

STUDENTS' MATHEMATICAL COMMUNICATION SKILLS IN SOLVING QUADRATIC EQUATION PROBLEMS

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Article History Abstract. Mathematics learning today only emphasizes the mastery of the material alone and more one-way communication with students. The buildup of information from teachers results in the learning style of students who tend to Received: 20-08-2021 memorize. This research aims to find out the mathematical communication Revision: 13-09-2021 skills of students in solving quadratic equation problems. This type of research is qualitative descriptive. Determination of the subject using purposive Accepted: 07-10-2021 sampling techniques with the criteria of the student's test results. The study subjects numbered three people consisting of students who obtained grades in Published: 20-10-2021 high, medium, and low categories. Indicators of communication skills in this researcher are (1) explain and make mathematical statements that have been studied, (2) state everyday events in a language or mathematical symbol, and (3) provide an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically. The instruments used are researchers, tests and interviews. Data analysis techniques are using quantitataif data analysis with data reduction stages, data presentation, and conclusion withdrawal. The results of the data analysis showed that the KSS subject met 3 indicators of mathematical communication skills. AHB subjects meet 2 of the 3 indicators, namely the first and third indicators. WL subjects meet reached 1 of 3 indicators of mathematical communication skills, namely the first indicators.

Keywords: Mathematical Communication, Problems, Quadratic Equations

Abstrak. Pembelajaran matematika saat ini hanya menekankan pada penguasaan materi semata dan lebih banyak menjalin komunikasi satu arah dengan siswa. Penumpukan informasi dari guru mengakibatkan gaya belajar siswa yang cenderung menghafal. Penelitian ini bertujuan untuk untuk mengetahui kemampuan komunikasi matematika siswa dalam menyelesaikan masalah persamaan kuadrat. Jenis penelitian ini adalah deskriptif kualitatif. Penentuan subjek menggunakan teknik purposive sampling dengan kriteria hasil tes siswa. Subjek penelitian berjumlah tiga orang yang terdiri dari siswa yang memperoleh nilai dengan kategori tinggi, sedang, dan rendah. Indikator kemampuan komunikasi dalam peneliti ini yaitu (1) menjelaskan dan membuat pernyataan matematika yang telah dipelajari, (2) menyatakan peristiwa seharihari dalam bahasa atau simbol matematika, dan (3) memberikan penjelasan ide, konsep, atau situasi matematika dengan bahasa sendiri dalam bentuk penulisan secara matematik. Instrumen yang digunakan yaitu peneliti, tes dan wawancara. Teknik analisis data yaitu menggunakan analisis data kualitataif dengan tahapan reduksi data, penyajian data, dan penarikan kesimpulan. Hasil analisis data menunjukkan bahwa subjek KSS memenuhi 3 indikator kemampuan komunikasi matematis. Subjek AHB memenuhi 2 dari 3 indikator yaitu indikator pertama dan ketiga. Subjek WL memenuhi mencapai 1 dari 3 indikator kemampuan komunikasi matematik yaitu indikator pertama

Kata Kunci: Komunikasi Matematika, Masalah, Persamaan Kuadrat

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INTRODUCTION

Learning is a process that serves to guide students in life, namely guiding themselves in accordance with the tasks that must be carried out (Çelik & Özdemir, 2020; Simamora et al., 2018). The teaching and learning process will always be a process of interaction activities between students as learning parties and teachers as teaching parties (Ahmad & Nasution, 2018; Wijaya et al., 2016), with students as the main subject (Ulva & Resti Ayu Suri, 2019). Mathematics as one of the basic sciences both theoretical and applied aspects have a very important role in efforts to increase the mastery of science and technology. Mathematics is part of the benchmark of scientific and technological progress. In reality mathematics is considered a difficult and confusing subject. Mathematics as an exact science for children is generally an unsensitized subject, if not some hated subjects (Wardono & Mariani, 2014).

Math learning only emphasizes mastery of the material alone and more one-way communication with students (teacher center) so that students are less active in conveying their ideas (Kamsurya, 2019). The buildup of information from the teacher makes the learning style of students who tend to memorize (Hayashi & Takeuchi, 2018). In addition, many math teachers prioritize the results obtained without looking at the process carried out by students. The process of conveying ideas in solving a problem, the use of symbols to solve the problem is all neglected and invisible if the results obtained are not in accordance with the answer (Muttaqin et al., 2017).

SMA Negeri 2 Kuningan is one of the schools within the scope of the Ministry of National Education of Kuningan Regency. Based on interviews conducted to the teacher of mathematics subjects class X SMA Negeri 2 Kuningan, it is known that during this time students have shortcomings in terms of their mathematical communication skills. Students tend to be able to solve problems related to understanding concepts but still need a lot of direction to solve problems related to mathematical communication. This can be known from the teacher's recognition of assessments for students related to aspects of mathematical communication. During this time learning is carried out in an expository manner by placing the teacher as the main actor of learning (teacher centered).

Mathematical communication skills are one of the competencies that must be owned by students today. Mathematical communication skills are defined as the ability to reflect an image into mathematical ideas (Nuraida & Amam, 2019; Uzun et al., 2018). Mathematical problems by using symbols and providing explanations in their own language by writing them mathematically (Al-Momany, 2015; Rahmi et al., 2017).

The process of mathematical communication by equalizing a picture, graph or table is closely related to the ability of mathematical communication (Anggraini & Fauzan, 2018). Students can explain ideas or concepts that are closely related to mathematical problems by using pictures, graphs, tables or vice versa (Afacan & Gürel, 2019). Students can reflect pictures, tables and graphs into mathematical ideas (Haji & Abdullah, 2016; Muslimahayati, 2019). This research aims to find out the ability of mathematics communication students in solving quadratic equation problems.

METHOD

The type of research used in this study is qualitative descriptive. The study subjects amounted to 3 (three) students determined by purposive sampling technique, namely the process of determining the subject using certain goals or criteria, namely student test results. (Creswell & Creswell, 2018; Sugiyono, 2014). The subjects selected were students who obtained test results in high, medium, and low categories. Indicators of mathematical communication skills used in this study are (1) explaining and making mathematical statements that have been studied, (2) stating everyday events in a language or mathematical symbol, and (3) providing an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically.

The instruments used in the study include researchers, communication skills tests, and interviews. Researchers are used as instruments in this study, because researchers are directly involved in the research process. The test used in the form of a blurb test that aims to find out the ability of mathematics communication students in solving problems in the material quadratic equations. Interviews are conducted to find out the mathematical communication skills of students in solving problems in square equation material. The interview used is an unstructured interview (Sugiyono, 2014). Questions in interview guidelines are developed based on student test results as well as answers that students deliver during interviews. The data analysis technique used in this research is qualitative data analysis consisting of reduction data, display data, conclusion drawing (Miles & Huberman, 1994; Sukmadinata, 2012).

RESULTS

Data collection is done through interviews on students who are the subject of research. Based on the results of the mathematical communication skills test obtained by 3 students who were the subject of the study, namely the subject of WL who obtained the lowest test

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results, abb subjects who obtained results in the moderate category, and KSS subjects who obtained results in very high categories.

Interview Results with WL Subjects

When students solve the problem, researchers pay close attention to the process of solving problems carried out by students. As for the work of WL students on question number 1, namely as follows.

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Figure 1. The work of the subject of WL on problem number 1

- R : Can you explain to me the answer you got on question number 1?
- WL : In that question it is known the length of the base field is 4 cm and larger than its width, while the volume is 90 cm³. What was asked was the length and width of the base of the box. So to find the base and width of the meal is factored so that it is obtained the length is -9 and the width is 5
- R : Where did you get the length of the box to -9
- WL : From the results of the factoring
- R : Can the length of a box be negative?
- WL : (Students are silent and don't answer questions)
- R : Where do you get x = y + 4 and y = x 4?
- WL : From the matter.

When students solve the problem, researchers pay close attention to the process of solving problems carried out by students. As for the work of WL students on question number 2 as follows.

(x-9) (x+s) 2+=× 1 P-=× 2)-X-Y = 200 × (30-×)=200 30 × - ×2 + 200 =0 (X-18) (X+40)=0 X=15 / X=100

Figure 2. The work of the subject of WL on question number 2

- R : Can you explain where you got the answer to question number 2?
- WL : In question number 2 it is known that the sum of two numbers is 30 and the result of the two numbers is 200. What they ask is what these numbers are. So the numbers are x and y then x.y = 200 and multiplied x (30 x) = 200. So the result is x = 15 and x = 100.
- R : Where did you get the equation x.y = 200?
- WL : (Students were silent and did not answer questions submitted by the researchers)
- R : Where did you get the equation x (30 x) = 200?
- WL : From the matter.
- R : In the event that there is no equation x (30 x) = 200, then how can you get the equation?
- WL : (Students were silent and did not answer questions submitted by the researchers)

Based on the results of the interview above, it is known that the student's ability and understanding of the quadratic equation material is good enough, students can solve 2 questions out of 3 questions prepared in the process of conducting the test. But in this case the subject of WL has not been able to reflect or has not met the indicators of overall mathematical communication skills used in this study. This is seen in interviews where when students are told to explain the problems he has done, the subject of WL can only explain the problem, although the explanation of the subject of WL is done explaining in detail where the answer he got both on question number 1 and on question number 2.

When subjects are asked to create a mathematical model based on problem number 1 and number 2. In general, WL subjects are silent and do not answer questions submitted by researchers. In general, the subject of WL can solve the problem but cannot answer or explain the answer he has obtained based on the answer. Based on these steps, it can be concluded that the WL subject only meets 1 indicator of mathematical communication ability used in this study, namely explaining and making mathematical statements that have been studied, but on other indicators are not met or owned by the subject of WL.

Interview results with AHB subjects

The process of conducting interviews conducted on AHB subjects is carried out as well as the process of conducting interviews on WL subjects. The interview was conducted with the aim of knowing the mathematical communication skills of AHB subjects in the process of solving the problem of square equation material. Abb subjects are one of the subjects who obtained test results in the moderate category. As for the work of AHB students on question number 1, namely as follows.

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Noma : Aswar Heson Buten Valas ution : Matematika t). Mical : Panjam alos - x con Laboar alos = y cm maka : x = y + 4y = x - 4× (x-4)-2= 40 -> × (x-4)=40 x2- 4x - 45 =0 (x-9) (x+5) (1=9, X2=-5 4= 9-4=5 / 4=-5-4=

Figure 3. AHB subject work on question number 1

- R : Can you explain to me the answer you got on question number 1?
- AHB : Based on the number 1 problem it can be known that the length of the base of the box is 4 cm greater than the width, while the volume of the box is 90 cm³. What was asked was the length and width of the box. So the first step in solving the problem is we suppose first, namely the length of the base = x cm and the width of the base = y cm. Then the equation obtained is x = y + 4 then y = x 4. So that through the process of solving the problem using the equation above, it is obtained that the length of the base or x = 9 cm, and the width of the base or y = 5 cm.
- R : In the results of the solution of your problem it is seen that the value of x obtained in addition to 9 also has -5, why do you not use -5 as the length of the base of the box
- AHB : Because...... (Students were silent and no longer answered the researcher's questions)
- R : Where do you get the equation $x^2 4x 45$?
- AHB : The equation is derived from the description of x (x 4) = 45. The equation when subtitled in x is multiplied by (x - 4)=45. From the equation both segments are subtracted by 45 then obtained a quadratic equation that is $x^2 - 4x - 45 = 0$
- R : Why factor the equation you use the numbers of -9 and 5?
- AHB : Because these two numbers are the most accurate numbers to factor into the form of the equation above, and if using other numbers, not necessarily exactly like using the numbers -9 and 5.

When students solve the problem, researchers pay close attention to the process of solving problems carried out by students. The work of AHB students on question number 2 is as follows:

2). Misal × dan y X+4 = 30 atom 4= 30 -X-4 = 200 × (30-x)=200 30x - x2 = 200 X2 - 30 x + 200 = 0 (x-10) (x-20) x=20=0 x - 10 - 0 x = 10 X = 20 × = 10 = 30 - 10 4 = 30 - 20 20 = 10

Figure 4. AHB subject work number 2

- R : Can you explain where you got the answer to question number 2?
- AHB : To solve problem number 2, first we pay attention to the problem first. In that case there are several sentences that can be used as an aid, namely the sum of two numbers equal to 30. So from the statement, we can make a mathematical model, by suppose the numbers are x and y, then the equation made is x + y = 30, thus can be reflected to y = 30 x. In the second statement, the second time the number is 200, it can thus write x.y = 200. From the first and second equations we subtisusikan the first equation into the second equation that is x.y = 200, to x (30 x) = 200 so that a quadratic equation is obtained that is x2 30x + 200 = 0. From the equation we factor so that we get a value of x 10 or 20. Where if at the value x = 10 then y = 20, and if x = 20 then the value of y = 10.
- R : Why would you use the numbers -10 and -20 to factor in equations $x^2 30x + 200 = 0$?
- AHB : Because the numbers -10 and -20 are very precise numbers to factor in the equation. Because the two numbers if summed will get a value of -30 and if multiplied will get the value of -200. And that's an absolute requirement to factor in.

Based on the results of the above interview, it can be known that the AHB subject in the process of solving the problem of square equation material is very good when compared to the problem solving process carried out by the subject of WL. This is seen in the results of the work and the ability of each subject in answering various questions submitted in the interview process. Abb subjects in addition to being able to solve the problem well, AHB subjects can also explain the answers he obtained directly to the researcher in the interview process.

Mathematical communication skills possessed by AHB subjects in the process of solving the problem of square equation material, AHB subjects meet 2 indicators of mathematical communication skills from 3 indicators used in this study. The mathematical communication indicators that AHB subjects have in solving problems are:

- Explain and make mathematical statements that have been studied. The ability to explain and make mathematical statements is owned by the subject, because in solving the problem the subject is able to make the problem in the form of a story made into the form of mathematics before solving the problem. This is evidenced by the results of the following interviews:
 - R : Can you explain to me the answer you got in question number 1 above?
 - AHB : Based on the number 1 problem it can be known that the length of the base of the box is 4 cm greater than the width, while the volume of the box is 90 cm³. What was asked was the length and width of the box. So the first step in solving the problem is we suppose first, namely the length of the base = x cm and the width of the base = y cm. Then the equation obtained is x = y + 4then y = x - 4. So that through the process of solving the problem using the

equation above, it is obtained that the length of the base or x = 9 cm, and the width of the base or y = 5 cm.

- 2) 2) Provide an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically. Based on the results of interviews with AHB subjects, he was able to provide an explanation of the problem and how to resolve it well. The explanatory process uses its own language without help from others. This is evident from the results of the following interviews:
 - R : Where do you get the equation $x^2 4x 45$?
 - AHB : The equation is derived from the description of x (x 4) = 45. The equation when subtitled into the first equation is x multiplied by (x - 4) = 45. From the equation both segments are subtracted by 45 then obtained a quadratic equation that is $x^2 - 4x - 45 = 0$.
 - R : Why factor in the equation you use the numbers -9 and 5?
 - AHB : Because these two numbers are the most accurate numbers to factor into the nature of the above equation form, and if using other numbers, it is not necessarily exactly like using the numbers -9 and 5.

Interview Results with KSS Subjects

As the interview process is conducted on the subject of WL and the subject of AHB, the interview process with KSS subjects is also carried out based on the same stages. The interview focused on the mathematical communication skills of KSS subjects in solving problems in square equation material. The interview refers to indicators of students' mathematical communication skills. The subject's work in solving mathematical communication problems as follows.

misar buangan bang di cari x dan y misalkan alas x + 4 = 30 ALAO h = 30 - x maka maka X. 9: 200 : x (30 -x) : 700 90 x-H).2= Ax.2.2 Hx = -Hx = - 30 × + 200 : 0 (x -10) (x-90) 45 45 x, = 10 AtAU X2 = 20 (x+5) 4 = 30-20 : 30-10 5 ¥129 ×27-5 y=9-H=5 Y=-5-H=-9 - 10 20

Figure 5. KSS subject results numbers 1 and 2

R : Can you explain where you got the answer to question number 2?

KSS : In question number 2 we suppose the two numbers are x and y, then x + y = 30and the result of x.y = 200. As in problem number 1, in problem number 2 we also subtitusikan the first mathematical model into the second model by previously changing x + y = 30 to y = 30 - x. So obtained the form of the quadratic equation that is $x^2 - 30x + 200 = 0$. We take the values - 10 and -20 for the factoring process so that the value x = 10 or x = 20 is obtained. At the value x = 10 then the value y = 20, and vice versa if the value x = 20 then the value y = 10.

- R : Is the answer you got right?
- KSS : Sir, because I've tested it and I've had the same results.
- R : How do you test it?
- KSS : By entering the values x and y obtained into the form of the general quadratic equation. And when I entered got a value = 0. Thus the answer obtained is correct.

Based on the results of the above interview, the subject of KSS solves the problems in the square equation material very well. Because the subject is able to solve problems in the matter of quadratic equations, and not only that the subject is able to explain them to the researcher directly. In general, based on the results of the interview above, KSS subjects meet all indicators of mathematical communication skills in this study. To find out the ability of mathematical communication students in solving problems in the material quadratic equations are as follows.

- Explain and make mathematical statements that have been studied. Based on the results of the interview above, the KSS subject is able to explain and make mathematical statements that he has been a student. This is done in solving the problem given by the researcher, the subject is able to explain it very well and in accordance with the answers written in the results of his work. The results are seen, from the results of the following interviews:
 - R : Can you explain where you got the answer to question number 1?
 - KSS : In the matter of being told to look for the length of the base and the width of the base from the box. Here we suppose the length = x cm and the width of y cm. Based on the problem we get a mathematical model that is x y = 4 so that we can write it into y = x 4. We subatomic this equation into the form of the second model that is x.y = 90 So as to obtain the form of the quadratic equation that is $x^2 4x 45 = 0$ Of the square equation we factor so as to obtain the value x = -9 or x = 5. We use x = 9 because the length cannot be negative, then the value y = 5 is obtained.
 - R : Why is the value x y = 4 you change to y = x 4?
 - KSS : Because, if it is not changed we cannot manipulate the mathematical model into quadratic equations. So we need to change the mathematical model.
- 2) States everyday events in a language or mathematical symbol. In addition to being able to solve problems in the matter of quadratic equations, subjects can also state problems that occur everyday into mathematical form. This is evident from the results of the following interviews:
 - R : Can you give examples of everyday problems that can be solved using the form of quadratic equations?
 - KSS : Suppose we are asked a question from my father at home. Dad bought clothes and pants with a total price of Rp100,000. And dad also said the price of

clothes and pants if multiplied then the price is Rp1,875,000,000. We are asked to determine the price of the shirt and pants.

- R : If the question is like that, how do you solve the problem?
- KSS : If the problem is like that, then our first step is to make a mathematical model of the various questions above, so as to obtain the form of quadratic equations. So let's suppose first the price of clothes = x and the price of pants = y. So we get the mathematical model that is x + y = 100,000 and x.y = 1,875,000,000. From this form eats us to subtitusikan the first equation into the second equation then will get a form of quadratic equation based on these statements. From there we can determine how much the clothes and pants cost..
- 3) 3) Provide an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically. Subjects in addition to being able to solve the problem of square equation material well, the subject can also explain it in accordance with the steps of solving the problem. All the problems solved by the subject are able to explain back to the researcher directly. This can be seen from the results of the following interviews:
 - R : Can you explain where you got the answer to question number 2?
 - KSS : In question number 2 we suppose the two numbers are x and y, then x + y = 30 and the result of x.y = 200. As in problem number 1, in problem number 2 we also subtitusikan the first mathematical model into the second model by previously changing x + y = 30 to y = 30 x. So obtained the form of the quadratic equation that is $x^2 30x + 200 = 0$. We take the values 10 and -20 for the factoring process so that the value x = 10 or x = 20 is obtained. At the value x = 10 then the value y = 20, and vice versa if the value x = 20 then the value y = 10
 - R : Is the answer you got right?
 - KSS : I've tested it before and I've had the same results.

Based on the results of interviews conducted by researchers on the subjects of WL, AHB, and KSS it can be known that the subject of WL in solving problems in solving problems only focuses on the knowledge he has without using mathematical communication in the process of solving the problem, abb subjects meet indicators of mathematical communication skills but are still limited to two indicators of the 3 indicators used in the study, and the subject of KSS meets 3 indicators or all indicators used in the study.

DISCUSSION

The learning process in the classroom is an activity carried out between teachers and students (Bećirović et al., 2019). In its implementation the use of methods determines the success and absence of the learning process. Mathematics learning is a learning process that emphasizes the implementation of students' thought processes (Egmir & Ocak, 2020;

Munawaroh, 2018). Because in studying mathematics, the relationship between matter with each other has a very close relationship (Erdoğan & Gül, 2020).

Based on the results of research conducted by researchers in the students of Grade X of SMA Negeri 2 Kuningan by taking three subjects, it was obtained that the subjects selected in their learning reflected the attitudes or characteristics of mathematical communication skills, where the subject was able to create and explain mathematical models that had been studied, able to make mathematical models and be able to explain them well. Mathematical communication can also be viewed as a process used when an individual brings in or comes up with a new idea (Jailani et al., 2020; Setiana et al., 2020). It is to create a mathematical model based on problems found in everyday life. The idea is a combination of previous ideas that have never been realized. This understanding focuses more on the individual process to come up with new ideas that are a combination of previous ideas that have not been realized or are still in thought (Bilican Demir, 2018).

The attitude or characteristics of mathematical communication skills are known based on the results of interviews with the subject directly. In general, the interview results of the subject reflect that of 3 subjects are able to reflect indicators of mathematical communication skills, although in WL and AHB subjects do not meet the overall indicator of mathematical communication skills. Because in the learning that takes place the subject is able to reflect that used in this study. Attitudes or characteristics of mathematical communication. Not only in the learning process, but in the interview process when the subject is asked to solve the problems directly in front of the WL, AHB and KSS subject researchers are able to complete them well, create mathematical models and can explain them. With this attitude, the mathematical communication skills possessed by the subject can be measured well (Kusumaningrum, 2016; Rahmawati, 2013).

More specifically the mathematical communication skills for indicators to explain and make mathematical statements that have been studied are owned by the subjects of WL, AHB and KSS. This is evident from the three subjects were able to explain where the mathematical model he obtained, although in the subject WL did not fully meet the indicator of mathematical communication skills. Different things happen to able and KSS subjects, in the interview process both subjects are able to solve the problem well and are able to explain where or how to make a mathematical model and then get answers to the problem.

The same thing also happens in indicators providing explanations of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically. On the indicator is fulfilled by the subject AHB and KSS because both subjects are able to provide a

complete and detailed explanation of the ideas or concepts they have in the process of solving the problem. While the subject of WL was unable to explain the answers he had obtained in the interview process took place.

The last indicator is that everyday events in a language or mathematical symbol are only achieved by the subject of KSS. KSS subjects in the interview process are able to make examples of mathematical models as well as ways of completion related to everyday life. While on the subject of WL and AHB can not answer the questions submitted by researchers related to the indicator.

In general, the indicators achieved by each subject, namely the subject of WL, reached one indicator of mathematical communication, namely the subject explaining and making mathematical statements that have been studied, abb subjects only reached 2 of 3 indicators of mathematical communication skills, namely explaining and making mathematical statements that have been studied and providing explanations of mathematical ideas, concepts, or situations with their own language in the form of mathematical writing, While the subject of KSS achieves the overall indicator of mathematical communication skills used in this study, namely explaining and making mathematical statements that have been studied, stating everyday events in a language or mathematical symbol, and providing an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematical ideas, stating everyday events in a language or mathematical symbol, and providing an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematical ideas, stating everyday events in a language or mathematical symbol, and providing an explanation of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically (Asikin & Junaedi, 2013).

CONCLUSION

Based on the results of the above research, it can be concluded that mathematical communication skills are achieved by 1 subject, namely KSS subjects. AHB subjects only reached 2 of 3 indicators of mathematical communication skills, namely explaining and making mathematical statements that have been studied and providing explanations of mathematical ideas, concepts, or situations with their own language in the form of writing mathematically, and WL subjects only reached 1 of 3 indicators of mathematical communication skills, namely explaining and making mathematical statements that have been studied and providing explanations of stills, and WL subjects only reached 1 of 3 indicators of mathematical statements that have been studied.

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