Descriptive Analysis of Mathematical Connection Ability in Comparative Materials for Junior High School Students

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Abstract

The purpose of this research is to analyze the mathematical connection ability of the comparative material of junior high school students. This research used descriptive research method with qualitative approach. Determination of the subject in this research employed a purposive sampling technique. The subjects in this research were seventh-grade students of Al-Maghfiroh Junior High School. Data collection techniques used were tests. The results show that the students' mathematical connection ability is classified as moderate with a percentage of 66.7%. In completing mathematical connections, accuracy is needed to solve mathematical connection problems according to indicators. It is expected to pay more attention to the difficulties experienced by students to improve their mathematical connection skills. Therefore, educators can introduce questions related to everyday life so that students can relate mathematical concepts to everyday life problems.

Keywords: Connection Ability, Mathematical, Comparative Material

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INTRODUCTION

Mathematics is a structured Science and has a relationship between one concept and another (Nugraha, 2018). This means that Mathematics can be used to develop other Sciences. However, some students still think that Mathematics is a difficult subject According to Aprilia & Fitriana, (2022) Mathematics is considered difficult because students already think Mathematics is difficult and complicated because it is always associated with formulas, calculations, and so on. Mathematics is very important to be learned and mastered by students because in everyday life it is very closely related to Mathematics (Fashihah & Qohar, 2020). By studying and mastering Mathematics properly, you will feel at ease with various uses (Zulfah, 2019). Learning Mathematics is a process of learning and teaching Mathematics. Puteri & Riwayati, (2017) state that one of the goals of learning Mathematics is to have the ability to connect between mathematical concepts.

At this time the process of learning Mathematics in Indonesia is still not running optimally, because students are only recipients of information from the teacher. Students are still less contributing during the Mathematics learning process. This agrees with Ilma et al., (2023) that learning Mathematics still does not involve student's activity. Success in the learning process can be measured by mastering the material in Mathematics because students who can master Mathematics well mean that they understand mathematical material. The results of the Program For International Student Assessment (PISA) assessment by Hewi & Shaleh, (2020) that Indonesia in the category of mathematical ability was ranked 73 out of 79 countries that took part in the assessment.

Based on The results of the assessment, show that Indonesian students are still classified as lacking in the mastery of Mathematics.

To be able to master mathematical material, students must have mathematical skills. Based on the National Council of Teachers of Mathematics (NCTM) in Siagian, (2016) there are standards of mathematical abilities that students must have, namely problem-solving abilities, reasoning abilities, communication abilities, connection abilities, and representation abilities. Therefore, the ability to connect mathematically is one of the most important abilities for students to achieve the goals of learning Mathematics.

Mathematical connection is a connection of mathematical ideas or concepts with mathematical concepts or with other fields in everyday life (Nurafni & Pujiastuti, 2019). Meanwhile, mathematical connection ability is the ability to identify, apply, and connect concepts in Mathematics and outside Mathematics (Muflihah et al., 2019). From the description, it can be concluded that the ability of mathematical connection is an ability to connect the relationship between one mathematical concept with another mathematical concept or with other field concepts.

The results of Sudirman et al., (2018) research show that students' mathematical connection abilities only reach 36%. In addition, Sugiman also conducted research on students' mathematical connection abilities with an average achievement of 53.8%, this achievement is still in the low category (Zuyyina et al., 2018). Based on these studies, it can be seen that the ability of students' mathematical connection abilities is still relatively low. Adni et al., (2018) state that students can write down mathematical concepts related to real problems, but not many students can explain these concepts that can be used. Therefore, students' mathematical connection skills need to be trained so that students can see the relationship between mathematical concepts and non-mathematical concepts and be able to explain why these concepts can be used.

The factors that can affect the ability of mathematical connections. According to Hayati et al., (2018), the factors that affect the ability of mathematical connections include 1) lack of understanding students to understand the problem, interpret the question, and determine a concept; 2) lack of students' ability to explain concepts in solving problems and lack of thoroughness in connecting concepts; and 3) lack of students' ability to draw conclusions from the calculation process that has been carried out.

Based on these factors, the ability of mathematical connections is very necessary to be instilled in students to achieve learning objectives. According to Hendriana & Sumarmo, (2017) indicators of mathematical connection ability, include: 1) identifying the relationship between various representations of mathematical concepts and procedures; 2) identifying the relationship of one procedure to another in an equivalent representation; 3) explaining the application of mathematical topics in the content of other fields of study or problems of daily life.

Various studies on the ability of mathematical connections of junior high school students that have been carried out are the analysis of mathematical connection abilities in Pythagoras material and two-variable observation systems by relating to problem-solving and through Project Based Learning learning with a Realistic Mathematics Education approach (Agoestanto & Rinawati, 2023; Diana et al., 2020; Isnaeni et al., 2019; Mufidah & Machromah, 2023; Purwati et al., 2022; Wahyuni & Prihatiningtyas, 2020; Yusuf et al., 2022), While the research conducted focuses on analyzing mathematical connections in comparison material based on minimum completeness criteria. Based on these problems, this study aims to determine the ability of mathematics connections of junior high school students on comparison material.

METHODS

This research used a descriptive research method with a qualitative approach. Descriptive research aims to provide a description, explanation, and validation of the phenomenon under study (Ramdhan, 2021). This research focused on describing the ability of mathematical connections in comparative material. The research was conducted in the Tsanawiyah Madrasa Al-Maghfiroh. The instruments in this study were tests of mathematical connection ability and interviews. Mathematical connection ability test instrument, as many as 3 questions, where the instrument had been tested for validity, reliability, difficulty index, and distinguishing power. The interview used a semi-structured method, where the interview process used interview guidelines but is more flexible so that researchers can ask questions outside the interview guidelines but should not be outside the topic studied. The interview was conducted by asking research subjects who had been categorized as having previous levels of mathematical connection ability, for questions asked by researchers related to the mathematical connection ability test that had been done before. This aims to obtain information related to the data needed in this research.

Subjects in this research were selected for each category using purposive sampling techniques. The selection of subjects was seen from students who had different levels of mathematical connection ability and were interviewed based on tests that had been done. The results of the students' mathematical connection ability test referred to indicators, namely: 1) identifying the relationship of various representations of mathematical concepts and procedures; 2) explaining the application of mathematical topics in the content of other subject areas or problems of daily life; and 3) identifying the relationship of one procedure to another in an equivalent representation (Hendriana et al., 2017). Then the level of mathematical connection ability can be obtained using a formula to identify the level of mathematical connection ability. The formula used, namely:

$$\text{Minimum Completeness Criteria} = \frac{\text{student scores}}{\text{maximum score}} \times 100$$

Furthermore, students' overall mathematical connection ability is determined by comparing the results of obtaining student test scores with the magnitude of the Minimum Completeness Criteria score in Mathematics subjects at the school, which was 70,

Table 1. Criteria for Mathematical Connection Ability

Interval	Criteria
Minimum Completeness Criteria ≥ 70	High
$50 <$ Minimum Completeness Criteria < 70	Currently
Minimum Completeness Criteria ≤ 50	Low

Source: (Setialesmana et al., 2017)

RESULTS & DISCUSSION

Results

Presentation of data in this research uses tables that aim to facilitate the analysis is a table of students' mathematical connection ability test results.

Table 2. Students' Mathematical Connection Ability Test Results

Research Subject Code	Score			Total Scor	Mathematical Connection Ability	Criteria
	1	2	3			
NR	16	5	14	35	53	Moderate
RA	16	18	9	43	65,1	Moderate
RT	16	18	16	50	75,7	High
AS	16	16	9	41	62,1	Moderate
HA	20	20	14	54	81,8	High
MR	11	9	13	33	50	Low
EM	16	12	13	41	62,1	Moderate
GF	16	16	13	45	68,1	Moderate
MA	16	10	20	46	69,7	Moderate

Based on Table 2, it shows that students have quite good mathematical connection ability because the scores obtained from the test are classified as moderate. Only 2 students out of 9 students scored above 75, while other students still scored below 75.

Table 3. Percentage of Mathematical Connection Ability

No	Score	Percentage	Criteria
1	Minimum Completeness Criteria ≥ 70	22,2%	High
2	50 < Minimum Completeness Criteria < 70	66,7%	Moderate
3	Minimum Completeness Criteria ≤ 50	11,1%	Low
Total		100%	

Table 3 shows that students have moderate mathematical connection abilities, meaning that students can solve mathematical connection ability well. 66.7% who are in the criteria are in solving the problem of mathematical connection ability. These results reinforce the results of research conducted by Menanti et al., (2018) which states that the average student's mathematical connection ability based on a diagnostic test is 60.47. Another study conducted by Ruspiani (2020) revealed that the average value of the mathematical connection ability of Indonesian high schools is around 22.2% for mathematical connections with other subjects, 44.9% for mathematical connections in other fields of study, and 67.3% for mathematical connections with everyday life.

The low ability of students' mathematical connections based on the results of the interviews is because most students had difficulty explaining the application of mathematical topics to content in other fields. Other research also shows that it is currently identifying the relationship of one procedure to another in an equivalent representation of 67.04% (Malinda & Zanthy, 2017). This result is due to many factors according to Rahmawati et al., (2017); Hikmawati et al., (2019) and Zainudin et al., (2021), namely 1) inaccuracy in reading questions is also an obstacle in solving word problems that use aspects of connection between mathematical topics so that students are also difficult to use concepts such as what there is a connection in the questions, 2) the teacher's teaching methods and strategies so that the conditions and attitudes of
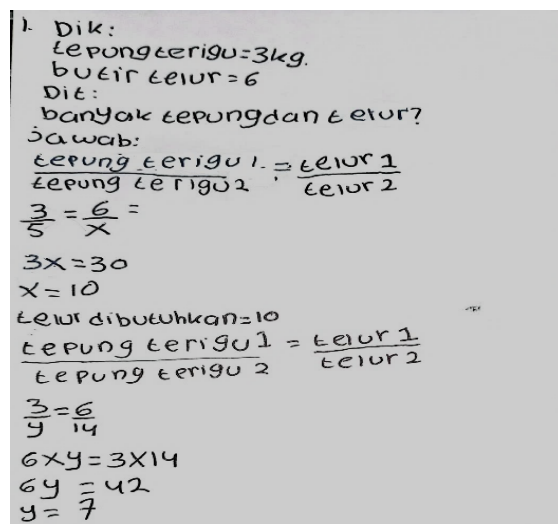
students when participating in the learning process are not optimal, and 3) errors related to concepts, and errors in counting.

The results of this research strengthen the research conducted by Sudirman et al., (2018) and Zuyyina et al., (2018) which state that students' mathematical connection abilities are still in the low category. Even the research conducted by Adni et al., (2018) states that students can write down mathematical concepts related to real problems, but not many students can explain these concepts that can be used. Therefore, students' mathematical connection abilities need to be trained so that students can see the relationship between mathematical concepts and non-mathematical concepts and be able to explain why these concepts can be used.

Discussion

1. Students who have low mathematical connection ability

Based on Table 3, respondents who have low mathematical connection ability are MR. Based on this, an interview is conducted. Here are the results of the interview with MR:

1) Identify relationships between various representations of mathematical concepts and procedures.
   Q   : What is known from the question?
   MR   : 3kg wheat flour and 6 eggs
   Q   : Then what is asked from the question?
   MR   : Lots of flour and eggs
2) Explain the application of mathematical topics in the content of other fields of study or problems of everyday life.
   Q   : How did you take steps to answer the questions?
   MR   : $\frac{1\ wheat\ flour}{2\ wheat\ flour} = \frac{1\ egg}{2\ egg}$ hence the $\frac{3}{5} = \frac{6}{x} = 3x = 6 \times 5$ is 30,
   *   so x = 10*
   Q   : Are you sure of the answer you wrote Is this true?
   MR   : Confident
   Q   : So what's the next step you're doing?
   MR   : $\frac{1\ wheat\ flour}{2\ wheat\ flour} = \frac{1\ egg}{2\ egg}$ so $\frac{3}{y} = \frac{6}{14} = 6y = 3 \times 14$ that is 42, So x = 7
   Q   : Are you sure of the answer you wrote is this true?

    MR   : Confident

3) Identify the relationship of one procedure to another in an equivalent representation:
    Q   : Why didn't you make a comparison table?
    MR   : Forgot
    Q   : Have you ever been taught how to create a table?
    MR   : Ever
    Q   : In what subjects?
    MR   : Mathematics
    Q   : Apart from maths subjects is there anything else?
    MR   : No
    Q   : Then do you understand how to create tables?
    MR   : No

Based on the results of mathematical connection abilities and interviews with MR, it can be seen that MR can identify things contained in the problem. On the answer sheet, MR can write what is known and what is asked, but it is incomplete. MR can apply topics or concepts in everyday life to problems. MR can answer questions correctly using the concept of comparison. In problems related to making comparison tables, MR cannot make comparison tables and MR cannot connect comparison concepts into table form. In this case, MR is classified as a student who has low mathematical connection abilities (Ni'mah et al., 2017; Permatasari & Nuraeni, 2021)

2.   Students who have moderate Mathematical Connection ability

Based on Table 3, respondents who have moderate mathematical connection ability are NR. Based on this, an interview is conducted. Here are the results of the interview with NR:

1) Identify relationships between various representations of mathematical concepts and procedures
    Q   : What do you know from the question?
    NR : Eeemm.. 3 kg of wheat flour and 6 eggs
    Q   : So what does this question ask?
    NR : The wheat flour is 5 kg looking for eggs. Then the 14-egg looks flour

2) Describe the application of mathematical topics in the content of other subject areas or problems of everyday life.
    Q   : How did you take steps to do the questions?
    NR : I worked on it like this $\frac{3}{6} = \frac{5}{y}$

    Q   : What is that?
    NR : The egg you're looking for
    Q   : What next?
    NR : $\frac{3}{6} = \frac{5}{y}$ cross-multiplied by 6 × 5 = 3 × y, then 30 = 3y
       then y it 30: 3 Result y = 10
    Q   : Then what else are you looking for?

NR : Look for wheat flour if there are 14 eggs
Q : How did you take steps to do it?
NR : It's more or less the same method as before, the result is y = 7
P : Are you convinced of the answer you wrote?
NR : Sure

3) Identify the relationship of one procedure to another in an equivalent representation.
Q : Have you ever been taught how to create a table?
NR : Yes ever
Q : In what subjects?
NR : Natural sciences
Q : Do you know how to create tables?
NR : Got it
Q : Are you sure the table you created is appropriate?
NR : Yes, sure

Based on the results of tests and interviews, NR can understand the existing problems. However, NR does not write down what is known and asked in the question but NR directly writes down the results of the answer. When asked, NR can explain what is known and what is asked on the question. NR answers the questions correctly and can explain the answers to the final results obtained. This shows that NR can solve the problem in the problem. NR data creates tables correctly and accordingly. NR can relate the concept of the ratio of wheat flour and eggs with tables that have been studied in Natural Science subjects (ANGGRAENI, 2014; Ansori, 2020).

3. Students who have high mathematical connection ability

Based on Table 3, respondents who have high mathematical connection ability are RT. Based on this, an interview is conducted. Here are the results of the interview with RT:

1) Identify the relationship of various representation concepts and Mathematics procedures.
Q : What is known from the question?
RT : All I know is 3kg of wheat flour and 6 grains eggs are A, 5kg of wheat flour are B and 14 eggs Eggs that c
Q : Then what is asked from the question?
RT : Egg b and wheat flour c

2) Explain the application of mathematical topics in the content of other subject areas or problems of everyday life.
Q : How's the move you're doing to do the problem?
RT : It is already known that a 3kg wheat flour same 6 eggs, so $\frac{3}{6}$. Then the b
5kg wheat flour and eggs are e.g. x, So be it $\frac{5}{x}$. Well made
a comparison $\frac{3}{6} = \frac{5}{x}$ multiplied cross x = 6 5 result 30 : 3 = 10 ×
Q : Why is it supposed to be x?
RT : If it's math, that's usually the case

Q : So what's the next step you're doing?
RT : Determine which wheat flour c
Q : How do you do that?
RT : The flour is 5kg and the eggs are from What was sought was 10 items,
so $\frac{5}{10}$. Continue which c eggs are 14 eggs and wheat flour e.g. with x,
so $\frac{x}{14}$. Made a comparison $\frac{5}{10} = \frac{x}{14}$, x = 5 ×14 Result 70 :10 = 7
Q : Are you sure of the answer?
RT : Sure
Q : What you wrote is correct?
RT : Sure

3) Identify the relationship of one procedure to another in an equivalent representation.
Q : Have you ever been taught how to create a table?
RT : Yes, that's right
Q : In what subjects?
RT : Social Sciences
Q : Do you know how to create tables?
RT : Got it
Q : Is the table you created appropriate?
RT : Already compliant

Based on the results of tests and interviews, RT can understand the problem but does not write down the identification of known problems or those asked about the problem. However, when asked, RT is able to identify the problem. RT can solve and apply the concept of comparison to everyday life problems. RT can create comparison tables correctly and accordingly. RT can connect the concept of the ratio of wheat flour and eggs into the form of a table. When asked, RT understands how to make tables because it has been studied in social science subjects (Fadilah et al., 2021; Fikri & Untarti, 2022; Yuwono et al., 2020).

CONCLUSION

Based on the results of research findings and discussions students' mathematical connection abilities are classified as moderate with a percentage of 66.7%. Based on the conclusions above, there are several suggestions that researchers can convey as follows: 1). Educators, it is expected to pay more attention to the difficulties experienced by students to improve their mathematical connection abilities. Therefore, educators can introduce questions related to everyday life so that students can relate mathematical concepts to everyday life problems; 2). For students, when working on description test questions, they should get used to writing things that are known and asked, and be more thorough in understanding the questions and the calculation process.

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