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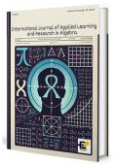

Profiling Seventh-Grade Students' Mathematical Connections in Rational Number Topics: A Study at an Islamic Integrated Junior High School in Pekanbaru

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ABSTRACT

Purpose – This study describes seventh-grade students' mathematical connection ability in rational number topics at an Islamic Integrated Junior High School in Pekanbaru, prompted by recurring difficulties with cross-conceptual and contextual problem solving.

Methodology – Using a descriptive qualitative design and purposive sampling, three Grade VII students were selected to represent high (DP), medium (KY), and low (IS) achievement. Data were gathered through a written test (three rational-number tasks) and in-depth interviews guided by NCTM (2000) mathematical connection indicators. Analysis included data reduction, indicator-based coding, test–interview triangulation, and conclusion drawing.

Findings – DP satisfied all three indicators consistently. KY met some indicators but showed weaknesses in symbolization and contextual application. IS showed limited connections within mathematics, across disciplines, and to daily-life situations. Connection ability varied with conceptual understanding and independence, suggesting the need for more contextually and integratively focused instruction on rational numbers.

Novelty – The study offers detailed qualitative profiles of mathematical connections in rational numbers across three distinct ability levels using NCTM (2000) indicators.

Significance – Results support teachers, curriculum developers, and researchers in designing learning tasks and interventions that explicitly cultivate mathematical connections.

Keywords: Descriptive qualitative; Mathematical connection ability; Problem solving; Rational numbers

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1. Introduction

Based on the 2003 law (Ministry of Education, 2003), national education has the main function in developing abilities and shaping the character and civilization of a dignified nation in order to educate people's lives. The purpose of this education is to develop the potential of students to become individuals who believe and fear God Almighty, have noble character, are healthy, knowledgeable, skilled, creative, independent, and become democratic and responsible citizens. To realize this function, various levels of formal education, such as basic education (SD/MI), secondary education (SMP/MTs), higher education (SMA/MA), and Higher Education (PT), play an important role in its implementation. Therefore, the ability to collect, select, and process information in a critical, systematic, logical, and creative way of thinking is needed (Novitasari & Wilujeng, 2018).

According to the National Research Council in (Putra et al., 2018) Mathematics is one of the branches of science that plays a crucial role in the advancement of science and technology, both as a tool for application in various disciplines and in the development of mathematics itself (Fadilla & Wandini, 2023). A good understanding of mathematics can be the key for students to achieve career success in the future.

According to the National Council of Teacher Mathematics (NCTM, 2000), there are five aspects of mathematical skills (doing math), namely: the ability to communicate, reason, solve problems, connect various concepts, and build a positive attitude towards mathematics. Mathematical connections are an important skill that must be taught so that students can connect different mathematical concepts (Muharomi & Afriansyah, 2022). In solving a mathematical problem, good mathematical connection skills are also needed as a supporting factor to relate various ideas.

At the secondary school level, one of the skills that students need to possess and develop is the ability to make mathematical connections. Mathematical connection ability is a student's skill in utilizing the relationship between a mathematical topic or concept with other concepts, with other subjects or other disciplines, and with daily life in solving mathematical problems. This ability is essential in helping students develop a deeper understanding of the interconnectedness between mathematical concepts and how they apply in different fields (Yunita et al., 2024).

As for the indicators of connection ability according to NCTM (2000), the indicators of mathematical connection ability include: (1) Establishing connections between various topics in mathematics, (2) Relating mathematical concepts with other fields of science outside mathematics, and (3) Applying mathematical concepts in daily life situations. Based on the NCTM statement, it can be seen that the ability to make mathematical connections is a student's skill in identifying and communicating relationships in mathematics, which includes the relationship between mathematical topics, relationships with other fields of science, and their application in daily life or real-world situations (Fatunnisa & Fitri, 2021). In other words, this skill is part of the ability to think at a higher level that supports students in understanding concepts more broadly and applicatively.

One of the challenges in learning mathematics is that students' mathematical connection skills are still low. According to (Fahira et al., 2023; Mulya, Darwati & Inayah, 2024; Madya, Angraini & Bonyah, 2025; Apriliani, Kania & Umar, 2025; Ashari, Mayda & Wahyuni, 2025) many students still have difficulty in solving math problems related to daily life situations. Most of them have not been able to interpret the problem well and convert it into

a mathematical model. This condition shows that students' mathematical connection skills are still weak, so they need to be strengthened through more contextual and applicative learning.

Based on the above explanation, we can see that the ability to make mathematical connections is a thinking ability that must be possessed by every student. Without mathematical connections, students must memorize many separate concepts and procedures. With these connections, students are expected to understand various aspects of problem solving Naziah & Setyaningsih, (2024). This mathematical connection ability must be developed at the junior high school level. Based on exposure Sukma et al., (2023) that in mathematics learning, students often face problems that are challenging and cannot be solved instantly. Therefore, they need to think logically, reason, try different approaches, model problems, and apply simple formulas before proving them. This thinking ability, including the skill of making mathematical connections, is an important aspect that every student must have.

Therefore, from the explanation above, it is important for students to have the ability to make mathematical connections. Both in mathematics learning, as well as in learning in other fields and in students' lives, they are not hampered in working on existing problems. Therefore, this study was conducted with the aim of finding out how the mathematical connection ability of grade VII junior high school students in learning mathematics in rational number material.

2. Methods

This research uses a qualitative approach, according to Creswell (2018), which explains exploring and understanding the meaning individuals or groups ascribe to a social or human problem," meaning that qualitative research is an approach to exploring and understanding the meaning that an individual or group gives to a social or human problem. The type or research model used is phenomenology. Haryoko et al., (2020) explains that phenomenology is a qualitative research approach that aims to understand and describe an individual's subjective experience of a phenomenon, with a focus on the "what" experienced and the "how" of how they experience it. This approach emphasizes the meaning that a person gives to his or her life experiences. The data analysis of this research is descriptive, Sugiono, (2013) explained that to describe the facts in the field based on data obtained through observation, tests, and interviews which aims to describe the mathematical connection ability of grade VII students at one of the Pekanbaru IT Junior High Schools on rational number material.

The subjects in this study were 22 grade VII students at one of the Pekanbaru IT Junior High Schools in the second semester of the 2024/2025 school year. The selection of students was carried out using the purposive sampling technique, which is selection based on certain criteria that are relevant to the research objectives (Lenaini, 2021). The criteria include students who have studied rational number material and are considered able to provide representative information related to mathematical connection skills.

The data collection procedure is carried out as follows: (1) a written test of rational number questions. The purpose of giving this test question is to understand how students solve math problems. The test questions in this study amounted to 3 rational number material questions that have described 3 mathematical connection abilities of students based on NCTM. (2) The guidelines used to strengthen the data on the analysis of students' mathematical connection abilities are interviews. (3) The researcher uses documentation when the student conducts the research and as supporting data in the research

The data analysis technique in this study uses an interactive analysis model, which consists of three main stages: data reduction, data presentation, and conclusion drawing or

verification, which takes place simultaneously throughout the Miles & Huberman research process in (Gunawan, 2022). The stages are as follows: (1) Data reduction is the process of analyzing in order to be able to select, decide, simplify, abstract and transform data that arises from field records; (2) data presentation is structured information that provides the possibility of drawing conclusions and taking actions, with the presentation of data, and will make it easier to understand what is happening, plan the next work based on what is understood. The triangulation used is source triangulation, by comparing data from student answers with interview transcripts of students; (3) drawing of conclusions, namely the process of giving conclusions and checking the correctness of the data that can answer the formulation of problems in research. Conclusion Drawing in this study was obtained by comparing the results of the analysis of the work of the written test and the interview of students who became research students so that the ability of students' mathematical connections in the process of solving problems in rational number material can be known.

The researcher analyzed the data based on the students' answers by looking at the categories of students' mathematical connection skills. The categories of students' mathematical connection abilities are as follows:

Table 1 - Categories of Mathematical Connection Capabilities

Category	Achievement of Mathematical Connection Ability
Tall	$\mathbf{70\%} \leq \boldsymbol{x} < \mathbf{100\%}$
Keep	$\mathbf{50\%} \leq \boldsymbol{x} < \mathbf{70\%}$
Low	$\mathbf{0\%} \leq \boldsymbol{x} < \mathbf{50\%}$

Source : Adaptation of (Widiyawati et al., 2022)

3. Results and Discussion

3.1 Results

The purpose of this study is to describe the mathematical connection ability of students who have high, medium, and low student mathematical connection ability categories. The selection of research students is purposive, including DP, KY, and IS. The following is a description of students with the initials DP. DP students are students who have a score of 85 from the results of the mathematical connection ability test where the score is in the high category. Then KY students are students who have a score of 56.25 which in the category is medium and for the IS subjel are students who have a score of 48.75 which is categorized as low. The following will be explained the mathematical connection ability of high, medium and low category students in solving rational number problems.

Provide a *brief* explanation of the table's meaning and significance. Experimental methods can be supported by a diagram that clearly illustrates the process and is accompanied by a legend. Include the scale/dimensions if required (see Figure 2).

3.1.1 DP Students

Based on the results of the test that has been carried out on DP students from 3 questions, the following answer sheet results are obtained.

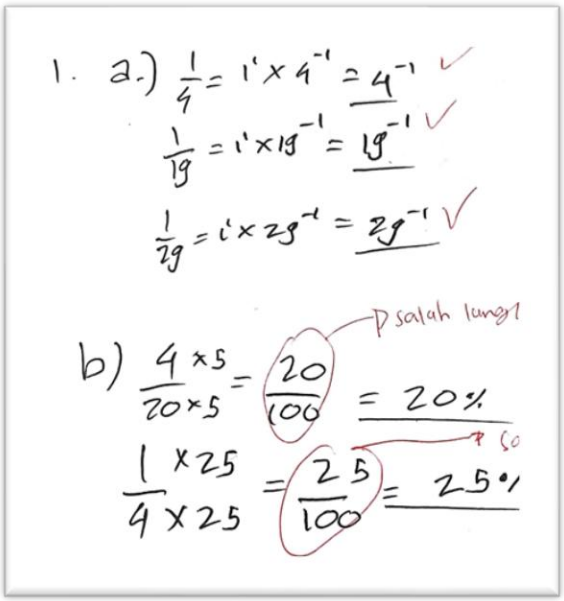

Figure 1. DP No. 1 Student Answer Sheet

DP students are able to solve problem 1a, which is to associate fraction material with the concept of negative rank. However, in question 1b, the student has done the procedure of changing the fraction to the percent form, but the student made a mistake in the work, but got the correct result even though the step used was wrong.

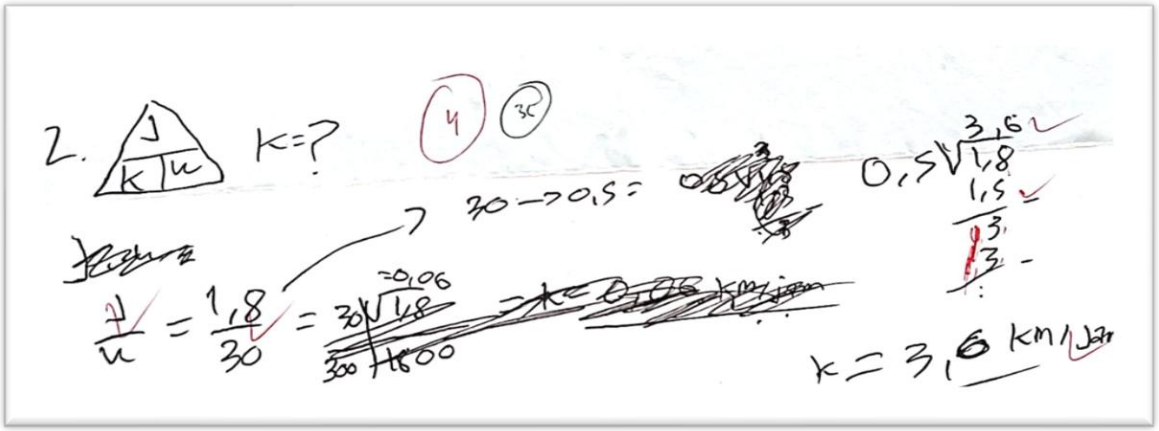

Figure 2. DP No. 2 Student Answer Sheet

DP students in question no. 2 are able to relate rational number material with physics material, precisely in the material on distance and speed calculation. Students can already apply the formula and complete the steps of the work. However, there are still some mistakes in the work steps with the results obtained.

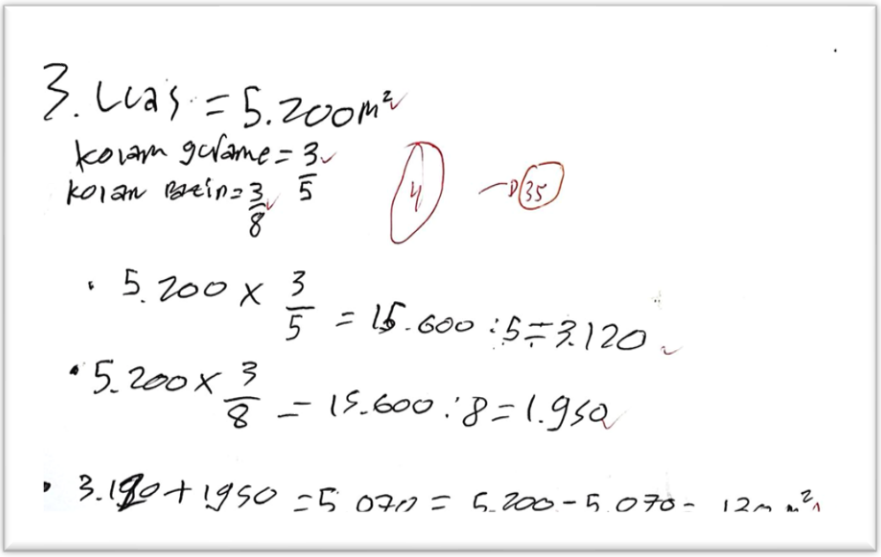

Figure 3. DP No. 3 Student Answer Sheet

DP students are able to present what is known in the questions and then solve problems related to daily life with the right steps and get the correct answers

Based on the transcripts of interviews conducted with DP students regarding information mining as described above, a summary of the interview results on mathematical connection ability is presented in Table 3.

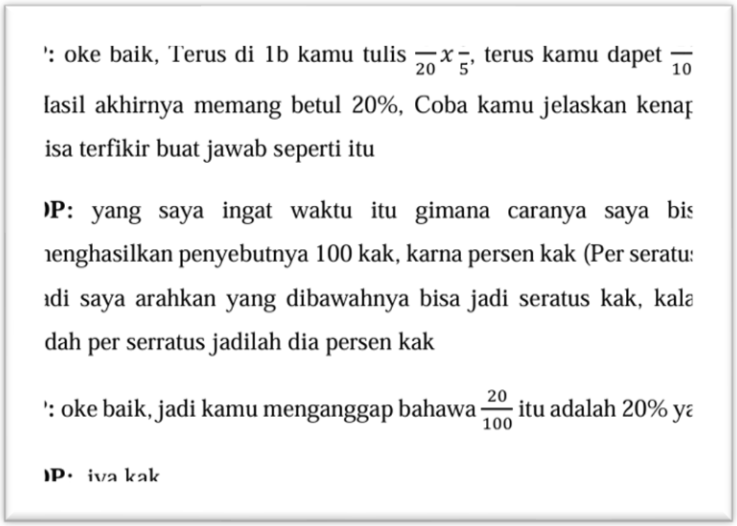

Figure 4. Interview with DP

The DP student stated that he was able to solve the problem given in question 1a, but in question 1b the DP student said that it was equivalent to 20%, because he understood that the percent form means per hundredth, so if the numerator and denominator can be adjusted to per hundredth, then the result is a percent form.$\frac{20}{100}$

Based on the results of tests and interviews, this shows that DP students do not fully understand the basic concept of fraction-to-percentage conversion thoroughly, and tend to rely on memorization of the final form without understanding the underlying logical process.

These findings are in line with research Ully & Hakim, (2022) which suggests that students' low numeracy literacy is often due to a lack of understanding of the basic context and procedures of mathematics. Eka Fauzanah et al., (2024) It also highlights that misconceptions occur due to a superficial understanding of concepts and a weak ability to connect mathematical ideas logically. From the perspective of mathematical connections, this reflects the weak representational ability of students in integrating verbal, numerical, and symbolic forms. Yunita et al., (2024) affirms that mathematical connections include the ability to transform various representations in meaningful contexts. Thus, learning that focuses on strengthening conceptual understanding and mathematical connections is needed so that students can think logically and solve problems in a structured manner.

Based on the results of tests and interviews, DP students showed good ability in meeting the indicators of mathematical connection, especially in relating mathematical concepts to other fields of science and the context of daily life. This can be seen from his ability to write formulas related to the relationship between distance, speed, and time, and visualize them through a triangular approach. In solving questions that test the understanding of the concept of speed, students are able to identify important information from the problem, such as distance traveled and travel time, to determine the value of speed appropriately. Follow-up interviews corroborated this finding, in which the student explained that he had learned the formula in physics, and was able to apply it again in the context of mathematical problems.

This ability reflects cross-disciplinary connections which is one of the important indicators of mathematical connections, as explained by Yunita et al., (2024) that mathematical connection skills include understanding concepts that can be applied flexibly in a variety of situations. These findings are also supported by research Hartley, (2022), which emphasizes that the integration of mathematics with other fields of study, such as physics, can strengthen conceptual thinking skills and broaden students' understanding of solving context-based problems. Thus, DP students demonstrate strong mathematical connections in applying cross-disciplinary concepts logically and relevantly.

Based on the results of the interviews, DP students showed good mathematical connection skills in solving contextual problems related to daily life, especially in the application of fraction and subtraction operations. In the question that displays the context of calculating the area of the fish pond, where students are asked to calculate the remaining area of the catfish pond after knowing the area of the other two ponds, students are able to understand the information presented in the form of a story and convert it into the form of a suitable mathematical model. Students also show accuracy in performing fraction multiplication and subtraction operations, until they obtain the correct wide calculation results.

This ability shows that students not only understand the basic concepts of fractions, but are also able to apply them in real-world contexts with a logical and systematic approach. These findings are in line with the results of the research of Imani, Maimunah, and Imani et al., (2023) which states that students who have high mathematical connection skills are able to identify important information from the story problem and relate it to the right concept. This is also reinforced by the Fahira et al., (2023)who found that mastery of fractional concepts is essential in supporting students' success in solving contextual math problems, especially those related to comparison, breadth, and volume. Thus, DP's success in solving the problem reflects the ability to integrate the understanding of concepts with contextual situations, which is an important aspect of mathematical connections. Based on the results of the analysis of the mathematical connection ability, it is known that the indicators that are fulfilled by DP students are shown in Table 4.

Table 4. Profile of Mathematical Connection Ability of DP Students

Mathematical Connection Ability Indicator	Steps in solving the problem	Information
Connecting concept representations with procedures	• Doing calculations on questions 1a & 1b	✓
	• Using the correct method in question 1a	✓
	• Using the correct method in question 1b	X
	• Write the final result correctly in question 1a	✓
	• Write the final result correctly in question 1b	X
Assess the relevance between math topics	• Write down formulas well and correctly	✓
	• Perform the calculations in the right way	✓
	• Write down the answer correctly	✓
Apply mathematical concepts in the field of economics and daily life	• Write down what you know about the question	✓
	• Solving problems in the right way	✓
	• Write down the final result with a banner and precise	✓

Description: ✓= Fulfilled
X = Unfulfilled

3.1.2 KY Students

Based on the results of the tests that have been carried out on KY students, a summary of the data on the results of the mathematical connection ability test is obtained as in Table 5.

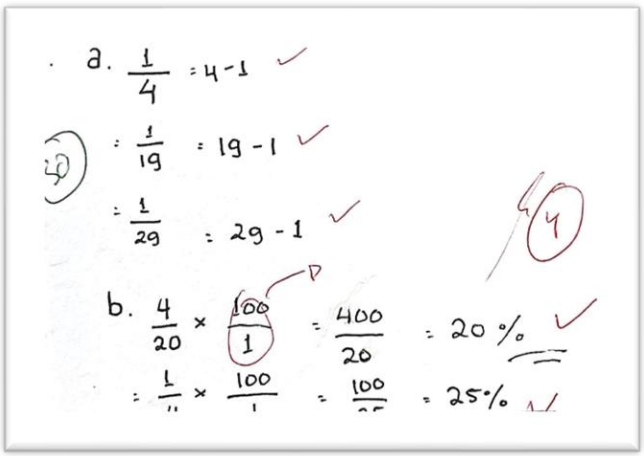

Figure 7. KY Student Answer Sheet No. 1

KY students are able to solve problem 1a, which is to associate fraction material with the concept of negative rank. Then in question 1b Sunjek KY was able to get the correct answer results in different ways, but the way of answering it is still very acceptable, and can still be said to be one of the correct ways as well. But still that KY students still have an error, namely not adding % to the number 100. However, this can still be accepted. $\frac{4}{20}\ x\ \frac{100}{1}$

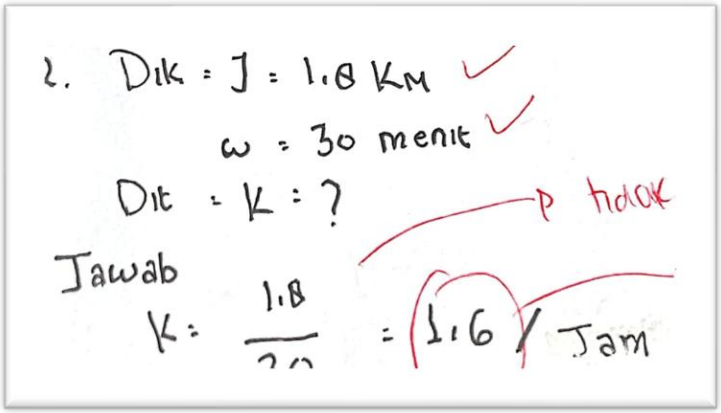

Figure 8. KY Student Answer Sheet No. 2

KY students in this question are able to write what is known in the problem, and can write down what is asked, but KY students do not write specifically related to the formula for calculating distance and speed, students just write what is known into the equation. However, in the process of working on the KY students, they experienced a calculation error, the student forgot to change 30 minutes to a unit of time, where the unit speed should be Km/Hour. This is what causes KY students to experience errors in the final results.

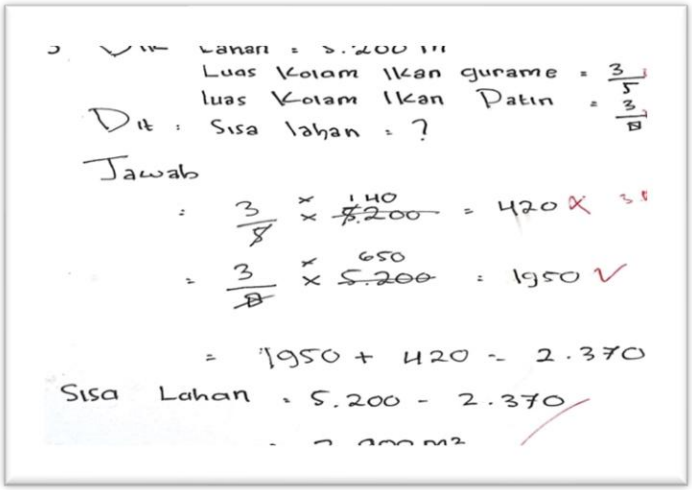

Figure 9. KY Student Answer Sheet No. 1

KY students are able to write down what is known on the problem and are able to write down what is asked, and are able to enter numbers into the equation, but in the process of calculating fraction multiplication it seems that KY students have a mistake where KY students are wrong in dividing, supposedly in the division of 5,200: 5 the result is 1,040, but the student writes 140, so what if multiplied by the number 3 produces the wrong answer, The dimna should be the result of 3,120.$\frac{3}{5}x$ 5,200

Based on the transcript of interviews that have been conducted with KY students, a summary of the results of the interview on mathematical connection ability is obtained as in Table 6.

P: oke kita lanjut ke soal 1b, kamu kerjakan konversi pecahan ke persen. Di situ kamu tulis $\frac{4}{20}\ x\ \frac{100}{1}$ jadi 20%, dan $\frac{1}{4}\ \frac{100}{1}$ jadi 25%, tapi awalnya kamu nggak nulis simbol persen. Kenapa, ya?

KY: oiya jugak ya kak seharusnya ada persen nya ya, tapi waktu itu nggak kepikiran Kak, aku kira tanpa nulis persen juga tetap benar.

Figure 10. Interview transcript question 1

The KY student said that he was able to solve question number 1a because he had studied it at school, but for the 1b, the KY student said that yes, it was not taught to write the % on the number 100, the KY student thought that not writing the % would not affect the result.

Based on the test results and interviews, it can be concluded that there is harmony and consistency between the data and KY students. This can be seen both in the results of the mathematical connection ability test and in the interviews conducted. Thus, data from KY students can be considered credible (valid) and worthy of further analysis to answer the research questions.

KY students from the test results and interviews showed quite good ability in solving the number 1a problem, which is related to the negative form of the rank of fractional numbers. Students are able to relate two concepts in mathematics, namely fractional and exponential operations, which indicate the connection between mathematical topics. In question 1b, which requires converting fractions to percentage form, students can solve it in a logical alternative way, and it is still accepted, even if there is a small mistake, because they do not write the percent symbol (%) in the final result. In an interview, the KY student admitted he was unaware of the symbol's importance and believed his absence would not affect the answer.

These findings suggest that although conceptual connections have been formed, understanding of mathematical representations, such as symbols and notation, still needs strengthening. This is in accordance with the results of research by J. D. Putra et al., (2022) which states that one obstacle to building students' mathematical connections is a limited understanding of mathematical symbols, even though the basic concepts have been well understood. Moreover Ningrum et al., (2024) He added that students with weak mathematical connection skills often have difficulty understanding and applying mathematical symbols and notation in everyday life.

In question 2, KY students were able to identify basic information about speed, but did not convert the unit of time correctly or write the formula explicitly. He admitted that he had forgotten that the unit of time had to be in hours, which showed the weak connection between mathematics and physics lessons. On the other hand, in question 3, which concerns daily life, KY students understand the problem situation but make mistakes when multiplying fractions. He admitted that the mistake was more due to a lack of precision in his calculations, not because he did not know how. This difference shows that in question 2, the weakness lies in the relationship between the fields of study, while in question 3, it lies more in the mathematical procedural aspect. This finding is in accordance with the results of research by

Nurjanah & Ristanto (2021) and Sari & Yusnaeni (2020) who stated that students' mathematical connections can be hampered both by weak interdisciplinary integration and by a lack of understanding of basic mathematical operations.

Table 7. Profile of Mathematical Connection Ability of KY Students

Mathematical Connection Ability Indicator	Steps in solving the problem	Information
Connecting concept representations with procedures	• Doing calculations on questions 1a & 1b	✓
	• Using the correct method in question 1a	✓
	• Using the correct method in question 1b	✓
	• Write the final result correctly in question 1a	✓
	• Write the final result correctly in question 1b	✓
Assess the relevance between math topics	• Write down formulas well and correctly	✓
	• Perform the calculations in the right way	X
	• Write down the answer correctly	X
Apply mathematical concepts in the field of economics and daily life	• Write down what you know about the question	✓
	• Solving problems in the right way	✓
	• Write down the final result with a banner and precise	X

Description: X = Unfulfilled

3.1.3 IS Students

Based on the results of the tests that have been carried out on IS students so that a summary of the data on the results of the mathematical connection ability test is obtained as in Table 8.

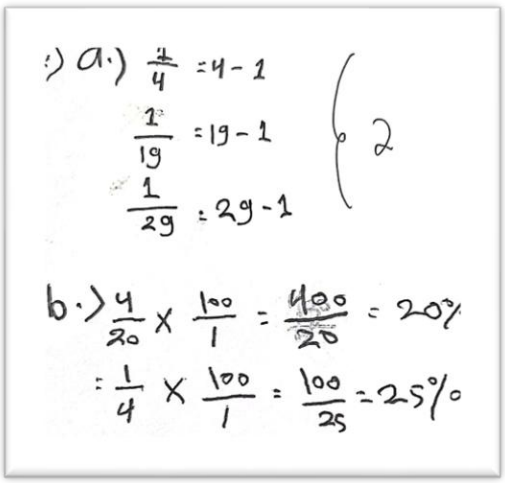

Figure 13. IS Student Answer Sheet No. 1

IS students are able to solve problem 1a, which involves associating fraction material with the concept of negative rank. Then, in question 1b, IS students can get the correct answer in different ways, but the way of answering is still very acceptable and can still be considered

one of the correct ways as well. But still that IS students still have an error, namely not adding % to the number 100. However, this can still be accepted $\frac{4}{20}\ x\ \frac{100}{1}$

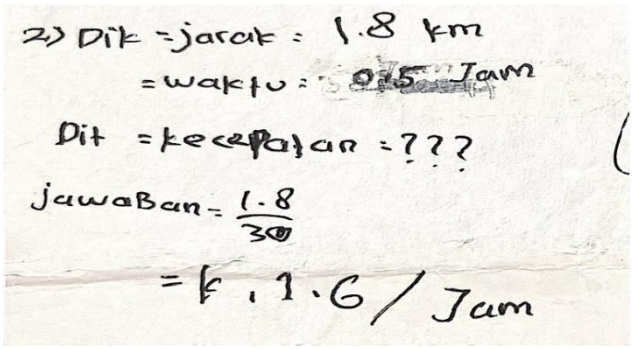

Figure 14. IS Student Answer Sheet No. 2

IS students in question 2 are able to write down what is known in the question and determine what is asked, but they do not include the speed formula on the answer sheet. In the results of the work, the IS student directly stated the distance and time in the form of fractions, but in this answer, there is a difference in the answer, where in the known part, the IS student has correctly written the time of 0.5 hours, but in the answer, the IS student wrote the time of 30 minutes. This caused a big error on the IS Student answer sheet.

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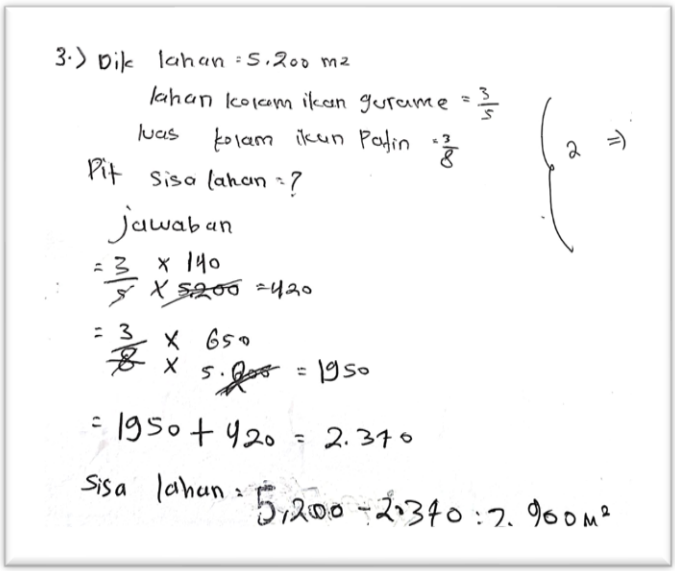

Figure 15. IS Student Answer Sheet No. 3

IS students can write down what is known in the correct question, as well as what is asked, but it is a little ambiguous and less clear. The steps in working on this question are

correct, but the results of the multiplication of divisions carried out contain errors, which produce incorrect answers. This shows that IS students have an error in calculating multiplication when dividing.

Based on the transcript of the interview that has been conducted with IS students, a summary of the results of the interview on mathematical connection ability is obtained, as shown in Table 9.

P: Baik, lalu soal 1b, kamu jawab Kamu ingat rumus atau gimana?

IS: Iya, aku inget dikit-dikit kak. Katanya kalau mau ubah pecahan ke persen tinggal dikali 100. Jadi aku kalikan aja langsung.

P: Kamu merasa jawabannya benar?

IS: Waktu nulis aku kira udah benar kak, soalnya kan dikali 100 terus dibagi, hasilnya persen. Tapi aku agak bingung juga pas nyederhanain pecahannya. Kadang suka ketukar mana dulu yang harus dikerjain.

P: Oke. Jadi kamu yakin ngerti cara ubah pecahan ke persen?

IS: Iya sih kak, cuma kadang aku lupa-lupa ingat bagian mana yang harus dihitung dulu. Jadi kadang jawabannya cuma aku tulis seadanya aja, biar nggak kosong.

Figure 16. Interview transcript question 1

Based on the test results and interviews, it can be concluded that there is harmony and consistency between the data and IS Students. This is reflected both in the results of the mathematical connection ability test and in interviews that support the answer pattern given. Thus, data from IS students can be considered credible (valid) and worthy of further analysis to answer research questions.

IS students showed a fairly good understanding of associating the concept of fractions with negative ranks in question 1a and of converting to the percent form in question 1b. However, there is a small mistake: the final answer does not include the percent symbol (%). In the interview, the IS student stated that he felt the answer was correct even though he did not include the symbol, indicating that his understanding of concepts and notation is not yet fully intact.

In question number 2, which is related to connecting mathematical concepts and other fields of study, such as physics, IS students experience different obstacles. He was able to write down the information in the question and understand it, but did not include the speed formula and was inconsistent in stating the time: he wrote 0.5 hours in the known section but used 30 minutes in the calculation. From the interview, it was revealed that he did not understand how to solve it and only imitated friends' answers, indicating a weak integration of concepts across disciplines.

Meanwhile, question number 3, which assesses the ability to apply mathematics in daily life, shows that IS students have a good understanding of problems but are slightly incorrect in performing calculations. These findings are in line with research by Amilawati, (2025) which states that students' mathematical connection abilities can be enhanced through STEM learning approaches that help them relate mathematical concepts to real-life contexts and other disciplines. Syarifah Ayu & Rahayu, (2022) explained that one of the solutions to this problem is to use a STEM approach that can improve students' mathematical connection skills in a real-life context.

In addition, the importance of numeracy literacy in daily life was emphasized by Mahmud (2025) and Aslam et al. (2024), who stated that numeracy literacy includes the ability of

individuals to acquire, interpret, use, and communicate mathematical information or symbols effectively.

Table 10. Profile of Mathematical Connection Ability of KY Students

Mathematical Connection Ability Indicator	Steps in solving the problem	Information
Connecting concept representations with procedures	• Doing calculations on questions 1a & 1b	✓
	• Using the correct method in question 1a	✓
	• Using the correct method in question 1b	✓
	• Write the final result correctly in question 1a	✓
	• Write the final result correctly in question 1b	✓
Assess the relevance between math topics	• Write down formulas well and correctly	X
	• Perform the calculations in the right way	X
	• Write down the answer correctly	X
Apply mathematical concepts in the field of economics and daily life	• Write down what you know about the question	✓
	• Solving problems in the right way	X
	• Write down the final result with a banner and precise	X

Description: ✓= Fulfilled
X = Unfulfilled

DP (high category) students demonstrate strong mathematical connection skills. He is able to relate concepts between topics (question 1a), even though there are procedural errors in 1b. He also succeeded in connecting mathematics to physics (question 2) and in applying mathematics appropriately in daily life (question 3). This is in line with Upara et al., (2024) which states that students with strong connections can integrate cross-contextual concepts logically. Not only that, Sekarsari et al., (2021) which states that students with a field-independent (FI) cognitive style have better mathematical connection skills, being able to effectively relate mathematical principles to real-world situations.

KY students (medium category) were able to solve questions 1a and 1b with an alternative approach, but were less accurate in the use of symbols (%). In question 2, he forgot to convert time to hours, and in question 3, he was wrong in the fractional operation. This reflects the weak symbolic and procedural connections. In accordance with the findings Fina et al., (2020), mathematical connections are disrupted if students have not mastered the basic representations and concepts thoroughly.

IS students (low category) solved questions 1a–1b with an approach that was less based on understanding, and even admitted to copying. He was inconsistent in question 2 and failed to calculate question 3. This shows the weak connection of concepts, procedures, and across disciplines. This is reinforced by Amilawati, (2025) and Pratiwi et al., (2024) stating that students with low numeracy literacy have difficulty understanding and applying mathematics in a real context.

3.2 Discussions

The findings across the three indicators reveal clear qualitative differences in students' mathematical connection abilities. In connections within mathematics topics, DP (high category) was able to relate fractions with negative exponents logically, although minor

procedural inaccuracies appeared in fraction-to-percentage conversion. This confirms that strong conceptual understanding does not automatically ensure representational precision. According to the The National Council of Teachers of Mathematics (NCTM), (2000) mathematical connection involves recognizing and using relationships among mathematical ideas; DP demonstrated this relational understanding, yet symbolic inconsistency indicates that conceptual integration must be accompanied by representational fluency. This aligns with Ningrum et al., (2024) KY (medium category) showed partial connections but lacked representational completeness, such as omitting the percent symbol, reflecting incomplete integration of verbal, symbolic, and procedural forms, as described by (Fina et al., 2020). Meanwhile, IS (low category) demonstrated surface-level understanding and admitted imitating peers' work, indicating procedural imitation rather than genuine conceptual linkage. As emphasized by Muharomi & Afriansyah, (2022) meaningful mathematical connections require independent construction of relationships between ideas.

Differences became more pronounced in cross-disciplinary and contextual applications. In the mathematics physics integration task (distance speed time), DP successfully transferred knowledge across domains, reflecting interdisciplinary integration as described by Putra & Nurcahyono, (2022), where mathematical concepts are flexibly applied beyond their original context. KY, however, failed to convert time units consistently, showing fragmented integration and lack of coherence between procedure and contextual constraints, an issue highlighted by Yunita et al., (2024) IS displayed even weaker interdisciplinary understanding, marked by inconsistency and reliance on peers, supporting Pratiwi et al., (2024) argument that limited numeracy literacy restricts students' ability to transfer mathematical reasoning into applied situations In daily-life contextual problems, DP demonstrated systematic modeling and accurate fraction operations, consistent with Imani et al., (2023) who state that strong mathematical connections enable students to extract relevant information and align it with appropriate procedures Conversely, KY and IS were able to interpret contextual information but made procedural errors, reinforcing Ully & Hakim, (2022) assertion that numeracy literacy requires not only contextual interpretation but also operational accuracy Collectively, these findings confirm that mathematical connection ability is shaped by the integration of conceptual understanding, representational precision, interdisciplinary transfer, and procedural fluency.

4. Conclusions

Based on a study conducted with three grade VII students at one of the Pekanbaru IT Junior High Schools, it can be concluded that the students' mathematical connection ability in solving rational number problems varies according to their respective levels of ability. DP students in the high category can meet all three indicators of mathematical connection: assessing the relationships among mathematical topics, connecting concepts with other fields (such as physics), and applying mathematics in daily life. DP demonstrates a strong conceptual understanding and logical, systematic problem-solving. KY students who are categorized as being able to solve problems that relate to mathematical topics, but still make mistakes in symbol representation, and experience difficulties in problems that require the application of concepts in real-world and cross-disciplinary contexts. Meanwhile, IS students in the low category show limited abilities across concepts and procedures. He tends to imitate, is inconsistent in solving problems, and has difficulty applying mathematical concepts in various contexts. The results of this study show that the ability to make mathematical connections is greatly influenced by the mastery of basic concepts, procedural understanding, and the skill of relating mathematics to other contexts independently and meaningfully.

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Conflict of Interest
The authors declare no conflicts of interest.

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