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Assessing Mathematical Connections Abilities in Algebraic Operations: A Qualitative Case Study of Eight-Grade Students

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Abstract: With a case study approach, this qualitative research aims to determine students' mathematical connection ability in solving mathematical problems with algebraic arithmetic operations. The subjects of this study were 30 students of grade VIII at a junior high school in Indramayu Regency. The data collection technique in this study used several instruments, namely mathematical connection ability test questions, interviews, and documentation. The data analysis technique used a descriptive method consisting of three main stages: data reduction, data presentation, and conclusion. Based on the analysis of the entire question instrument, it was found that most students had difficulty solving problems by linking relationships between topics in mathematics. In addition, students are not yet able to think about using mathematical concepts in other fields of study and have not been able to apply mathematical concepts widely in everyday life. This low mathematical connection ability can be caused by several factors, including students' lack of conceptual understanding, learning methods that have not optimized the relationship between topics in mathematics, and the lack of contextual and applicable practice questions. This indicates that the learning provided still tends to focus on procedures without emphasizing the relationship between concepts in more depth. More innovative learning strategies are needed to improve students' mathematical connection skills, such as problem-based learning, contextual learning, and integrating mathematical concepts with real life and other fields of study. Thus, the level of mathematical connection abilities of grade VIII students is still relatively low, so efforts are needed to improve learning strategies to develop mathematical thinking skills more broadly and connect with various contexts.

Keywords: algebraic operation, mathematical connection ability, mathematical problems.

▪ INTRODUCTION

Mathematics is a science that consistently solves various problems in life, so studying it is very important. This science is structured and systematic, developing from simple concepts to more complex ones (Jingga et al., 2018). The higher the educational level of a person, the more complex the topic to be studied will be (Fitriani & Nurfauziah, 2020). The main goal of teaching mathematics in secondary schools is for students to understand mathematical concepts. This understanding includes competence in explaining the relationship between concepts and applying concepts or algorithms in solving problems (Subchan et al., 2018). Learning mathematics at school is one of the essential learning areas because mathematics is a scientific discipline that relies on thinking processes. In addition to connecting concepts, students can also understand mathematical concepts (Pradika et al., 2019)

Students must be able to make connections between ideas from other scientific disciplines and daily life, as well as from within and outside of mathematics, to prepare for the learning objectives in mathematics to be successful. This ability is called the mathematical connection ability. Without the ability to make mathematical connections, students will experience difficulties in learning mathematics (Siregar & Surya, 2017). The capacity of a student to comprehend mathematical concepts, make connections between

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ideas and methods, and apply those notions to other scientific disciplines or daily life is known as mathematical connection ability (Putri, 2017). The relationship between concepts and procedures in a problem is the relationship between conceptual knowledge and procedural knowledge. Because both have a positive correlation, procedural and conceptual understanding are very important in building mathematical connections (Dolores-Flores et al., 2019). These correlations can be developed through instruction and improve mathematical understanding. Mathematics learning that engages students' ability to make mathematical connections can enhance their mathematics comprehension, helping them understand concepts better and retain them longer.

Students must learn to remember many mathematical concepts if they do not have mathematical connection abilities. Students will see mathematics as an integrated and not separate discipline when concepts can be connected (Fendrik, 2019). Based on this statement, mathematical connection skills provide benefits to students because they help them broaden their horizons, see mathematics as a whole, and understand the relationship and application of mathematics in various fields. Students who can build mathematical connections have specific criteria, which are referred to as indicators of mathematical connections. National Council of Teachers of Mathematics (2000) indicates that mathematical connections are divisible into three categories of connections, which shows the student's ability to make connections. This category includes connections between math topics, connections with other sciences, and connections with the natural world or everyday life. In this way, students can understand that mathematics is a broad science (Bernard, 2014), it is used in mathematics, other studies, and everyday life to build students' knowledge and abilities.

The findings in previous studies demonstrate that the proficiency of students with mathematical connections in mathematics courses is still relatively low. Among these studies are those conducted by the National Council of Teachers of Mathematics (2000), which concluded that students' mathematical connection abilities in spatial building based on gender differences fall into low categories. The research results showed significant differences between male and female students. This study revealed significant differences between male and female students, where female students' mathematical connection abilities were generally higher than male students. This finding emphasizes the importance of considering gender factors in mathematics learning to improve students' mathematical connection abilities. A study conducted by Krisno et al. (2019) found that grade VII students had low mathematical connection abilities in learning geometry. Students experience difficulty in linking mathematical concepts to solve connection problems between mathematical concepts. This shows the need for students to get used to working on problems that hone mathematical connection abilities. In several studies completed, mathematical connection abilities are of particular concern because mathematical connection abilities are students' ability to understand that mathematics consists of various related topics that share a connection (Apipah & Kartono, 2017). However, students' mathematical connection abilities are still relatively low, as indicated by their difficulties in solving problems involving mathematical connections (Krisno et al., 2019). Thus, it is clear that students' mathematical connection abilities still need to be improved. We already know that mathematical connection abilities are essential for secondary school. Therefore, there is hope that teachers can provide mathematics lessons

to students in a directed and planned manner so that they can see the picture and find the best way to improve students' mathematical connection abilities.

Students must master several topics in mathematics, one of which is algebra (Maharani et al., 2019). Algebra is a tool used to analyze various conditions in mathematical problems. Understanding the basic concepts of algebra is very important because it will benefit students when studying a topic that involves algebraic forms at a later stage. Algebraic operations require a deep understanding of the concept so that students can fully master it. Many students have good mathematical abilities but have difficulty conveying their work results to others (Rohmah & Rinaldi, 2019). One is that students still experience many errors in working on algebra problems, especially in writing symbols, operations, and signs (Nugraha et al., 2015).

This research differs from previous research because it involves grade VIII junior high school students and uses the topic of algebraic operations. Previous research involved reviewing gender and discussing geometry topics extensively. Therefore, researchers will analyze students' mathematical connection abilities in algebraic operations to determine the level of mathematical connection abilities of students in answering mathematical problems about algebraic operations.

Based on the statement above, a study is needed on the mathematical connection ability of grade VIII students on the topic of algebraic operations, considering the importance of students' mathematical connection ability in solving problems. The question to be answered in this study is: to what extent is the level of mathematical connection ability of grade VIII students in the school? Specifically, the results of this study can help teachers complete the given objectives and develop a general picture of the mathematical connection abilities of junior high school students.

▪ METHOD

Participants

This research was conducted in January 2024 at one of the junior high schools in the Indramayu Regency. The study subjects consisted of 30 grade VIII students with varying levels of ability, selected through a purposive sampling technique, which is a method of selecting subjects based on certain criteria and objectives. The subjects were selected based on observation results and teacher recommendations, hoping that they could represent the research objectives. Of the 30 students, the researcher chose five students as the main subjects based on their ability to communicate well so that they could provide more in-depth information regarding mathematical connection abilities.

Research Design and Procedures

This study uses a qualitative method with a case study approach. The researcher chose this approach to explore the learning barriers participants experienced in understanding exponential material. Qualitative research aims to present findings in narrative descriptions that comprehensively describe the situation being studied (Widiati et al., 2020).

The case study was chosen by (Creswell, 2018), which states that this method involves exploring a particular process, activity, or event. The study lasted for two weeks and began with giving participants a test containing exponential problems. The test was conducted under strict supervision to prevent using calculators, textbooks, or discussions

between students. The test results were recorded in a table, including the number of correct and incorrect answers. In addition, errors in the answers were analyzed and classified based on the type of error made by the student. This approach makes it easier to identify mistakes and helps students understand specific areas where they have difficulty.

After analyzing the test results, the researcher developed a rubric to evaluate students' mathematical connection abilities. Rubric scores range from 0 to 5, where a score of 0 indicates that the student did not provide an answer, while a score of 5 indicates that the student was able to answer the question completely and correctly. Table 1 presents the categories of mathematical connection abilities in this study.

Table 1. Categories of students' mathematical connection ability

Category	Mathematical connection ability achievement (%)
High	$70 \leq KKN < 100$
Currently	$50 \leq KKN < 70$
Low	$0 \leq KKN < 50$

Next, students were asked to identify and articulate the types of errors they made. Five students were then selected to participate in in-depth interviews as representatives. The interviews were conducted individually, and problems focused on students' thinking when answering problems and how they learned exponential topics.

Instruments

The instruments used in this study included semi-structured tests and interview sheets. The researchers developed the test instruments and validated them with the help of a mathematics education expert to ensure their validity and relevance in measuring students' understanding of algebraic operations. This test, given to 30 students, consisted of five essay problems designed to evaluate students' mathematical connection abilities in algebraic operations. The selection of essay-based questions was based on the consideration that this type of problem can provide an overview of students' thinking processes so that researchers can analyze level of their mathematical connection abilities.

The five problems were arranged based on mathematical connection indicators, which include (1) the application of relationships between various representations of concepts and procedures and understanding of relationships mathematical between topics, (2) the ability to solve mathematical problems in different forms that are relevant to various forms outside of mathematics, and (3) application of mathematical concepts and formulas to solve everyday problems. Each indicator is represented by one specific problem. During the test, students were prohibited from opening books or using calculators to ensure their answers reflected independent thinking processes. The test instrument is prepared based on indicators of mathematical connection ability and has a scoring rubric. The test instrument indicators are visible in Table 2.

Table 2. Indicators of mathematical connection ability problems

Indicator of mathematical connection abilities	Indicator of learning	Problems number
Students can apply the relationships betweenvarious representations of	Solving Algebra problems related to geometric concepts.	1. 2

concepts and proceduresand understand the relationships between mathematical topics.		
Students can solve mathematical problems in various forms outside mathematics.	Solving Algebra problems related to science concepts (Physics).	3
Students can apply problems, mathematical concepts, and formulas to problems related to every day.	Solve Algebra problems related to every day.	4. 5

The five problems designed based on connection mathematical ability indicators are below in Figures 1 to 5.

1. Students can apply the relationships between various representations of concepts and procedures and understand the relationships between mathematical topics.

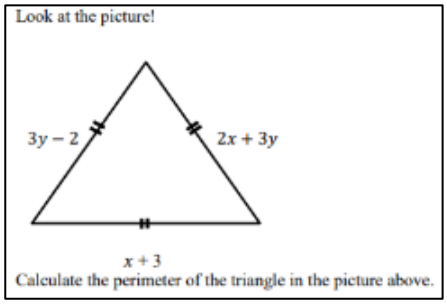

Figure 1. Problem 1

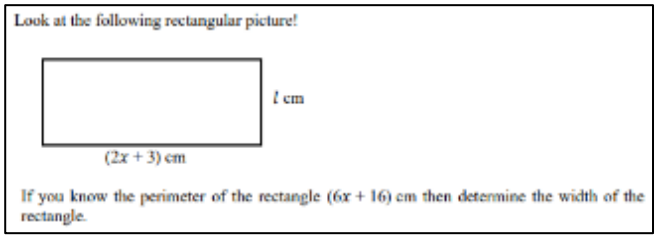

Figure 2. Problem 2

2. Students can solve mathematical problems in various forms outside mathematics.

A bicycle moves on a straight road and its position at any time can be expressed by $x = 2t^2 + 5t - 1$, x in meters, and t in seconds. Determine the average speed of the bicycle between t =2 seconds and t = 3 seconds.

Figure 3. Problem 3

3. Students can apply problems, mathematical concepts, and formulas to problems related to everyday life.

Ardi and Ahmad each bought beef and chicken at the same place. Ardi bought 2 kg of beef and3 kg of broiler chicken for IDR 354.000,00. Ahmad bought 1 kg of beef and 4 kg of broiler chicken for IDR 272.000,00. So, how much should they pay if they want to buy 6 kg of beef and 14 kg of broiler chicken?

Figure 4. Problem 4

The following is a conversation between two students, namely Azka and Bunga. Azka will guess Bunga's birth month.
Azka: Bunga, try multiplying the number of your birth month by 6, then add 15 to your answer,then divide by 3, and subtract the result by 5. What is the last number you get?
Bunga: Eight.
From the conversation between the two students, Bunga was born in what month?

Figure 5. Problem 5

Data Analysis

Data analysis in this study refers to the Miles and Huberman model, which consists of three main stages: data reduction, data presentation, and conclusion. In the first stage, data reduction, relevant data are selected from the results of mathematical connection tests and interviews, while unnecessary information is ignored. This process aims to organize data in a more structured way to facilitate analysis and conclusions.

The second stage, data presentation, includes classifying and identifying information based on indicators of students' mathematical connection abilities. Thus, data can be presented regularly to support more explicit interpretations. The final stage, concluding, involves deeply understanding students' mathematical connection abilities, identifying the factors that influence them, and formulating learning strategies and approaches appropriate to the local context to improve students' mathematical connections.

▪ RESULT AND DISSCUSSION

Based on the results of a written test by 30 grade VIII students on the topic of algebraic operations using a mathematical connection test instrument with five essay problems. The results obtained from this research are an analysis of students' answers based on the mathematical connection assessment guidelines shown in Table 1. The results of the mathematical connection assessment on algebraic operations can be seen in Table 3 below.

Table 3. Test results of students' abilities in mathematical connection

Problems number	N	Score						Total score	Percentage (%)
		0	1	2	3	4	5		
1	30	0	29	1	0	0	0	31	20.7
2	30	0	29	0	0	0	1	34	22.7
3	30	0	29	0	1	0	0	32	21.3
4	30	0	25	3	0	0	2	41	27.3
5	30	0	27	2	0	0	1	36	24

The percentage of students' mathematical connection abilities in calculating research results based on applicable mathematical formulas or rules, in problems 1 and 2 with percentages of 20.7% and 22.7%, respectively, meaning that students have not been able to solve the problems in this way and apply relationships between mathematical topics, however in problem 3, the percentage is 21.3%, meaning students are not yet able to think using mathematics in other subjects. In problems 4 and 5, the respective percentages are 27.3% and 24%, which means students have difficulty applying mathematical concepts to real-life situations, which shows the difficulty in generalizing mathematical thinking into everyday scenarios. The average percentage of students' connection abilities in all problems reached 23.2%, which means that grade VIII students have relatively low connection abilities.

In response to problem 1, students were asked to calculate a triangle's perimeter where each side is an algebraic form by relating the concept of an equilateral triangle. The analysis revealed that only one student, or 3.3%, got a score of 2, and 29 students, or 96.7%, received a score of 1. Figures 6 and 7 show examples of the work of students who experienced errors in solving problems.

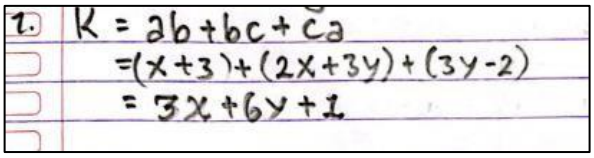

Figure 6. Solution of S1

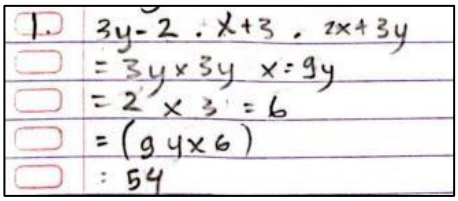

Figure 7. Solution of S2

The first issue was left unanswered by any of the subjects, and the indications of the mathematical link still had to be satisfied. The test results revealed that almost all students failed to answer problem 1. Visible from 30 students, only one student got a score of 2. The student knows mathematical concepts but needs help to apply them to find solutions. S1 already understands what the problem requires, namely the basic idea of the circumference of a triangle by dividing each side into sides, a, b, and c. Still, he has not been able to determine the relationship between the circumference of a triangle and the properties of an equilateral triangle, namely that all three sides are the same length. S1 only adds up the three known sides, making the solution less precise. Meanwhile, in S2, they need help understanding the meaning of the problems. Meanwhile, S2 had a misconception by multiplying the lengths of the sides of the triangle instead of adding them. This error indicates a lack of conceptual understanding and difficulty applying the formula correctly. The causative factors can come from too procedural learning, minimal contextual practice problems, and lack of discussion and reflection in class. To overcome this, teachers need to prioritize conceptual understanding before moving on to more complex questions, use visual illustrations, and involve students in discussions of errors so that they better understand the concept of the perimeter of a triangle.

In response to problem 2, students were requested to determine the width of a flat shape by relating the concept of the perimeter of a rectangle, where each side is an algebraic form. It is known from the analysis findings only one student, or 3.3%, got a score of 5, and 29 students, or 96.7%, received a score of 1. Examples of students' work results in solving problems are visible in Figure 8 and Figure 9.

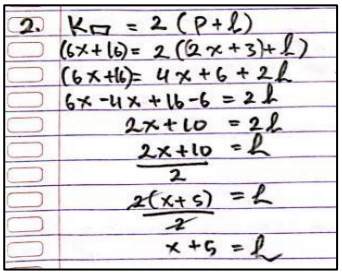

Figure 8. Solution of S1

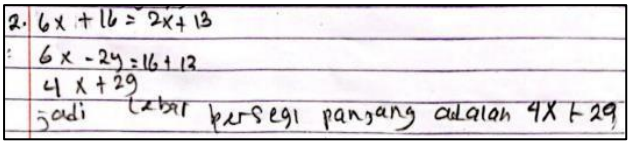

Figure 9. Solution of S4

There is a difference in understanding between S1 and S4 when solving the perimeter of a rectangle problem. S1 already understands what the problem requires, namely the basic concept of a rectangle's perimeter, and can solve the problem clearly and coherently and find the right solution. In contrast, S4 made a mistake in interpreting the problem, assuming that the perimeter of a rectangle is the same as its length. S4 made

a mistake in interpreting the problem; he interpreted the sentence "if the perimeter of a rectangle is (6x + 16) cm" as the same as "the length of the rectangle" even though the two pieces of information have different meanings. This results in the final answer obtained needing to be more accurate. This error indicates a lack of understanding of the conceptual differences between length and perimeter. The causative factor could be a lack of knowledge of the language in the problem or the lack of strong basic geometric concepts. To overcome this, more diverse practice questions, visual approaches, and discussions about common mistakes are needed so that students can understand the idea better.

In response to problem 3, students were asked to calculate a bicycle's speed of movement by relating the concept of average speed to science subjects, especially physics. It is known from the analysis findings that only one student, or 3.3%, got a score of 3, and 29 students, or 96.7%, received a score of 1. Examples of the work of students who experienced errors in solving problems are visible in Figures 10 and 11.

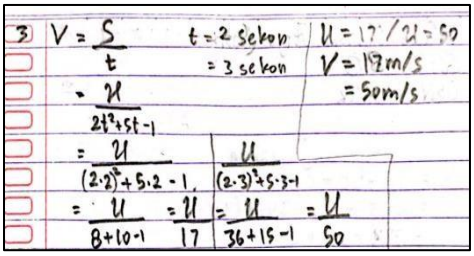

Figure 10. Solution of S1

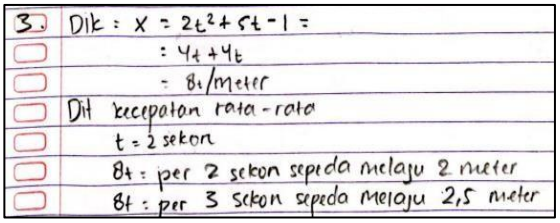

Figure 11. Solution of S3

No participants answered question number 3 correctly or met the mathematical relatedness indicator. Almost all students needed help in solving the problem. It is visible that S1 understood the basic concept of speed and could write the formula but had difficulty applying it to find the solution. In the meantime, S3 has had more difficulty comprehending the problem's meaning. S3 only adds up each number term contained in a known equation, such as 2t2 calculated to be 4t (the first number term) obtained from 2 as a coefficient multiplied by two as a power, then multiplied by t, then 5t-1 is calculated to be 4t (term the second number) obtainable from 5 as the t coefficient minus one as a constant. Hence, the result is 8t obtained from 4t + 4t. This error indicates a lack of conceptual understanding and difficulty interpreting algebraic symbols and structures. To overcome this, a more exploratory learning approach is needed, such as contextual examples, visualization of concepts, and exercises considering understanding concepts before calculation procedures.

In response to problem 4, students were requested to calculate the price of each kg of each meat, which is related to daily life. Only two students, or 6.7%, got a score of 5, 3 students, or 10%, earned a score of 2, and 25 students, or 83.3%, earned a score of 1. These findings depend on the analysis. Examples of students' work in solving problems are visible in Figures 12, 13, and 14.

There are differences in students' understanding of solving linear equations with two variables. S1 already knows what the inquiry is asking for, meaning that he is to comprehend the idea of a system of linear equations in two variables by assuming that chicken broiler is y and beef is x. The required equation and the correct solution are then

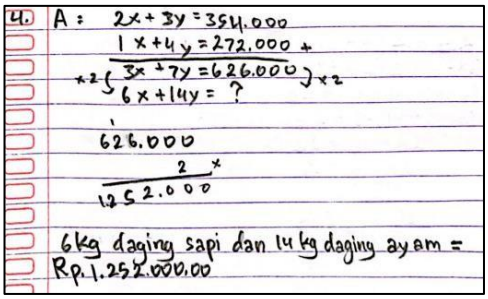

Figure 12. Solution of S1

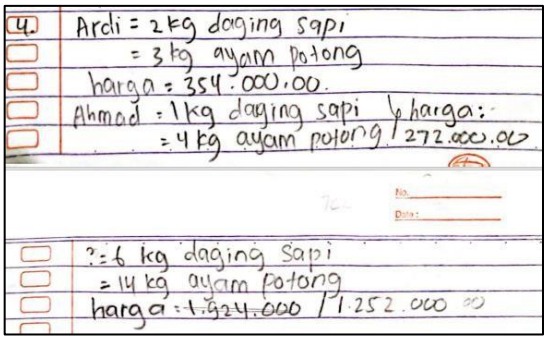

Figure 13. Solution of S2

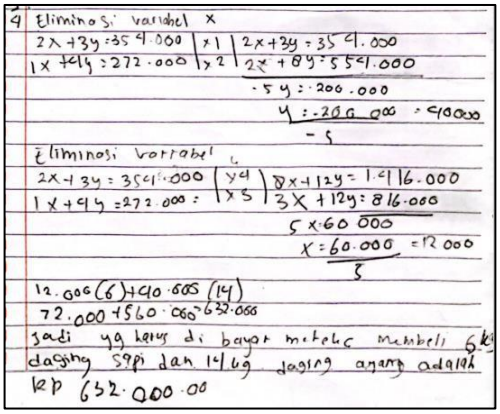

Figure 14. Solution of S4

obtained by adding the two equations and multiplying by two. S2 has difficulty understanding the problem, so his answer lacks conceptual understanding. Meanwhile, S4 already understands the purpose of the problem but makes mistakes in the calculations, so the final answer is not entirely correct. These mistakes show the importance of understanding the concept and the application of the accurate calculation procedure. To overcome this, exercises are needed that emphasize the relationship between ideas and solution strategies and get used to verifying calculation results.

In response to problem 5, students were requested to find out a person's birth month, which is related to everyday life. According to the analysis findings, just one student, or 3.3%, got a score of 5, 2 students, or 6.7%, earned a score of 2, and 27 students, or 90%, received a score of 1. Examples of students' work in solving problems are visible in Figures 15, 16, and 17.

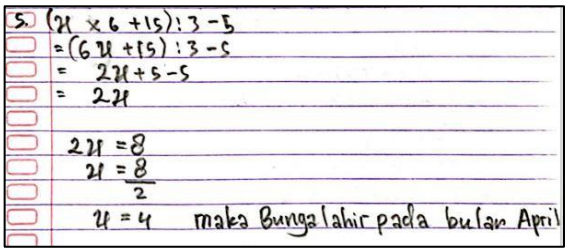

Figure 15. Solution of S1

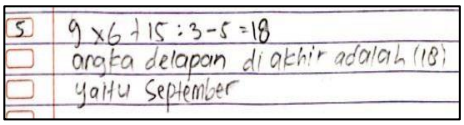

Figure 16. Solution of S2

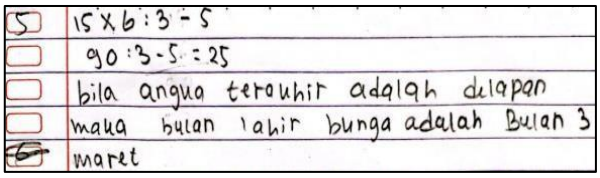

Figure 17. Solution of S4

Based on the test results, There are differences in students' understanding of solving algebraic operations problems. S1 understands the concept well by assuming Bunga's birth month as the variable x and successfully finds the correct solution. In contrast, S2 does not include the birth month in the calculation, resulting in an error in the process, and the final answer is less precise. S4 also made a similar error by not taking the birth month into account and making a mistake in determining the arithmetic operation, where he only multiplied 15 by 6 without following the instructions of the problem as a whole. This error shows a lack of understanding of variables and algebraic operations. To overcome this, more structured practice, the use of concrete examples, and getting used to translating problems into correct mathematical models are needed.

To understand the level of students' mathematical connection ability in solving algebraic operation problems, an analysis was conducted based on the results of a written test involving 30 grade VIII students. The results of this assessment are then presented in the diagram in Figure 18 below to provide a clearer picture of the percentage distribution of students' mathematical connection ability on each problem.

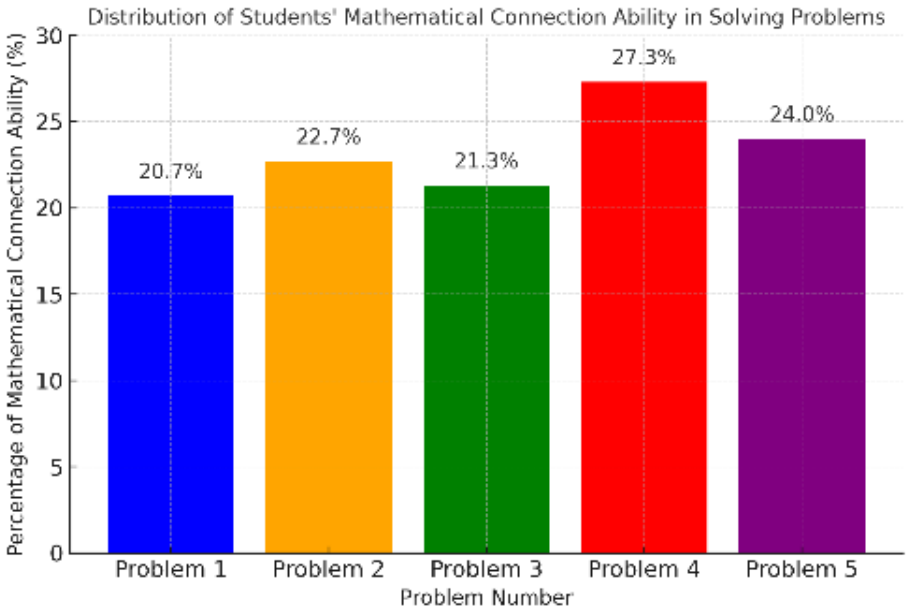

Figure 18. Mathematical connection ability distribution in solving algebraic operation problems

The diagram shows that students' connection mathematical ability in solving problems is still relatively low, with an average of only 23.2%. Problem 4 has the highest

percentage (27.3%), indicating that students are relatively more able to connect mathematical concepts in everyday life, such as calculating the price of goods. Problem 1 has the lowest percentage (20.7%), which indicates students' difficulty in understanding basic geometry concepts, especially in calculating the circumference of a triangle with algebraic forms. Problem 3 (21.3%) is also relatively low, indicating that students have difficulty connecting mathematical concepts with other sciences, such as calculating speed in physics. These results suggest that students still struggle to understand the relationship between mathematical concepts and apply them in various contexts. A learning approach based on conceptual understanding and real applications is needed to improve students' mathematical connection abilities.

In addition to the previously mentioned results of the study and analysis, the researcher conducted conversations with several students who participated as research subjects to obtain additional specific information. According to the research results, not all students can solve mathematical problems by producing the correct answer. Instead, they are requested to think about mathematical connections and try to solve problems as best as possible. According to Kiswanto Kenedi et al. (2019), the mathematical problem-solving process is an activity that can build students' mathematical connections, help students understand the relationship between mathematical concepts and procedures, and use mathematics to solve problems in everyday life. Learning and the process of learning mathematics can be challenging for everyone (Brousseau, 2002). Learning obstacles make it harder for students to study or work through challenges (Khairin et al., 2019).

The application of relationships between various representations of concepts and procedures and understanding of relationships mathematical between topics

None of the students were able to answer the first problem correctly. The inability of the subjects to comprehend the information offered in the photos made it difficult for them to answer the problems. Students' understanding of mathematical language is still lacking, so students cannot interpret the problems given, and students also experience difficulties in understanding the initial concept of flat shapes, which causes them to be unable to solve problems correctly (Fadillah et al., 2022). Aside from that, S1 acknowledged that he was aware that the triangle in issue was a triangular equilateral triangle and that each of its three sides had the same length. However, S1 was unsure of what to do next and finally just added the triangle's three sides, which remained in algebraic form. Some students can use relationships between mathematical concepts but must provide appropriate solutions to problems (Qondiyana et al., 2021). Meanwhile, S2 admitted that he had forgotten the formula for the perimeter of a flat shape. Students' mistakes in working on mathematics problems tend to be that they need help understanding the situation and have difficulty solving algebraic issues, thus indicating that their initial knowledge is not well-connected (Diana et al., 2020).

In problem 2, of the 30 students who acted as research subjects, only one person worked on it and got the correct answer, namely S1. Based on the interview results, he answered every problem clearly and confidently. However, S1 did not write a conclusion at the end of the answer. Meanwhile, S4 had difficulty finding ideas that had to be linked to the concept of circumference in flat shapes to solve the problem given. Students' lowest abilities are in connections between mathematics topics (Lestari, 2014). The vast number of mathematical topics that are to be connected to answer issues, as opposed to the

connections between mathematics and other scientific domains and the actual world, is among the elements that contribute to the low degree of connection ability between problems. Hence, they require a high range of thinking. Conceptual errors are a type of error that students make when solving math problems. Mistakes in formulating a theorem that responds to the difficulties are considered conceptual mistakes that are costly, or errors in using a theorem that do not meet the prerequisites for its validity (Budiyono, 2008).

The ability to solve mathematical problems in different forms that are relevant to various forms outside of mathematics

Three was the problem that none of the participants answered right. All students needed help understanding the relationship between algebraic form and average speed. According to the findings of many student interviews, the study subjects need assistance in coming up with the best solutions to the problem. During the interview, S1 realized his mistake, namely not understanding the sentence "the average speed of a bicycle is between t = 2 seconds and t = 3 seconds", so he used the speed formula instead of average speed, which resulted in his answer being less precise. Most students experience difficulty understanding problems and choosing appropriate mathematical concepts or procedures for solving problems, so students have difficulty connecting topics in other subjects with relevant mathematical concepts (Putri & Wutsqa, 2019). Even if students understand the connections between mathematics and physics, they nevertheless fail to establish the connection (Sari et al., 2020).

Application of mathematical concepts and formulas to solve everyday problems

In problem 4, two people answered the problem correctly, namely S1 and S2, even though the implementation process differed. Each person has their stages of completion and opinions in problem-solving, even though the problem is solved the same way (Diana et al., 2020). S1 worked on the problems correctly and systematically, even though the answer sheet did not say what was known and asked in the problems. When interviewed, S1 could explain the results of the written work again, meaning S1 understood the information in the problem without writing it back on the answer sheet. Meanwhile, S2, when interviewed, was unable to explain the results of his work even though the final results were correct, and he only stated that he needed to remember why he answered problems like those in Figure 13. Students experience difficulty modeling contextual problems correctly, applying the mathematical concepts and procedures they have learned, and developing mathematical ideas to solve problems (Ayunani et al., 2020). Even though the answer from S4 is not correct, the stages of completion are proper. The main mistake made by S4 was doing the calculations incorrectly so that the answer could have been more precise. Sometimes, students are not careful in their work even though they understand mathematical concepts (Qondiyana et al., 2021).

Out of the thirty students that participated in the research, in problem 5, only one person got the correct answer, and several other students tried to do it but made mistakes during the mathematical modeling process (changing the problem sentence into a mathematical model) so that the answer was not correct. The errors experienced by students include not being able to identify connecting words in the topic of algebraic operations and not being able to carry out transformations from story problems into

algebraic form (Farida et al., 2021; Malihatuddaroj et al., 2019). S1 can answer problems concerning his work with firmness and clarity based on the interview's outcomes. However, several other students could not retell the plot of the work they had written and only said they did not know because they were working on free composition. Due to the minimum degree of algebraic competence in the form of narrative problems (Farida et al., 2021), students' ability to solve algebraic problems is still poor (Mulyani et al., 2018).

Factors causing low mathematical connection

Based on the interview results, students' difficulties in building mathematical connections when solving story problems on algebraic operations are caused by several main factors. One of the leading causes is low problem-solving skills, which hinder understanding and solving problems that require relationships between concepts. In addition, the lack of fluency in the solution procedure causes students' answers to be incomplete, so their scores are reduced, and their mathematical connection abilities are not visible. Another factor is low reasoning ability, which hinders students from determining the right solution strategy, so errors often occur in applying the correct concept or procedure. Lack of accuracy in reading questions is also an obstacle, especially in story problems that require understanding the relationship between mathematical topics. Errors in understanding this information make it difficult for students to determine the appropriate concept to use in solving. In addition, students' weak memory also contributes to their difficulties in working on problems, especially if the material being tested has been studied for a long time.

Therefore, mathematical connection abilities play an important role in learning mathematics. If this skill is not developed correctly, students will experience difficulties understanding and solving problems thoroughly. For this reason, students' mathematical abilities need to be strengthened in the learning process at school to become more skilled in connecting various mathematical concepts and applying them in problem-solving.

The relationship between the findings and previous research

Previous research by Krisno et al. (2019) highlighted grade VII students' low mathematical connection ability in geometry learning, where students had difficulty connecting mathematical concepts to solve problems. This aligns with the findings showing that students still have difficulty understanding and applying basic mathematical concepts, such as the circumference of a triangle, speed, and algebraic operations. Both studies emphasize the importance of learning, emphasizing conceptual understanding and the relationship between mathematical concepts. However, the difference lies in the focus of the analysis: Krisno et al. (2019) research highlights the general mathematical connection aspect, while the findings through interviews are the types of errors made by students and the causal factors, such as overly procedural learning and lack of reflection. Thus, the first statement offers concrete solutions, such as visual illustrations, error discussions, and contextual exercises, which can be steps to improve the problems identified in previous studies.

▪ CONCLUSION

Based on the research results, the mathematical connection ability of grade VIII students in one of the junior high schools in Indramayu Regency on the topic of algebraic

operations is relatively low. This can be seen from students' average connection ability, which reached 23.2%, as shown through the results of working on mathematical connection instrument problems. Students need help to apply the concepts they have learned previously to the concepts found in flat shapes, resulting in difficulty in solving problems. Students need to remember the topic about distance, time, and speed, so they need clarification in determining the ideas to solve problems. Most students have been unable to solve algebraic calculation operation problems related to everyday life. Some limitations of this research include interference and a lack of research results, including the limited data used. Despite the researchers analyzing three indicators of mathematical connection abilities, a more in-depth analysis needs research on the factors that impact students' ability to make mathematical connections. Based on the research results obtained, the researcher makes the following suggestions: (1) Giving students questions can help teachers identify their mathematical connection abilities; therefore, it is recommended to apply problem-based learning in the learning process. (2) The research results show that students' mathematical connection abilities in solving problems vary. Be expected that these differences will be helpful as a reference for teachers in determining suitable learning models to balance differences in students' connection abilities, learning models whose application requires discussion between students to achieve the same success.

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