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Analysis of Mathematical Connection Ability in Minimum Competency Assessment Algebra Test Viewed From Students' Intrapersonal and Interpersonal Intelligence

Fitri Salsabila Ayu Andriani[1], Siti Inganah[2], Arif Hidayatul Khusna[3*]

[1] Universitas Muhammadiyah Malang, Malang, Indonesia; fitrisalsabila1001@gmail.com
[2] Universitas Muhammadiyah Malang, Malang, Indonesia; singanah@gmail.com
[3*] Universitas Muhammadiyah Malang, Malang, Indonesia; khusna@umm.ac.id

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ABSTRACT

Mathematical connection is a crucial skill for students, as it reduces the need to memorize numerous concepts and procedures independently. This study explores the variance in mathematical connection abilities among students with different intelligence types, specifically intrapersonal and interpersonal, in the context of solving algebraic problems on the AKM (Minimum Competency Assessment) test. Utilizing a qualitative descriptive methodology, this research focused on four students from class VIII-B at an Islamic Junior High School in Blitar. Data were gathered through questionnaires assessing intrapersonal and interpersonal intelligence, followed by the AKM Algebra test and interviews with selected students—two from each intelligence category. The findings reveal that students with interpersonal intelligence demonstrated superior mathematical connection abilities compared to their intrapersonal counterparts. Individuals with interpersonal intelligence met all indicators of mathematical connections, whereas intrapersonal intelligence subjects varied, with some meeting only one or two. This discrepancy underscores that students of the same intelligence type can exhibit differing levels of mathematical connection abilities, influenced by various factors such as mathematical skills, development of geometric thinking, and reasoning abilities.

Corresponding Author:
Arif Hidayatul Khusna
Universitas Muhammadiyah Malang; khusna@umm.ac.id

1. INTRODUCTION

Mathematics is a discipline characterized by its interconnected topics and concepts, encompassing not only the interrelations within its own domain but also its connections to other scientific fields and everyday life applications. This integrative aspect of mathematics is referred to as 'mathematical connection' (Iswara et al., 2019). In alignment with the Regulation of the Minister of National Education Number 22 of 2006 concerning Content Standards, one of the primary objectives of mathematics education is to equip students with the capability to comprehend mathematical concepts thoroughly. Students are expected to articulate the interconnections among these concepts and apply them accurately,

efficiently, and precisely in problem-solving scenarios. The capacity to grasp the composite nature of mathematics, and recognizing the relationships among its various topics, constitutes the essence of forming mathematical connections (Bakhril et al., 2019).

Mathematical connection ability is the ability to present internal and external relationships in mathematics, which include connections between mathematical topics, connections with other fields of science and connections in everyday life (Santia & Kusumaningrum, 2017). According to research conducted by (Ina & Nia, 2020), mathematical connection ability is one of the abilities that students must master. According to ((NCTM), 2000), without a mathematical connection, students are required to learn and remember too many concepts and procedures, which will make students feel complicated and confused. Having mathematical connection skills makes it easy for a student to understand related mathematical topics and concepts, which is very supportive for a teacher in understanding student abilities. A teacher, in understanding the abilities of his students, needed an evaluation tool to measure the knowledge of his students. Evaluation is interpreted as an assessment or determination of the quality and value of an object (Indahri, 2021). The evaluation tool that has been used so far is the AKM.

AKM is an assessment of the fundamental competencies each student needs to develop their abilities and participate in activities that have positive value (Kemendikbud, 2020). The questions used in AKM can develop student creativity and find interrelationships between processes in a mathematical concept (Yanti Simamora, 2019). Mathematical connection skills are needed to find the interrelationships between these mathematical concepts. One of the materials included in the content of numeric numbers on the AKM test is algebraic material. Algebra is part of the science of mathematics, which includes number theory, geometry, and analysis of their solutions. Algebraic concepts are interrelated with other mathematical topics (Silviana, 2020). In addition, the Algebraic form has a form which in its presentation contains letters to represent unknown numbers which can be used to solve problems in everyday life. (Sukestiyarno & Karomah, 2020) Because of its structure, many mathematical connections are needed to help make students' thinking simpler and easier to understand.

Connecting math topics with other topics depends on the student's ability. Line (Hadi, 2017), there are many reasons why the abilities of each student differ from one another. One of the factors causing this is the level of intelligence. Likewise, research conducted by (Utami, 2012) says that intelligent humans cannot be measured only from the academic side but also from various aspects of development. It should be noted that a lack of self-understanding can prevent students from developing fewer strengths and overcoming their weaknesses (Irwan et al., 2018). Gardner explains that emotional intelligence consists of intrapersonal intelligence and interpersonal intelligence. Intrapersonal intelligence is the intelligence that helps one know and understand the strengths and weaknesses that one has compared to other people (Musfiroh, 2014). In learning mathematics, students with intrapersonal intelligence will optimize their abilities by actively practising, introspecting mistakes, and motivating themselves. So that students can perform well and display their potential (Suarca et al., 2016).

Meanwhile, interpersonal intelligence is the ability to understand and communicate with other people and form and maintain relationships in a social environment. Research conducted by (Latifah & Widjajanti, 2017) states that the aspect of social attitude is an important thing that needs attention in the learning process. Social attitude can also be interpreted as interpersonal intelligence. Students with interpersonal intelligence can place themselves in interactions to add insight that they don't have from other people. Students with this intelligence tend to have a high curiosity.

Previous research has significantly contributed to our understanding of factors influencing students' mathematical connection abilities. For instance, Aliyah et al. (2019) found gender differences in mathematical connection abilities, noting that female students outperformed male students across both intelligence types. This finding introduces an essential perspective on gender as a variable in mathematical learning outcomes. Agustiani, Halidin, & Nasruddin (2020) extended the inquiry into environmental influences by examining the impact of students' family backgrounds. Their study underscores the role of the family environment in shaping students' abilities to connect mathematical concepts, revealing disparities in connection ability indicators attributable to familial factors.

Further, Fani & Effendi (2021) explored the relationship between students' inner learning anxiety and their mathematical connection abilities, particularly in the context of solving circle material problems. Their findings highlight how varying levels of learning anxiety correlate with students' ability to achieve mathematical connection indicators, suggesting an emotional component to mathematical understanding. Lastly, research by Firdausi, Inganah, & Putri Rosyadi (2018) investigated the influence of cognitive styles on mathematical connection abilities. This study revealed that cognitive styles lead to differences in how students meet the indicators of mathematical connection, pointing to the cognitive diversity among learners.

Distinct from these approaches, this research leverages the AKM (Minimum Competency Assessment) to examine how intrapersonal and interpersonal intelligence types affect students' abilities to make mathematical connections in algebra. This focus contributes to the burgeoning literature on mathematical connection abilities and offers a nuanced understanding of how specific intelligence types can influence students' performance in algebra, a fundamental mathematical discipline. Through this lens, our study aims to provide deeper insights into the educational strategies that could be employed to enhance mathematical connection abilities across diverse intelligence profiles. In the domain of mathematics education, the development of intrapersonal and interpersonal intelligence is paramount for students to fully understand their capabilities and effectively utilize their skills in mathematical problem-solving. Such cognitive competencies are particularly crucial in fostering students' mathematical connection skills, enabling them to tackle algebraic problems proficiently (Kusumahadi & Fitriyani, 2021). Against this backdrop, this study seeks to elucidate the mathematical connection abilities of Grade VIII junior high school students in solving algebraic problems on the AKM test, focusing on individuals characterized by notable intrapersonal and interpersonal bits of intelligence.

2. METHODS

This type of research is a descriptive analysis that aims to determine students' mathematical connection abilities when viewed from the perspective of students' intrapersonal and interpersonal intelligence in solving problems based on the AKM test on algebraic material. The research was conducted at one of the Islamic Junior High School in Blitar. The subjects of this study were four students of class VIII-B, representing two students with intrapersonal intelligence and two students with interpersonal intelligence.

There are three stages of the research procedure carried out in this study, namely (1) research planning, (2) research implementation, and (3) after-research. Research planning was carried out by discussions with mathematics teachers regarding the class determination and plans related to research implementation. At this stage, the researcher compiled research instruments in the form of intrapersonal and interpersonal intelligence questionnaires, tests in the form of AKM questions on algebraic material, and interview guidelines—instruments in research from previously validated sources. The research was carried out by giving intrapersonal intelligence and interpersonal intelligence questionnaires to all students of class VIII-B. Furthermore, the researcher analyzed and examined the results of the student questionnaire to take two students with intrapersonal intelligence in the high category and two students with interpersonal intelligence in the high category by paying attention to the highest total score of students in the same category. In the next stage, the researcher gave 3 AKM test questions to 4 students selected to work on AKM Algebra-based mathematical connection ability questions and interviews. In the following stage of the research, the researcher compiled a research report that contained an analysis of the data processed descriptively about the ability of mathematical connections in each indicator of mathematical connections in students representing types of intrapersonal intelligence and interpersonal intelligence analyzed based on existing facts.

The data collection technique was carried out by giving assignments to the subjects as a questionnaire classifying the level of students' intrapersonal intelligence and interpersonal intelligence to 33 students of class VIII-B. Next, four students were selected with two intrapersonal intelligence subjects and two interpersonal intelligence subjects for a mathematical connection ability test based on AKM

Algebra tests and interviews. The indicators of mathematical connection ability ((NCTM), 2000) in this study are: (1) being able to connect between mathematical topics; (2) being able to connect mathematics with other disciplines; (3) being able to connect mathematics in the real world or everyday life.

The data analysis technique used in this study is adapted to Miles and Huberman's theory, namely (1) data reduction. Data reduction was carried out at the stage of processing the questionnaire and processing the results of the interviews, and (2) presenting the data. Presentation of data is done by raising and showing a collection of data or information that has been categorized, which allows a conclusion or action to be drawn, (3) concluding. Concluding this study was obtained by comparing student work and interview results.

3. FINDINGS AND DISCUSSION

3.1 Findings

Research data is presented, and the mathematical connection ability of class VIII-B students on questions based on AKM Algebra material is discussed. Data was collected through interpersonal and intrapersonal intelligence questionnaires, mathematical connection ability tests, and interviews. A total of 33 students filled out an intrapersonal and interpersonal intelligence questionnaire so that the following results were obtained:

Table 1. Results of the Interpersonal and Intrapersonal Intelligence Questionnaire for Grade VIII-B Students

Intelligence Type	Category	The Number of Students
Interpersonal Intelligence	High	4
	Medium	21
	Low	3
Intrapersonal Intelligence	High	3
	Medium	2
	Low	0

Based on the scores obtained by the students in filling out the questionnaire, the researcher chose four students to be selected as subjects, with two students each with interpersonal intelligence in the high category and two students with intrapersonal intelligence in the high category. The selection of subjects is based on the highest total score in the same category (high), with two subjects of interpersonal intelligence and two of intrapersonal intelligence.

Table 2. Research Subject

Intelligence Type	Category	Skor	Initials
Interpersonal Intelligence	High	101	S1
		97	S2
Intrapersonal Intelligence	High	92	S3
		87	S4

3.1.1 Data Analysis of Students' Mathematical Connection Ability

Based on the results of the tests and interviews of mathematical connection skills, which were attended by two students of interpersonal intelligence and two students of intrapersonal intelligence, the connection ability data obtained in Table 4 shows that subjects with interpersonal intelligence were able to fulfil all indicators of mathematical connection. While subjects with intrapersonal intelligence can solve different problems, some fulfil two or one of the mathematical connection indicators. This shows that students with the same intelligence type have different mathematical connection abilities.

Table 3. Mathematical Connection Ability in Each Subject

Numb.	Indicator	Interpersonal Intelligence Subject	Interpersonal Intelligence Subject	Intrapersonal Intelligence Subject	Intrapersonal Intelligence Subject
1	Connecting between mathematical concepts	√	√	×	×
2	Connecting mathematical concepts with other fields of science	√	√	√	×
3	Connecting mathematical concepts with everyday life	√	√	√	√
Mathematical connection ability		Very High	Very High	Medium	Low

3.1.2 Mathematical Connection Ability Viewed From Interpersonal Intelligence

The research subjects chosen for the type of interpersonal intelligence are S1 and S2. The research subjects were given test questions on mathematical connection ability where question number 1 states indicators of the ability to connect between mathematical topics, number 2 states connecting ability indicator mathematics with other disciplines, and question number 3 states an indicator of the ability to connect mathematics with everyday life.

1. S1 Subject

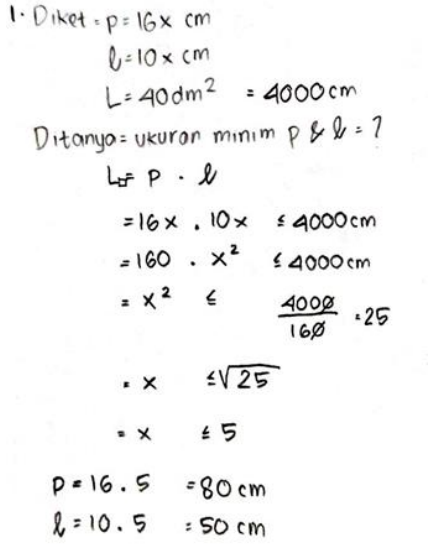

Fig 1. Results of S1 Answers to Question Number 1

The S1 subject was able to answer question number 1 correctly, whereas the S1 subject was able to associate the concept of one variable linear inequality with the concept of geometry (flat shape). It can be seen from the answer that subject S1 can use the formula for the area of a rectangle. S1 substitutes the rectangle's known length, width, and area for obtaining the algebraic form of a one-variable linear inequality. Subject S1 substitutes the value of x with the length and width of the rectangle to get the correct result.

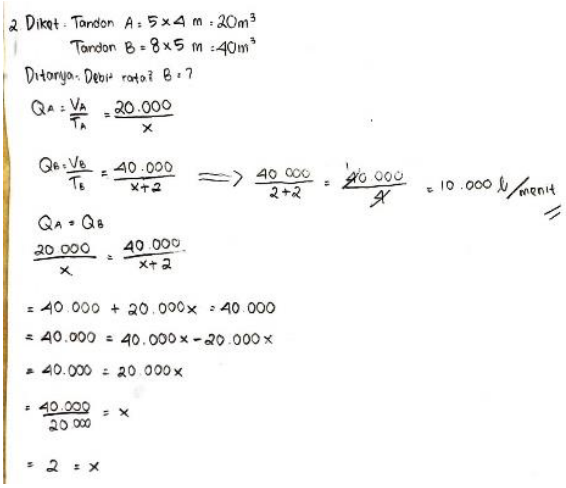

Figure 2. Results of S1 Answers to Question Number 2

S1 subjects were able to link the relationship between mathematics in the material of one-variable linear equations and physics (average discharge). It can be seen that subject S1 can write down the time needed for pump A with x minutes and the time for pump B with (2 + x) minutes. Subject S1 found the time needed by pump A by writing the formula for the average discharge. In this case, S1 subjects can realize the relationship between mathematical concepts and concepts outside mathematics (Physics).

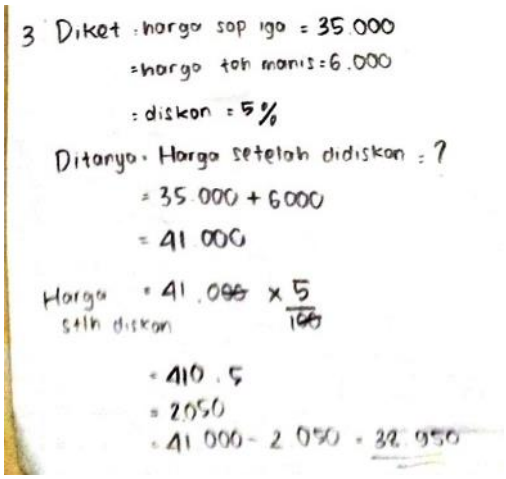

Figure 3. Results of S1 Answers to Question Number 3

As for question number 3, the S1 subject was able to connect mathematical concepts in ratios and proportions with everyday life; that is, he was able to determine what steps to use according to the problem in solving problem number 3.

Overall, S1 can fulfil all the mathematical connection indicators. In this case, the mathematical connection ability of S1 is in the very high category.

2. *S2 Subject*

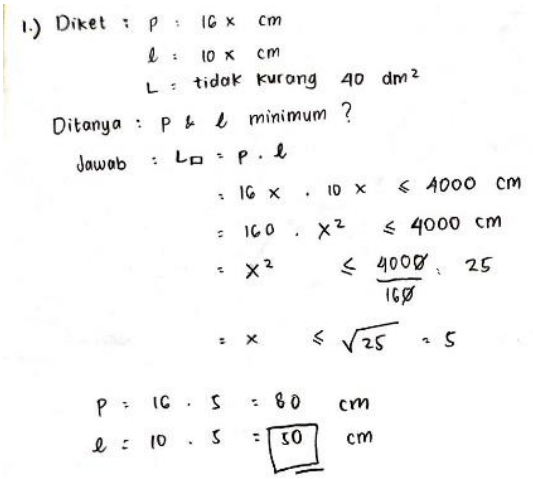

Figure 4. Results of S2 Answers to Question Number 1

Subject S2 could answer question 1 correctly, whereas subject S2 could relate the concept of linear inequality of one variable to the concept of geometry (flat shape). It can be seen from the answer that subject S2 can write the formula for the area of a rectangle. S2 substitutes the rectangle's known length, width, and area for obtaining the algebraic form of a one-variable linear inequality.

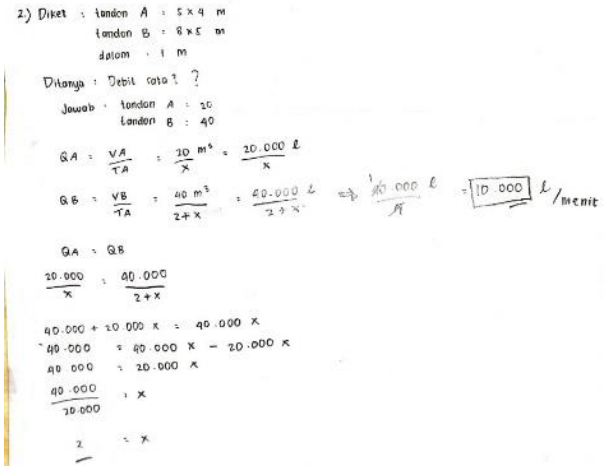

Figure 5. Results of S2 Answers to Question Number 2

S2 subjects could relate the relationship between mathematics in the material of one-variable linear equations and physics (average discharge). Subject S2 can write down the time needed for pump A with x minutes and pump B with 2+x minutes. Subject S2 found the time required by pump A by writing the formula for the average discharge. In this case, the S2 subject can realize the existence of concepts outside of mathematics (Physics).

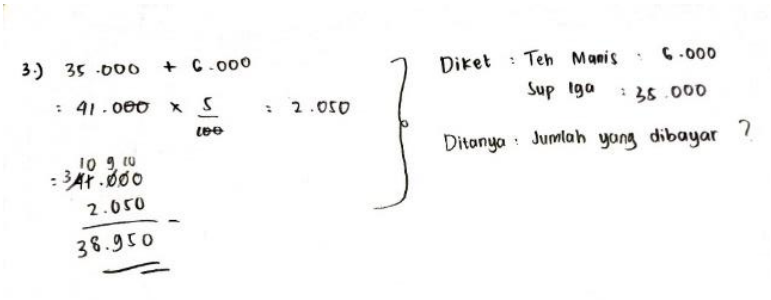

Figure 6. Results of S2 Answers to Question Number 3

As for question number 3, the master's subject connected the mathematical concepts of ratios and proportions with everyday life; that is, he was able to determine what steps to use according to the problem in solving problem number 3. The research results above show that S2 subjects could fulfil all mathematical connection indicators. In this case, it can be said that the mathematical connection ability of S2 is in the very high category.

Overall, subjects with interpersonal intelligence have very high mathematical connection abilities. The subject of interpersonal intelligence can relate the interrelationships between concepts in mathematics, with other fields of science, and in everyday life.

3.1.3 Mathematical Connection Ability Viewed From Intrapersonal Intelligence

The research subjects chosen for the type of intrapersonal intelligence are S3 and S4 subjects. The research subjects were given test questions on mathematical connection ability where question number 1 indicates the ability to connect between mathematical topics, number 2 states connecting ability indicator mathematics with other disciplines, and question number 3 indicates the ability to connect mathematics with everyday life.

1. S3 Subject

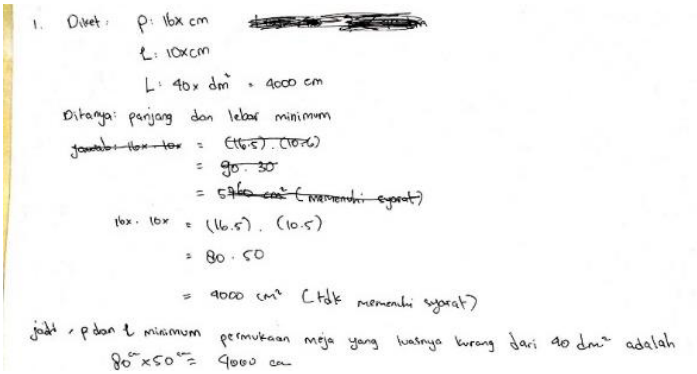

Figure 7. Results of S3 Answers to Question Number 1

The S3 subject has not been able to answer and explain all the mathematical connection indicators. The S3 subject has been unable to answer question number 1 correctly, whereas the S3 subject does not understand the question's intent, so it is less precise in solving it.

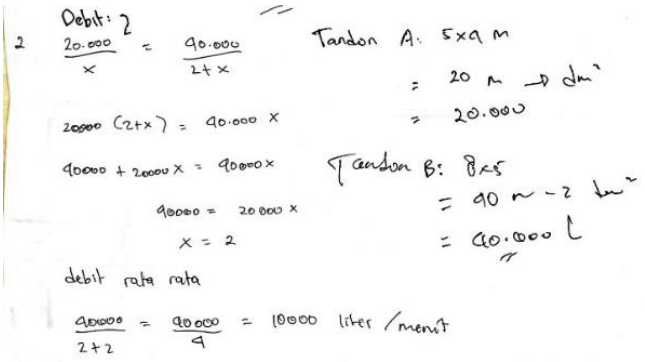

Figure 8. Results of S3 Answers to Question Number 2

For question number 2, S3 was able to relate the relationship between the topic of mathematics in the material of one-variable linear equations with Physics (average discharge). Subject S3 could simulate pump B time by making a mathematical model (2 + x) minutes. In this case, the S3 subject can use the concept of a system of one-variable linear equations. The S3 subject is also aware that there are concepts outside of mathematics (Physics) that the S3 uses by mentioning the average discharge formula. The S3 can meet the indicators of connecting mathematical concepts with other fields of science.

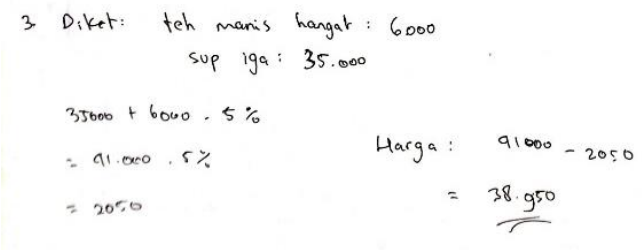

Fig 9. Results of S3 Answers to Question Number 3

As for question number 3, the S3 subject connected mathematical concepts in ratios and proportions with everyday life; that is, they were able to determine what steps to use according to the problem in solving problem number 3.

Overall, S3 subjects have yet to be able to fulfil all the mathematical connection indicators. S3 subjects could only meet the indicators of connecting mathematical concepts with other sciences and mathematical concepts in everyday life, so the ability to connect mathematically in S3 was in the excellent category.

2. S4 Subject

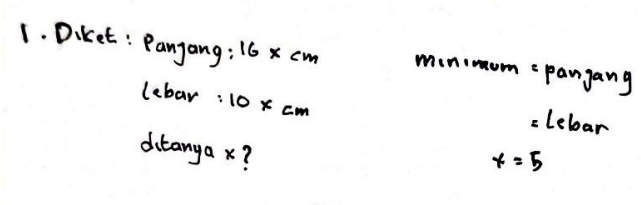

Fig 10. Results of S4 Answers to Question Number 1

Subject S4 has yet to be able to answer and explain all the mathematical connection indicators. Subject S4 needs to be able to answer question number 1 correctly. In contrast, subject S4 needs help understanding the question's meaning and needs help identifying the concept to be used, resulting in an incorrect answer.

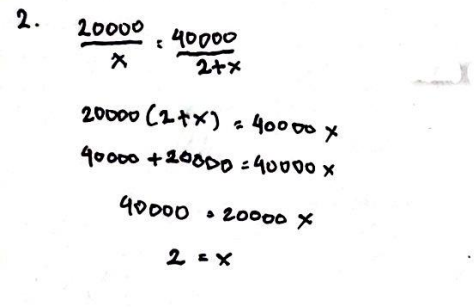

Fig 11. Results of S4 Answers to Question Number 2

For question number 2, S4 has yet to link the relationship between the topic of mathematics in the material of one-variable linear equations with Physics (average discharge), where S4 subjects cannot complete the completion steps on the answer sheet. It can be seen from the answers of the subjects who did not work on the questions until they were finished due to the lack of understanding that subject S4 had of the material.

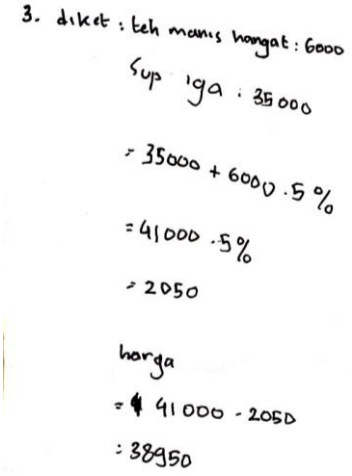

Fig 12. Results of S4 Answers to Question Number 3

As for question number 3, subject S4 can connect mathematical concepts in ratios and proportions with everyday life; that is, they can determine what steps to use by the problem in solving problem number 3.

Overall, S4 subjects could only fulfil one indicator of mathematical connection, namely connecting mathematical topics with everyday life. In this case, the mathematical connection capability of the S4 is in the low category.

3.2 Discussion

The findings indicate that individuals possessing interpersonal intelligence exhibit markedly high abilities in mathematical connections. Specifically, those with interpersonal intelligence demonstrate a proficient capacity to discern and integrate interrelationships among mathematical concepts across various scientific disciplines and daily life contexts. This observation aligns with the study by Wulandari (2018), which highlighted that students with elevated levels of interpersonal intelligence adeptly meet all the criteria for mathematical connection indicators. Furthermore, these students display a preference for collaborative interactions and problem-solving endeavors, leveraging their superior communication skills to enhance conceptual understanding and foster the generation of innovative ideas (Francisca et al., 2020). The ability to grasp concepts is fundamental in mathematics

education, playing a crucial role in the development of students' cognitive frameworks and optimizing their comprehension of the learning material (Suparta, 2018). Consequently, mathematical connection skills, which facilitate the application and interlinking of concepts, are essential. The study posits that interpersonal intelligence significantly contributes to enhancing students' mathematical connection abilities.

Meanwhile, students with intrapersonal intelligence types in the same category have differences in fulfilling each mathematical connection indicator. Students with intrapersonal intelligence can only fulfil two or one of the indicators of mathematical connection. This is in line with research conducted by (Kusumahadi & Fitriyani, 2021), which states that students' intrapersonal intelligence is not directly proportional to students' mathematical connection abilities. Many factors can cause this; among the contributing factors are students' mathematical abilities, the development of students' geometric thinking, and students' reasoning abilities. In this study, the selection of subjects did not consider students' mathematical abilities, so it was possible for students with intrapersonal intelligence in the same category to have different mathematical abilities.

The study conducted by Jayanti et al. (2020) elucidates that conceptual understanding in mathematics extends beyond traditional methods of teacher-led explanations, direct content delivery, or rote memorization of formulas. It posits that a deep comprehension of mathematical concepts emerges from engaging with the inherent meanings of these concepts. Complementing this perspective, research by Fatimah et al. (2021) highlights that students characterized by intrapersonal intelligence tend to engage in reflective practices and self-improvement efforts to address their limitations and enhance their problem-solving skills and grasp of mathematical concepts. This suggests that conceptual understanding can be fostered through the provision of appropriate materials and questions that cater to the development of intrapersonal intelligence.

Recognizing the significance of intrapersonal intelligence in students' academic development necessitates initiatives aimed at its enhancement. Annisa et al. (2023) contribute to this discourse by indicating that students with pronounced intrapersonal intelligence have a heightened awareness of their capabilities, facilitating a more profound understanding of mathematical concepts. Intrapersonal intelligence empowers students to create conducive learning environments for themselves, thereby enabling them to diligently explore and connect previously acquired concepts with new ones under investigation. This self-driven learning approach underscores the vital role of intrapersonal intelligence in the acquisition and application of mathematical knowledge.

In learning mathematics at school, students' interpersonal intelligence cannot be ignored (Daniyati, 2015). Interpersonal intelligence will facilitate students' exchange of knowledge during learning activities. For example, when discussing with colleagues. Thus, for teachers or practitioners who support collaborative learning settings, students' interpersonal intelligence will significantly impact the learning process because collaborative learning emphasizes the exchange of knowledge between students (Hofmann & Mercer, 2016).

4. CONCLUSION

The comparative analysis of students' mathematical connection abilities, with respect to their intrapersonal and interpersonal intelligences in completing Algebra-based AKM mathematical connection tests, revealed distinct outcomes. Specifically, individuals exhibiting interpersonal intelligence demonstrated superior mathematical connection abilities compared to their intrapersonal counterparts. Subjects characterized by interpersonal intelligence consistently met all established indicators of mathematical connections. In contrast, those with intrapersonal intelligence exhibited variability in their problem-solving approaches, with some meeting only one or two of the mathematical connection indicators. This variability indicates that students of the same intelligence type can display divergent abilities in mathematical connections, underscoring the influence of additional factors such as mathematical aptitude, the development of geometric thinking, and reasoning abilities on these competencies. Future research is advised to broaden the scope of the

investigation to include various reference sources that examine mathematical connection abilities in relation to other potential influencing factors. Additionally, this study encountered limitations concerning the respondents' pool for the questionnaire. Future studies should, therefore, consider increasing the sample size to enhance the comprehensiveness and reliability of the data collected.

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