



Analysis of Mathematic Connection Ability of Junior High School Students Class VII on Integer Numbers

Dila Anggaraini¹, Afra Rahmaulydina²

¹ Universitas Riau, INDONESIA

² Integrated Islamic Elementary School 396 Alhusnayain Padangsidimpuan, INDONESIA

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ABSTRACT

The research conducted aims to examine the ability in mathematical connections possessed by Junior High School Class VII students through integer material. The instrument in this study was in the form of a test of mathematical connection ability with as many as six essay questions. The study uses a qualitative approach with a descriptive method of technical data analysis. The results of the study obtained that the test results score from mathematical connection ability are three students with the high ability with a percentage of 15%, there are 13 students with medium category with a percentage of 65%, and there are four students with the low ability with a percentage of 20%.

Corresponding address:

Dila Anggaraini,

[E-mail: dila.anggaraini7423@grad.unri.ac.id](mailto:dila.anggaraini7423@grad.unri.ac.id)

INTRODUCTION

Mathematics is a systematic science that continues to develop, and mathematics is a science that grows and is formed based on the experience of humans. In this case, mathematics has an important role in all aspects of everyday life [1]. The goal is to facilitate the activities of daily human life. According to [2], mathematics is an important and indispensable discipline and plays an important role in everyday human life. This process continues until found mathematical concepts.

These concepts are structured, systematic, and interrelated. Mathematics is a science where every idea is related and cannot be separated. In daily human life, mathematics is also related to other disciplines. In mathematics, the material discussed is possible to be a requirement for the following material, or it can be said that in describing one concept, another concept is needed. Based on [3], mathematics is said to be science-related to one another, so sufficient mathematical connection skills are needed for students. Thus, in learning mathematics subjects, it is recommended that students be able to connect between these concepts. Students should be given more opportunities or opportunities to observe the relationship between mathematics and other disciplines. Students will have a broader knowledge of dealing with the *problems* currently faced if students can observe these relationships.

The parameter of the mathematics learning process is when students can observe or see a relationship. Quoted from [4], Arwinie argues, based on the NCTM (National Council of Teachers of Mathematics) in 2000, suggests that the parameters in the mathematics education process are in the basic capabilities of mathematics such as problem-solving, reasoning, connection, communication, and representation. In this case, mathematical connection skills are very important

for students. As [5], it is important to have mathematical connection skills that align with the nature of mathematics as a systematic and structured science, and it contains interrelated concepts. Mathematical connection ability can help students solve a problem and master the concept. Mathematical Connection is a science that consists of several parts related to each other, structured and intact, and can be said to be the body of knowledge of mathematics. The importance of mathematical connection skills is also stated in the opinion. His research says that mathematical connection skills are an important part that must be mastered or possessed by students at every level of education. With mathematical connection abilities, students will see the relationships and benefits of mathematics [6].

The ability of students to connect between topics in mathematics and connect mathematics in everyday life, students' mathematical connection abilities can make students have thoughts and insights that are open to mathematics, not only focusing on one topic of study but also being able to connect with other topics related to mathematics. Build students to be better in learning [7]. The ability of connections is a student's ability to understand that mathematics consists of various topics. This is in contrast to what occurs in the field where students' connection abilities are still low because students are unable to solve problems or problems regarding students' mathematical connection abilities [8]. This is in line with the opinion of [9] in their research that students' weak mathematical connection ability is seen in the inability of students to connect concepts or material that has been studied by students, which makes students difficult in solving problems that arise given by the teacher. Student so far feel that the material math is unrelated and difficult applied in their life daily [10]. Mathematical connection ability is an ability that must be built properly so that students can know the relationship between various concepts in mathematics or with other concepts and can apply mathematics in everyday life [11].

According to Wahyudin in [12], mathematical connection ability must be emphasized in learning mathematics because students who can connect mathematical concepts will have a deeper understanding and consider the learning given well. Students who have a deep understanding or good connection skills can think of the steps in solving a given mathematical problem. Students will know what to do after taking a step in solving a given mathematical problem, or they will be able to find solutions to the mathematical problems they face. Mathematical connection ability is the ability of students to find the relationship of a representation of concepts and procedures in understanding mathematical topics and the ability of students to apply concepts in other or everyday life [13]. This is in line with the opinion [14] in his research that argues that mathematical connection ability is the ability of students to connect a mathematical concept itself or mathematical concepts with other fields.

Quoted in [15], Suherman argues about mathematical connections as the ability to connect one mathematical concept to another, linking mathematical topics with other fields of study, or connecting them to the real world through an application. According to the Opinion of Septiaba and Komala, a study conducted by [16], the purpose of mathematical connection ability is so that students can view mathematics as a unified whole, understand mathematical ideas that are Next, investigate and use the mind and create models to solve problems both in mathematics and in other disciplines or mathematical concepts in everyday life.

Sumarmo [17] suggests several activities that are included in mathematical connections, including:

1. Looking for the relationship between procedures with multiple representations of concepts,
2. Understanding the relationship between mathematical procedures and topics;

3. Applying mathematics in everyday life or other fields;
4. Knowing the representation of the equivalent concept;
5. Looking for the relationship between one procedure with another procedure on an equivalent representation;
6. Using between mathematics and various other mathematical topics.

Mathematical connection ability is a mathematical relationship that refers to the recognition and use of relationships between mathematical ideas or ideas, which aims to understand that mathematical ideas and ideas are interrelated and form a unified system, as well as knowing and applying mathematics to various contexts in the field. Others in everyday life [18].

Paradigm changes in learning mathematics and developments in science and technology require students to be able to solve mathematics-related problems related to its application in students' daily lives. In this case, students are also required to be able to solve problems and apply connections between rules in mathematics or between concepts and other disciplines. Judging from this, in educating mathematics subjects, students must have adequate mathematical connection skills. Relationships in the mathematics education process can help students understand the relationship between mathematical topics that have been studied and are fundamental knowledge for students, which aims to make it easier for students to learn mathematics and understand various new concepts [1].

The basis in the mathematics learning process, namely integer material, is material that is very easy to relate to in everyday life, as the opinion of [8], where the material about integers is often found in everyday life on mathematical connections. The ability of mathematical connections in learning integers is a mandatory ability for students to solve problems in the given mathematics. As stated by [19], students who have adequate mathematical connection skills can support these students in knowing and understanding the interrelationships between concepts in mathematics and being able to apply them in daily human life. The applied mathematical connection makes it easy for students to understand and relate integer questions to real-life problems. Based on the description above, the relationship between mathematical connections to integer material is why researchers analyze the application of Mathematical Connection Ability in junior high school students on the Integer material.

METHODS

The method in this study used a qualitative approach with descriptive research used by researchers for this study. Based on the opinion of Meleong in [20], descriptive research is data that is not in the form of numbers but the form of pictures or words. Meanwhile, according to Sugiono in [9], qualitative research is used to describe and examine social activities or events regarding situations or events. SMP Negeri 22 Pekanbaru became the place for the research to be carried out with 20 students in class VII as the research subjects. The material used is Integers. The implementation of this research is to examine the mathematical connection ability of students at SMP Negeri 22 Pekanbaru in solving problems regarding integers given to students with a total of 6 questions in the form of a description test.

The instrument given is in the form of a test that aims to analyze the students' mathematical connection abilities in solving integer questions. The indicators of mathematical connection, according to NCTM in [11], are:

1. Understanding and using the various interrelationships between several mathematical ideas.
2. Understanding the process or method that underlies if mathematical ideas are interrelated with one another and give birth to a harmonious whole.

3. Understanding and implementing mathematics into several external mathematical contexts.

As for in this study, the authors took the indicators according to NCTM. Based on these indicators, the authors divide it into three aspects of the assessment, namely:

1. Understanding the use of connections between various topics in mathematics. In this aspect, students are expected to be able to relate the previous material with the information obtained.
2. Knowing and understanding the connections between fields of science. In this aspect, students are expected to be able to relate other subjects to the material being studied.
3. Knowing and using mathematics with relationships outside of mathematics. Based on this aspect, it is hoped that students can relate *problems* in their daily lives to lessons.

Next, the mathematical connection ability scores obtained by the students were classified into 3 (three) categories: high, medium, and low. In this case, the researcher uses the theory according to Arikunto [11] to classify the criteria for students' mathematical connection abilities. These classifications include:

Table 1 . Mathematical Connection Ability Classification Criteria

Category	Value Criteria
High	$x > \bar{x} + s$
Medium	$\bar{x} - s \leq x \leq \bar{x} + s$
Low	$x < \bar{x} - s$

Description:

x : student grade

$\bar{x}$: student's average score

s : standard deviation

RESULTS AND DISCUSSION

The research results were obtained from the mathematical connection ability test on the integer material. The results of these tests are:

Table 2. Maximum Value, Minimum Value, Average, and Standard Deviation

The Number of Students	Maximum Value	Minimum Value	Average	Standard Deviation
20	96	54	77.55	12.45

Based on Table 2 above, it can be concluded that the students' mathematical connection abilities have met the Minimum Completeness Criteria (KKM). The KKM set at SMPN 22 Pekanbaru for class VII students is 76. The maximum score achieved by students is 96, and the minimum student score is 54, with an average student score of 77.55 and a standard deviation of 12.45. Here, some students still get scores below the KKM or have not reached the Minimum Completeness Criteria (KKM) at SMPN 22 Pekanbaru. Based on the test results of the instrument test on the matter of the mathematical connection ability of the integer material, it was found that the students' ability to understand mathematical connections was in the medium category. The next stage in determining the categories of students on mathematical connection abilities obtained from the instruments given includes:

Table 3. Percentage of Criteria for Classification of Mathematical Connection Ability

Value Criteria	The number of students	Percentage	Category
Value > 90	3	15%	High
65 Value 90	13	65%	Medium
value _ 65	4	20%	Low
	20	100%	

Based on the results of research on students' mathematical connection abilities, it can be seen based on the answers that have been obtained by students, which are discussed as follows:

1. Question no.1, Fitri and Aisyah went to the school cooperative together. Fitri bought a pen for Rp. 1,500,00 and a notebook for Rp. 2,000.00-. Meanwhile, Aisyah bought a pencil for Rp . 1,000,00 - and a book for Rp. 2,000.00-. Fitri paid with two two thousand bills, and Aisyah paid with five thousand notes. Whose total spending is more lavish? (indicator 3 is understanding and applying mathematics by connecting other topics outside the field of mathematics in students' daily lives).

From question number 1, 17 students were able to get the highest score, namely 4 (four). The indicator used to assess students getting the highest score of 4 is that students can relate problems in their daily lives to the math problems being studied. These students can solve problems related to integers correctly and precisely. The following is an example of a student who scored 4 in question no. 1.

Handwritten student answer for question 1:

$$\begin{aligned}
 &1) \text{ Fitri: } \text{Pena} = \text{Rp } 1.500,00 - \\
 &\quad \text{Buku} = \text{Rp } 2.000,00 - \\
 &\quad = 1.500,00 + 2.000,00 = 3.500,00 \\
 &\text{Aisyah: } \text{Pensil} = \text{Rp } 1.000,00 - \\
 &\quad \text{Buku} = \text{Rp } 2.000,00 - \\
 &\quad = 1.000,00 + 2.000,00 = 3.000,00 \\
 &\text{Uang Fitri: } \text{Rp } 4.000,00 \\
 &\text{Uang Aisyah: } \text{Rp } 5.000,00 \\
 &\text{Fitri: } 4.000,00 - 3.500,00 = \text{Rp } 500,00 \text{ (uang kembalian)} \\
 &\text{Aisyah: } 5.000,00 - 3.000,00 = \text{Rp } 2.000,00 \text{ (uang kembalian)} \\
 &\text{lebih banyak belanjaan adalah Fitri (Rp } 3.500,00)
 \end{aligned}$$

Figure 1. Student Answers at No. 1 With a Score of 4

Two students got the lowest score on these questions, namely with a score of 1 (one). The indicator that students assess in getting the lowest score of 1 is that students have not been able to relate the *problems* that occur in their daily lives to the math problems being studied. The student has not been able to solve integer problems correctly and correctly. The following is an example of a student who scored 1 in question Number 1.

Handwritten student answer for question 1:

$$\begin{aligned}
 &1. \text{ Fitri: } \text{Pena} = 1500 \\
 &\quad \text{buku tulis} = 2000 \\
 &\text{aisyah: } \text{pensil} = 1000 \\
 &\quad \text{Buku} = 2000 \\
 &\text{Fitri membayar } 4000 \\
 &\text{aisyah membayar } 3000 \\
 &\text{Fitri: } 4000 - 3.500 = 500 \\
 &\text{aisyah: } 5000 - 3000 = 2000
 \end{aligned}$$

Additional notes: "yang paling banyak" (the most), "belanjaan" (shopping), "lebih banyak" (more).

Figure 2. The Student's Answer is Number 1 with Score 1

Based on the answers obtained by these students, they have been able to understand and apply mathematics by connecting other topics outside the field of mathematics in students' daily lives because students who get a score of 4 are 85% of the total number of students and 10% of the number of students get a score of 1 In indicator 3, namely understanding and applying mathematics by connecting other topics outside the field of mathematics in students' daily lives, it can be concluded that the majority of students have high abilities in solving problems regarding integer material. In line with the research of, in the results of his study, it was found that based on indicators of applying mathematics to everyday life, students have high abilities, with a percentage of 81.82% in the high category.

2. Problem no.2, the initial room temperature is 25°C. The room will be used to store fish. Therefore the temperature of the room is lowered to -30°C. How much temperature change occurs in the room? (indicator 2 is the connection between other fields of science).

From question number 2, 16 students were able to get the highest score, namely 4 (four). The indicators that become the assessment of students in getting the highest score of 4 are students can know and understand connections between fields of science or other subjects. These students can correctly and precisely solve math problems regarding the given integers. The following is an example of a student who scored 4 in question no. 2.

② Diketahui : suhu mula-mula = 25°C
 suhu diturunkan = -30°
 Ditanya : Besar perubahan suhu
 Jb : Perubahan suhu = $25^{\circ}\text{C} - (-30^{\circ}\text{C})$
 $= 55^{\circ}\text{C}$
 Jadi, besar perubahan suhunya adalah 55°C

Figure 3. Student's Answer on Number 2 with a Score of 4

Three students got a score of 2 (two) on these questions. The indicator used to assess students in getting the lowest score of 2 is that students have not been able to know and understand connections between fields of science or other subjects. These students have not been precise and correct in solving integer math problems previously given. The following is an example of a student who scored 2 in question no. 2.

2) Suhu mula-mula = 25°C
 diturunkan menjadi = -30°
 Besar perubahan suhu = $25 - (-30)$
 $= -5^{\circ}\text{C}$

Figure 4. Student Answers on Number 2 with a Score of 2

From the answers obtained by these students, they have been able to use connections between other disciplines because those who get a score of 4 are 80% of the total number of students, and 10% of the number of students get a score of 2, in indicator 2, namely the relationship between fields-other fields of science. In this case, it can be said that if the students' ability in mathematical connections is in terms of solving integer problems related to other materials or fields of science, students have high skills. As in line with [11], namely in the results of his research, it can be concluded that based on the indicator of knowing and understanding the connection between fields of science, junior high school students have a high ability to achieve these indicators.

3. Question no. 3, one car can hold up to 45 liters of fuel. Each car used to drive a distance of 100 km will use up to 8 liters of fuel. At one time, the car's tank was full of fuel and was used to travel up to a distance of 350 km. How much fuel is left in the car after it reaches its destination? (indicator 2 is the connection between other fields of science).

From question number 3, 12 students were able to get the highest score, namely 4 (four). The indicators that become the assessment of students in getting the highest score of 4 are students that can know and understand connections between fields of science or other subjects and students who can solve math problems related to integers given correctly and precisely. The following is an example of a student who scored 4 in question no. 3.

3. Dik = Terisi 45 liter
 = 8 liter untuk berkendara sejauh 100
 = Jarak 350 km

$$= \frac{350}{100} \times 8 \text{ liter} = 3,5 \times 8 = 28$$

 Sisa = $45 - 28 = 17$ liter

Figure 5. Student's Answer on Number 3 with Score 4

Three students got a score of 3 (three) on these questions. The indicator that students assess in getting the lowest score of 3 is that students have not been able to know and understand connections between fields of science or other subjects. These students can answer questions about integers correctly, but still not quite. The following is an example of a student who scored 3 in question no. 3.

3. Diketahui: Bahan bakar terisi penuh sebanyak 45 liter
 : 8 liter Setiap berkendara 100 km
 Dit: Bahan bakar yg tersisa sampai tujuan
 penye: $8 + 8 + 8 + 4 = 28 \text{ liter}$ $45 \text{ liter} - 28 \text{ liter} = 17 \text{ liter}$ Sisa bahan bakar sampai tujuan

Figure 6. Student's Answer on Number 3 with Score 3

From the answers obtained by these students, they have been able to use connections between other disciplines because those who get a score of 4 are 60% of the total number of students, and those who get a score of 3 are 15% of the total number of students. Indicator 2 is the connection between other fields of science. In this case, it can be said that if the students' ability to make mathematical connections, namely in terms of solving integer problems related to other materials or fields of science, students have moderate skills. As in line with [11], in the results of their research, students have achieved indicators of mathematical connection in topics of other disciplines with connection abilities in the medium category.

4. Problem number 4, Pak Aswar's house has a rectangular living room of 5 m x 4 m. The living room floor is tiled with tiles measuring 25 cm x 25 cm. How many tiles were used to cover the floor of Pak Aswar's living room? (indicator 1 is the connection between various topics in mathematics).

From question number 4, 10 students were able to get the highest score, namely 4 (four). The indicators that become the assessment of students in getting the highest score of 4 are students can understand the use of connections between various topics in mathematics. These students can answer math questions about integers correctly and precisely. The following is an example of a student who scored 4 in question no. 4.

4) P = 5m
 L = 4m
 Luas = P x L

$$= 5 \text{ m} = 5 \times 100 = 500 \text{ cm}$$

$$= 4 \text{ m} = 4 \times 100 = 400 \text{ cm}$$

$$500 \times 400 = 200.000 \text{ cm}^2$$

 Keramik = $25 \text{ cm} \times 25 \text{ cm} = 625 \text{ cm}^2$

$$= \frac{200.000}{625} = 320 \text{ Keramik}$$

Figure 7. Student's Answer on Number 4 with Score 4

2) $5 \text{ m} \times 4 \text{ m} = 20 \text{ m}^2$
 $25 \text{ cm} \times 25 \text{ cm} = 625 \text{ cm}^2$
 Banyak keramik yg moautu
 lantai ruangan = 625 cm

From the answers obtained by these students, they have been able to understand and apply the interrelationships between mathematical topics because students who get a score of 4 are 50% of the total number of students. Students who earn a score of 2 are 10% of the number of students in indicator 1, namely, students able to understand the use of connections between various topics in mathematics. It can be concluded that students who can answer integer questions are in a low category. As in line with the opinion of [11] in his research on indicators of recognizing and using connections between mathematical topics, the data obtained in his study were 38.10% of students who can be said to be still unable to connect topics between mathematics.

- From question number 5, 3 students were able to get the highest score, namely 4 (four). The indicators that become the assessment of students in getting the highest score of 4 are that students can understand the use of connections between various topics in mathematics and the material given previously and can find the correct answer. The following is an example of the answers obtained by students who scored four on question number 5.

5) HPP	Rp			Rp	
2	200	100	150	2	200
2	100	200	75	-	terbanyak
2	50	100	75	-	dan lebih banyak yg dapat dibuat
5	25	50	75	-	- dan air mineral = 200
3	25	25	75	-	$50 = \frac{20}{5} = 4$
5	25	25	25	5	- beras = 100
5	5	5	5	5	$50 = \frac{10}{5} = 2$
5	1	1	1	5	- minyak = 150
					$50 = \frac{15}{5} = 3$

Eight students got a score of 1 (one) on these questions. The indicator that becomes the assessment of students in getting a score of 1 is that students have not been able to understand the use of connections between various topics in mathematics and topics that have been previously given, and the answers obtained are wrong. The following is an example of a student who scored 1 in question no. 5.

5

	A	B	C	D
200	400	150	2	
100	200	75	1	
50	100	35	1	
25	50	15	1	
10	20	5	1	
5	10	2	1	
1	1	1	1	

$$\text{FPB} = 2 \times 5 \times 5 = 50 \text{ Raket}$$

$$400 : 200 : 150 = 2 : 1 : 1$$

$$= 75$$

Figure 10. Student's Answer on Number 5 with Score 1

From the answers obtained by these students, they have been able to understand the use of connections between various topics in mathematics and the material is given previously because students who can get a score of 4 are 15% of the total number of students and students who earn a score of 1 are 40% of the total number of students. Students on indicator 1, namely students who understand the use of connections between various topics in mathematics in solving integer material problems on students' mathematical connection abilities are categorized as low, in this case in line with the opinion [11] from the results of his research that the smallest percentage or low is found in the indicator of the connection between typical mathematics with a percentage value of 36.04%.

6. Problem no.6, Alif visits the library once every four days. Haris visits the same library every five days, and Nizam visits the library every six days. On Saturday, Alif, Haris, and Nizam visited the library together. After how many days will Alif, Haris and Nizam visit the library together? and on what day? (indicator 3 is understanding and applying mathematics by connecting other topics outside the field of mathematics in students' daily lives).

From question number 5, 8 students were able to get the highest score, namely 4 (four). The indicator used to assess students in getting the highest score of 4 is that students are able to relate problems in their daily life to the math problems being studied, and these students can solve problems related to integers correctly and precisely. The following is an example of a student who scored 4 in question no. 6.

6. $4 = 2^2$
 $5 = 5 \times 1$
 $6 = 2 \times 3$

KPK = $2^2 \times 3 \times 5 = 60 : 7 = 8 \text{ minggu}$
lebih 4 hari

Setelah 60 hari lagi
hari Rabu

Figure 11. Student's Answer on Number 6 with Score 4

Four students got a score of 3 (three) on these questions. The indicator that becomes the assessment of students in getting a score of 3 is that students can relate *problems* that occur in their daily lives to the integer math problems being studied. The student can answer integer questions correctly, but still not quite right. The following is an example of a student who scored 3 in question no. 6.

6. $4 = 2^2$
 $5 = 5 \times 1$
 $6 = 2 \times 3$

KPK = $2^2 \times 5 \times 3 \times 1 = 60$
dari Sabtu
ke Selasa

Figure 12. Student's Answer on Number 6 with Score 3

From the answers obtained by these students, they have been able to relate *problems* in their daily life to the math problems being studied. Because 40% of the students can get a score of 4, and as many as 20% get a score of 3. In indicator 3, namely linking *problems* in daily life to the mathematics problems studied, it is concluded that students can solve integer problems in Mathematical connection ability is still low. This is in line with the opinion [18] that the results of his research concluded that students who have low connection abilities are students who cannot relate to and apply mathematics outside of other math topics in students daily lives.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the study, it can be concluded that the students' mathematical connection abilities, specifically the topic of integers with the research subject, were students of class VII SMP studied at one of the Pekanbaru City schools with the number of students tested as many as 20 students having the category level of mathematical connection ability are diverse. The results of this study indicate that the results obtained by students from the mathematical connection ability test are that there are three high-ability students with a percentage of 15%, there are 13 students with moderate abilities with a percentage of 65%, and there are four students with low abilities with a percentage of 20%. Based on the research that has been done, the researcher suggests that other researchers or further research that will research students' mathematical connection abilities are advised to pay attention to students in working on the questions given.

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BIOGRAPHY

Dila Anggaraini

Dila Anggaraini is the seventh child of the couple Syahari and Kartini. Born in Teluk Kabung, on August 28, 1996, she studied at (1) SD Negeri 009 Teluk Kabung, (2) SMP Negeri SEATAP Teluk Kabung, (3) SMA Simpang Gaung, (4) S1 State Islamic University Sulthan Syarif Kasim Riau and is currently studying Master's Degree Program in Mathematics Education, Riau University. Contact Person: 082296605661. Email: dila.anggaraini7423@grad.unri.ac.id.

Afra Rahmaulydina

Afra Rahmaulydina is the first child of the couple Aswar Mulyadi and Singgar Niari. Born in Padang Sidempuan, August 15, 1996, she studied at (1) SD Negeri 200309 Purwodadi, (2) SMP Negeri 2 Padang Sidempuan, (3) SMA Negeri 3 Padang Sidempuan, (4) S1 Mathematics Education at the State Islamic University of Sulthan Syarif Kasim Riau (5) Teacher at SDS 396 Islam Terpadu Alhusnayain, Padangsidempuan.