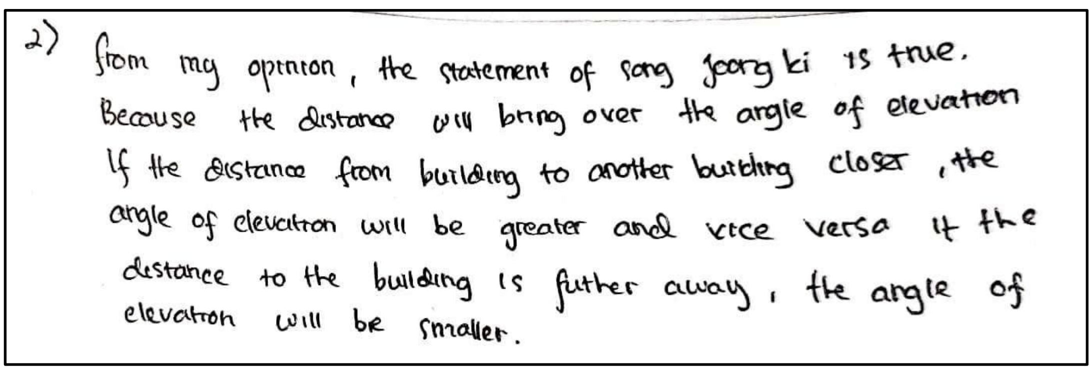
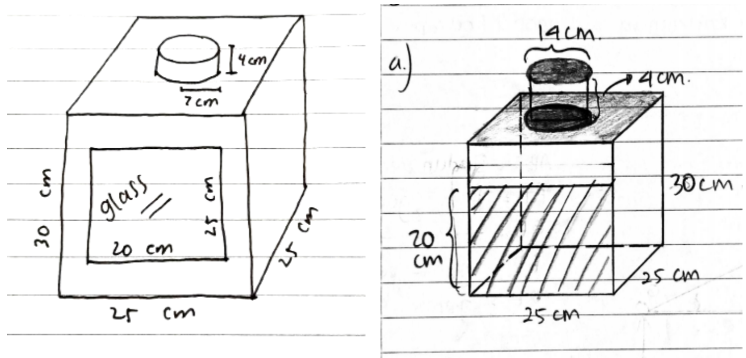


FIGURE 7. Submission using sentences

Problem Number 3

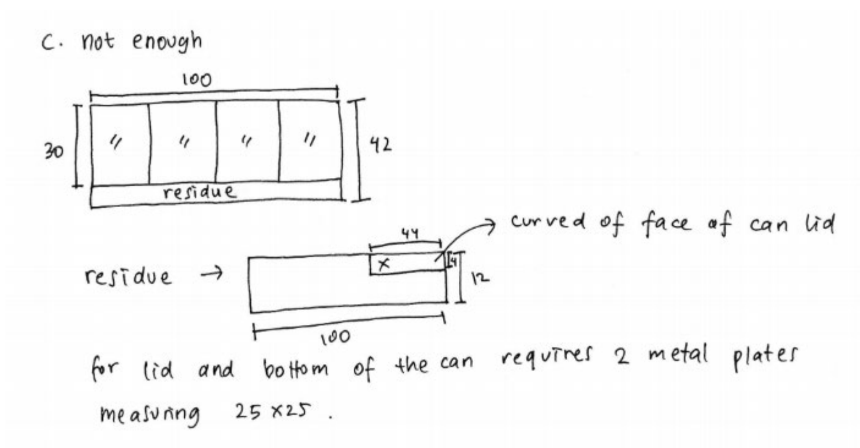
Item number 3 contains two indicators, namely indicator 2 and indicator 4. Indicator 2 relates to the coherent extract of mathematical ideas in the form of models/illustrations/formulas for solving problems, while indicator 4 relates to the use of mathematical languages to express mathematical ideas appropriately. The percentage of success of indicator 2 in question point number 3 reached 49.54%, while the percentage of success of indicator 4 in question point number 3 reached 66.67%.

Based on the results of research on indicator 2, the subject was able to write down mathematical ideas in the form of a model /illustration/formula correctly but less complete in problem-solving. In part a, 2 subject groups illustrate as follows, further paying attention to figures 8 a and b. The first group illustrates the problem by depicting the glass in a portrait position, while the second group depicts the glass in a landscape position. Both groups can illustrate well however, cans of crackers, in general, have a glass with a portrait position on the side of the can of crackers.

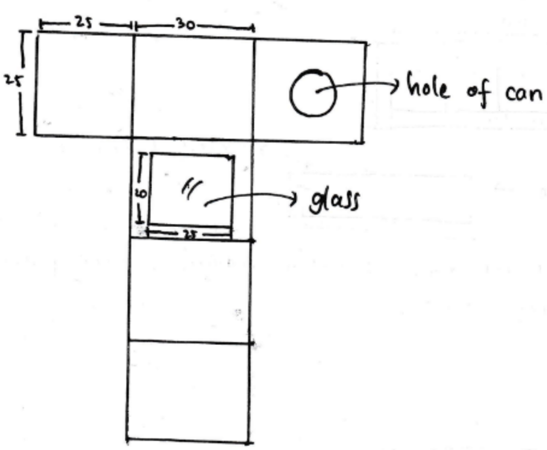


(a) (b)

FIGURE 8. Subject Answer Results Related to the illustration of cracker can. (a) subject illustrates a glass in portrait position (b) subject illustrates a glass in landscape position.



(a)

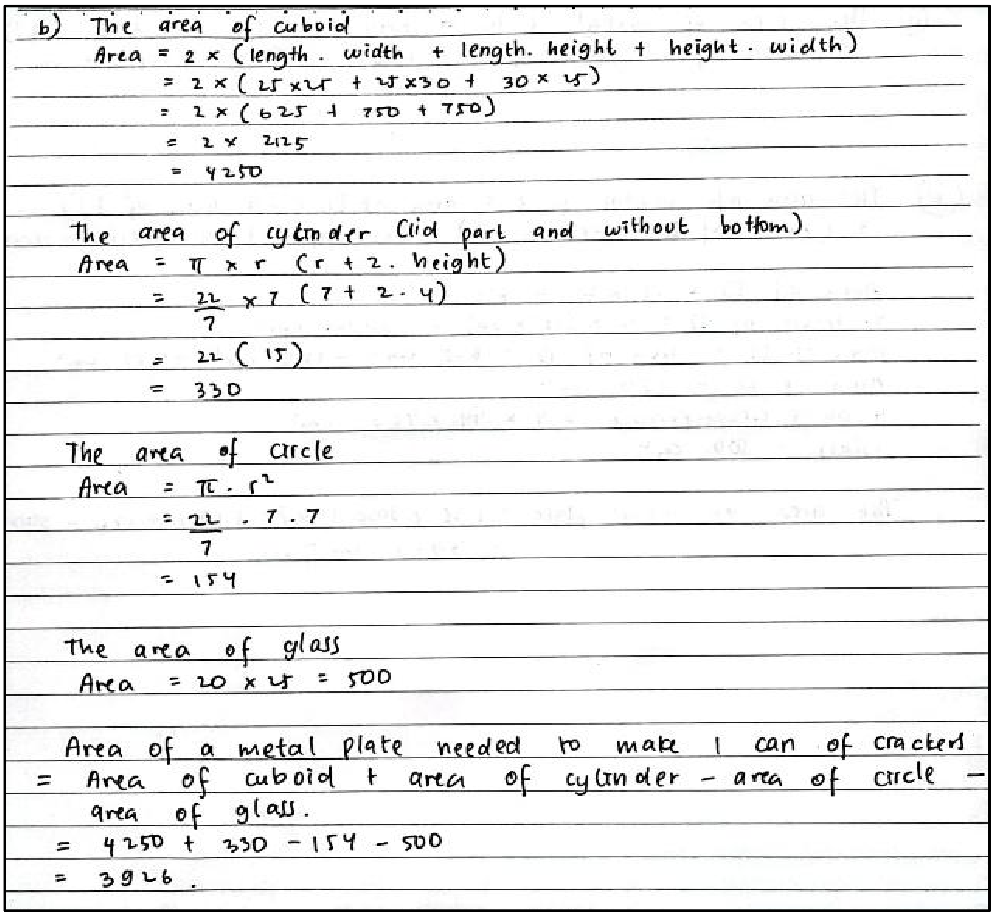


(b)

FIGURE 9. Subject Answer Results Related to the illustration of make cracker cans from metal plates measuring 100 cm × 42 cm. (a) subject illustrates metal plates marked by the division of each side of the cracker can (b) subject illustrates block nets for cracker can.

Based on figure 8 in question part c, 2 subject groups illustrate as follows, further paying attention to figures 9 a and b. The first group illustrates the problem by providing sheet metal plates marked by the division of each side of the cracker can and drawing conclusions if the provided metal plates are insufficient. The answer to the subject in the first group is correct. Meanwhile, the second group illustrates the problem by describing the block nets. The mistake made by the subject of the second group was not to describe the lid of the can and not draw enough conclusions or not the metal plate yang provided to make one can of crackers. Common mistakes that occur, among others: the subject does not write a description of the size in describing the illustration, the subject does not thoroughly understand the question so that the answer of the subject does not correspond to what is asked from the question.

Based on figure 9, the results of the study on indicator 4, the subject was able to use the language of mathematics appropriately but was less complete in problem-solving. In part b, 2 subject groups work as follows:


b) The area of cuboid
Area = 2 × (length . width + length. height + height . width)
= 2 × (25×25 + 25×30 + 30 × 25)
= 2 × (625 + 750 + 750)
= 2 × 2125
= 4250

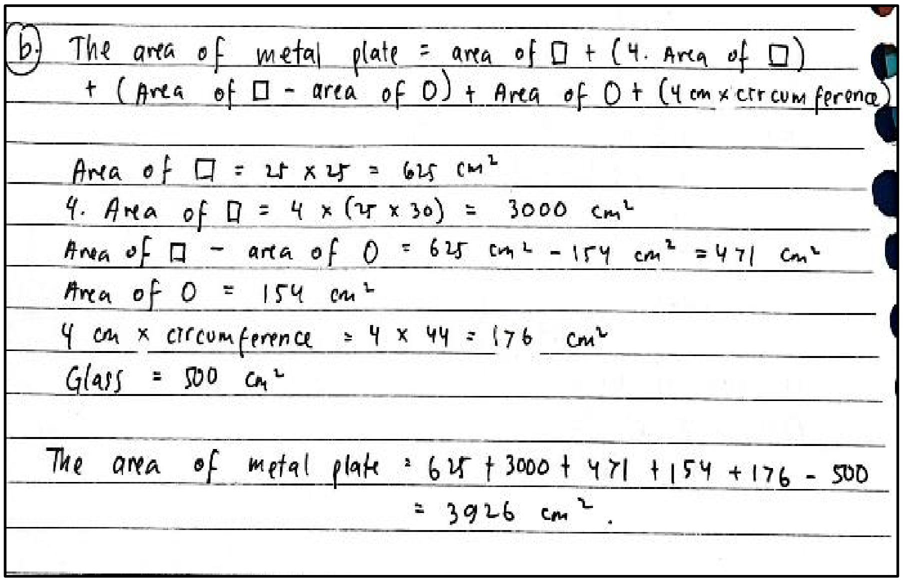
the area of cylinder (lid part and without bottom)
Area = π × r (r + 2. height)
= 22/7 × 7 (7 + 2 . 4)
= 22 (15)
= 330

The area of circle
Area = π . r²
= 22/7 . 7 . 7
= 154

The area of glass
Area = 20 × 25 = 500

Area of a metal plate needed to make 1 can of crackers
= Area of cuboid + area of cylinder − area of circle − area of glass.
= 4250 + 330 − 154 − 500
= 3926.

(a)



(b)

FIGURE 10. Subject Answer Results Related to the calculates the area of cracker can. (a) Subject calculates the area of the construction of the building is a beam and tube that is reduced by empty sides (without metal plates) (b) Subject calculates the area the construction of the building is one by one the sides.

In figure 10a, the first group and the second group use mathematical language precisely to calculate the area of a metal plate from a can of crackers. If the first group calculates the area of the construction of the building is a beam and tube that is reduced by empty sides (without metal plates). Meanwhile, in figure 10b, the second group counts one by one the sides. From the above results, the same result obtained that is 3,926, however, the result is cm^2not appropriate because the subject does not calculate the part of the mouth of the cracker can. Thus, the common mistake that occurs is the subject is less thorough in understanding the problem that results in a lack of precision in the calculation process so that the answer of the subject is not following what is asked of the question.

Communication is an important ability to be possessed by students, teachers, and prospective teachers. In mathematics learning, good communication can improve the quality of learning. The results showed that the mathematical communication skills of prospective students of mathematics teachers fall into the moderate category with the achievement rate of mathematical communication ability indicators reaching 49.19%. There are at least two strategies offered to improve mathematical communication capabilities. The first strategy is to use the problem-solving learning model (17). The second strategy is the use of the PMRI (Indonesian Realistic Mathematics Education) approach in learning. The use of the PMRI approach is expected to be able to mathematical communication skills of learners (18-19). In addition, teachers can also apply problem-based learning to improve students' mathematical communication skills, this is based on research conducted by Perwitasari and Surya (20). Another way that can be done to improve mathematical communication skills is that teachers develop tasks that privilege different forms of communication in visual contexts. According to Vale and Barbosa (21) the tasks proposed focus on seeing the information directly or listening to information without seeing.

CONCLUSION

Communication is an important ability to be possessed by students, teachers, and prospective teachers. In mathematics learning, good communication can improve the quality of learning. The average student communication ability was 47.82 in the moderate category. There are 94% of students in the moderate category and 16% in the low category. The average achievement of mathematical communication indicators is 49.19%, in the moderate category. The best indicator is “use math language to express mathematical ideas appropriately” with 66.67% achievement, while the indicator that needs to be improved is “organizing and consolidating mathematical thinking through communication” with 31.94% achievement. Indicator “Expressing mathematical ideas coherently and clearly to other students, teachers, and others” and “Analyze or evaluate the mathematical thinking and strategies of others” with

45,60% dan 52,55% in the moderate category.

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