



Analysis of Students' Junior High School Mathematical Connection Ability

Nenta Dumalia Siregar^{a*}, Edy Surya^b

^{a,b}*Mathematics Education Post Graduate Program Study, State University of Medan, Jl. Willem Iskandar Pasar
V, Medan 20221, Indonesia*

^a*Email: missnenta@gmail.com*

^b*Email: edy_surya71@yahoo.com*

Abstract

The purpose of this study was to analyze the student's mathematical connection ability of class IX SMP Muhammadiyah-22 Kisaran. The type of the study is qualitative descriptive. The subject of the study were 36 students of class IX-A SMP Muhammadiyah-22 Kisaran 2016/2017 Academic Year. The instruments of the study was Mathematical Connection Ability Test. The result showed that the percentage of students' mathematical connection ability in first indicator was 51,11 %, the second indicator was 17,78 %.

Keywords: mathematical connection ability; mathematic learning.

1. Introduction

Basically, learning is the result of the synergy of the three main learning components namely students, teacher competence, and learning facilities. Mathematics learning is a process or activity of a mathematics teacher in teaching mathematics to its students, in which the teacher's efforts to create climate and service to the ability, potential, interests, talents, and needs of students about math are very diverse in order to occur optimal interaction Between teachers and students as well as between students and students [1]. It means that learning will work best if the three main components support each other.

* Corresponding author.

In the world of education, especially in the learning of mathematics, the ability to connect a material with another material or with everyday life plays an important role in the learning process, especially mathematics learning. In mathematics contains some capabilities that are expected to be mastered by students, one of which is the ability to connect mathematically. Through the ability of mathematical connections, students' thinking ability towards mathematics is expected to become increasingly widespread. In addition, mathematical connections can also improve students' cognitive abilities such as recall, understand the application of a concept to the environment and so on. Without applying the concept to the student's experience, it will be difficult to recall a given material and remember too many separate concepts whereas math is rich in principles.

Educational standards all over the world (for example NSC in South Africa, NTSM in USA, diverse curricula in Germany) recommend that teachers enable pupils to recognize and to make connections among mathematical ideas [2].

Mathematical connection capability is the ability of students in linking the various issues related to mathematics. The connection is included in mathematics and between mathematics with things outside mathematics. As link the concepts included in Algebra with the concepts included in Geometry. The linking of mathematics to other disciplines and to everyday life [3].

According to the National Council of Teachers of Mathematics in 1989 [4], mathematical connections were an important part that should be get an emphasis in every level of education. Mathematical connection is the linkage between mathematical topics, the linkage between mathematics with other disciplines and mathematical relationships with the world real or in everyday life. Mathematical connections are an important part that should be emphasized at every level of education.

But in reality, the mathematics curriculum is generally is seen as a collection of a number of topics so that each topic

Tend to be taught separately. This of course makes students should considering too many concepts and not recognizing the principles commonly relevant to various fields.

Therefore, the curriculum should help students to can see how mathematical ideas are interrelated. If the idea mathematics is associated with the day-to-day experience of the student then of course students will appreciate the usefulness of mathematics.

2. Mathematical Connection Ability

The mathematical connection comes from English from the word Mathematical Connection which was then popularized by NCTM in 1989 and used as one of the curriculum standards aimed at assisting the formation of student perceptions, by looking at mathematics as a unified whole As a stand-alone material and recognize the relevance and benefits of mathematics both at school and beyond school.

Mathematical connections are the interrelationships between mathematical topics, the interrelation between

mathematics with other disciplines, and the relation of mathematics to the real world or everyday life. Reference [5] states that the mathematical connection includes internal and external relationships mathematically.

Correspondingly with [6] argues that mathematical connections are related to internal connections and external connections. Internal connections include connections between math topics while external connections include connections with other subjects and connections with everyday life

Reference [7] suggest that the literature has identified two major types of mathematical connections. The first is recognizing and applying mathematics to contexts outside of mathematics (the links between mathematics, other disciplines or the real world). The second concerns the interconnections between ideas in mathematics.

Mathematical knowledge about organized structure [8]. Organizations in mathematics linking the various elements contained therein. The elements in mathematics may consist of: Algebra, Geometry, Arithmetic, Probability, and Calculus. In addition, the mathematics may also consist of facts, concepts, principles, and skills. As the link between the concept of a square with a parallelogram. The square is a parallelogram that all sides are equal in length and all the right-angled corners.

According to NCTM [9] the mathematical connection is divided into three classifications:

1. The connections between topics, and mathematical processes,
2. Connections between mathematics with other sciences, and
3. Connections between mathematical concepts to everyday life.

Mathematical connections ability required students in studying several mathematical topics that are interconnected with each other. If a topic is given individually then the lesson will lose a moment that is very valuable in an effort to improve student's mathematics achievement generally. Without a mathematical connection ability students will have difficulty learning mathematics.

In recent studies epistemological aspects of mathematics are seen in their interdependence with sociological aspects [10]. According to that, interconnections in mathematics refer not only to mathematical objects and scientific topics but also to the cooperation among mathematicians. Thereby high theoretical coherence as epistemic component and wide spread of social consensus is recognized as a characteristic quality of mathematics.

Reference [11] argue that one shows a deep understanding of mathematics through:

- *connections* made between different mathematical ideas
- different *representations* of mathematical ideas
- *reasoning* between different mathematical ideas.

They suggest that ‘in order to examine someone’s understanding of a mathematical concept, it is important that we examine the connections that a person makes to that concept ...’ (pp. 5–6).

Reference [12] stated that One can define a mathematical connection broadly as:

- a relationship between ideas or processes that one can use to link topics in mathematics
- a process of making or recognising links between mathematical ideas
- an association a person might make between two or more mathematical ideas
- a causal or logical relationship or interdependence between two mathematical entities.

The literature has often captured these broad views into three ways of considering mathematical interconnectedness:

1. as a feature of mathematics (a priori – implying that it exists independently of the learner)
2. as a relationship that the learner constructs
3. as a process that is part of the activity of doing mathematics [13].

Bruner [14] states that there is no concept or operation in mathematics that is not connected with other concepts or operations in a system, because of the fact that the essence of mathematics is something that is always associated with something else. Making connections is a way of creating understanding and conversely understanding something means making connections. The perception that mathematical concepts are interrelated concepts must be pervasive in the learning of mathematics in schools. If this perception is the basis of the teacher in the learning of mathematics then each review the material always associate with other material from daily life.

According to [15], indicators for mathematical connection ability are: (1) Recognizing and exploiting relationships between ideas in mathematics; (2) Understanding how ideas in mathematics interconnect and underlie each other to produce a coherent whole; (3) To recognize and apply mathematics in contexts outside mathematics

While according to [16], students' mathematical connection ability can be seen from the following indicators :

1. Looking for and understand the relationship of various representations of concepts and procedures.
2. Using mathematics in other fields of study or daily life.
3. Understanding the equivalent representation of the same concept or procedure.
4. Looking for connection of one procedure to another procedure in equivalent representation.
5. Using connections between mathematical topics, and between mathematical topics and other topics.

Reference [17] describes indicators of mathematical connections, among others: (1) Finding relationships from various representations of mathematical concepts and procedures. (2) Understanding the relationship between topics in mathematics. (3) Able to use mathematics in solving problems in everyday life. (4) Understanding the equivalent representation of concepts (5) Finding relationships between procedures one to another equivalent.

(6) Using a connection between mathematics with mathematics itself and with other science.

So to connect, students must understand the information they receive, so they can see, dig, problem, try to find solutions by using mathematical ideas to solve problems, whether related to mathematics, other disciplines, or with daily life, day. In connecting, students must understand the newly acquired information to be directed to information that has been received earlier.

From the above description, it can be concluded that the ability of mathematical connections is the ability in relating mathematical concepts, either between the mathematical concepts themselves and with other fields (with other subjects and with real life, day to day).

3. Limitations

This study used only a method that analysis of students' junior high school mathematical connection ability of class IX SMP Muhammadiyah-22 Kisaran on Congruence Triangle.

The mathematical connection ability is analyzed by two indicators. The indicators are the relationship between mathematics and daily life, and the relationship between objects with mathematical concepts.

4. Methods

This research is a qualitative descriptive. Reference [18] said that a qualitative descriptive research is the basic types of research that major purpose is description of the state of affairs as it exists at present.

This research is a qualitative descriptive that aimed to see the pictures of student's mathematical connection ability. The subjects of this study were 36 students of class IX-A in SMP Muhammadiyah-22 Kisaran. Mathematical connection ability tests in the form consisted one problem with two questions of Triangle Congruence. The scoring techniques used in this study using the following guidelines:

Table 1: Grid of Mathematical Connection Ability

Indicators of Mathematical Connection Ability	Indicators of Congruence Triangle	Number of Test
The relationship between mathematics and daily life	Students can apply the concept of congruence triangle in the daily life problems	1a
The relationship between objects with mathematical concepts	Students can state the concept used and its relationship to the problem	1b

Table 2: Test Scoring Guidelines Mathematical Connection Ability

Rated Aspect	Reaction To The Problem	Score
The relationship between mathematics and daily life	No Answer	0
	Answer are almost inconsistent with questions or problems	1
	Some answers according to the question or with the problem but the connection is not clear	2
	Some answers according to questions or with problems and connections clear but not complete	3
	Answer according to questions or with problems but not complete	4
	Answer according to questions or with problems and complete	5
The relationship between objects with mathematical concepts	No Answer	0
	Answer are almost inconsistent with questions or problems	1
	Some answers according to the question or with the problem but the connection is not clear	2
	Some answers according to questions or with problems and connections clear but not complete	3
	Answer according to questions or with problems but not complete	4
	Answer according to questions or with problems and complete	5

To calculate the percentage of the total score for each indicator of problem solving ability (P_k) used :

$$P_k = \frac{\text{Acquisition score on indicator to } - k}{\text{Total score on indicator to } - k} \times 100\%$$

$$k = 1, 2, 3, 4$$

With the qualification such as table 3 below:

Table 3: The Qualification of Total Score Percentage (source [18].)

Percentage	Qualification
$85 \leq P_k \leq 100$	Very Good
$70 \leq P_k \leq 84,99$	Good
$55 \leq P_k \leq 69,99$	Good Enough
$40 \leq P_k \leq 54,99$	Not Enough
$0 \leq P_k \leq 39,99$	Very Less

5. Result Of The Research

The test results of students' mathematical connection ability obtained from the research results shown in the following table:

Table 4: Students' Score of Mathematical Connection Ability Indicators

Code of Student	Score of Indicators	
	The relationship between mathematics and daily life	The relationship between objects with mathematical concepts
S1	2	1
S2	3	1
S3	3	2
S4	1	0
S5	2	2
S6	3	1
S7	4	2
S8	2	1
S9	2	0
S10	1	0
S11	2	0
S12	2	0
S13	3	1
S14	4	2
S15	3	0
S16	4	2
S17	2	0
S18	3	1
S19	2	0
S20	3	1
S21	4	1
S22	3	2
S23	2	1
S24	3	1
S25	3	0
S26	3	1
S27	3	1
S28	3	1
S29	2	0
S30	2	1
S31	4	3
S32	3	1
S33	1	1
S34	2	1
S35	1	0
S36	2	0

Here is examples of students' answers on mathematical connection abilities test:

Question:

1. A park with triangle shaped ABC is right-angled at B, AB = 6 m, AC = 10 m. Toni's garden is triangle-shaped DEF congruence with park ABC with DE = 27 m.
 - a. If for every m^2 of Toni's garden it takes 1 kg of fertilizer, how many kilograms of fertilizer needed to cultivate the whole of Toni's garden?
 - b. Write down the concepts used and relate to the problem!

Table 5: Mathematical Connection Ability Percentage Based on the Indicators

Indicators of Problem Solving	Score of Students	Total Score	Persentase	Category
The relationship between mathematics and daily life	92	180	51,11	Not Enough
The relationship between objects with mathematical concepts	32	180	17,78	Very Less

Student's answer sheets:

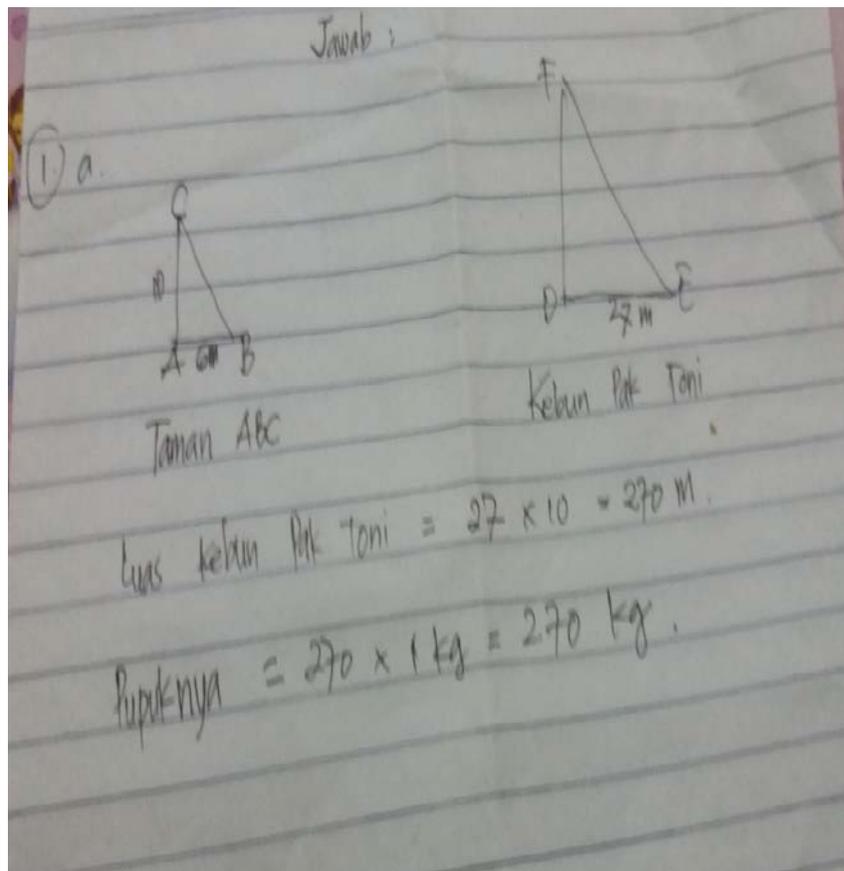


Figure 1: Student's answer sheet

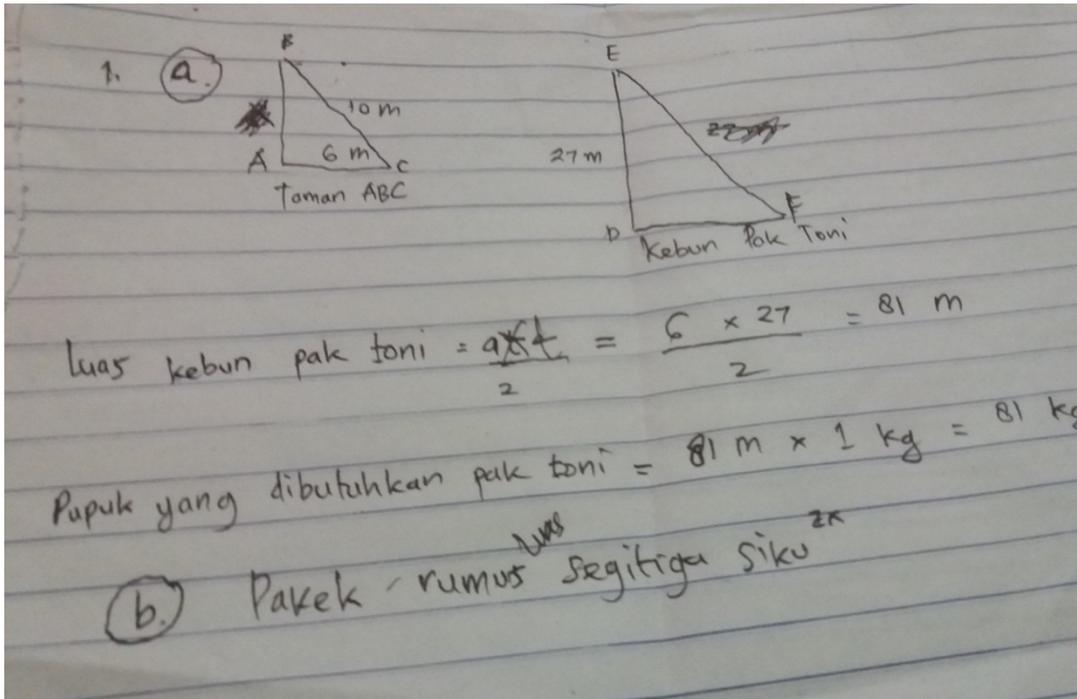


Figure 2: Student's answer sheet

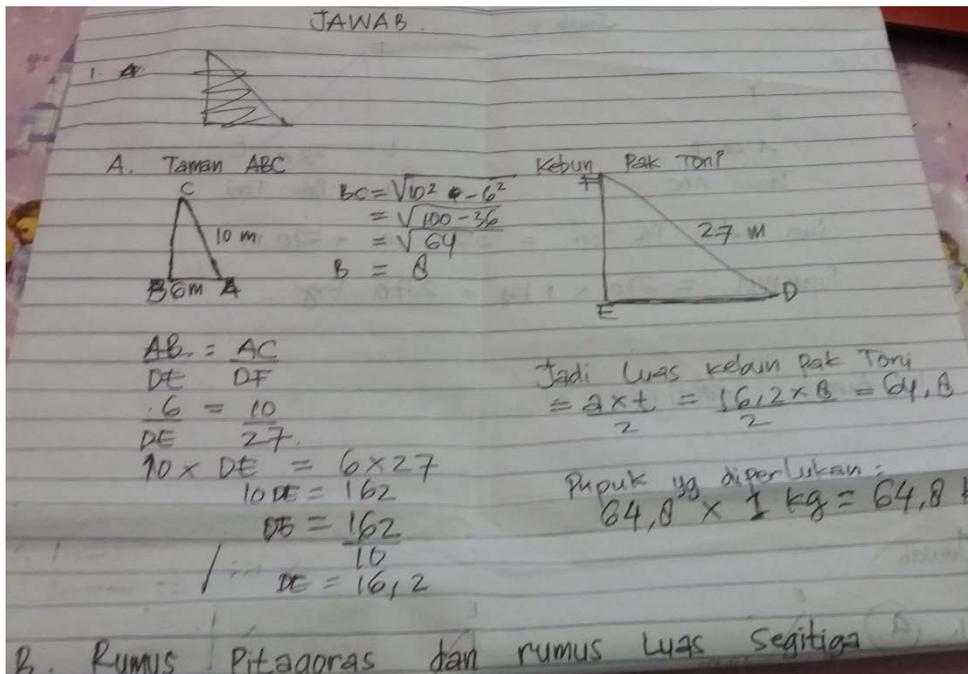


Figure 3: Student's answer sheet

From some sample picture of student answers above, we can get the conclusion :

- Student's answer on Fig-1 are not according to the question or with the problem given. Students just multiply the number contained in the problem. He didn't even answer the second question.

- Student's answer on Fig-2 almost inconsistent with questions or problems given. But the connection not clear.
- Student's answer on Fig-3 according to questions or with problems though not complete. But the student can connection the problem between objects with mathematical concepts.

6. Discussions

The results showed that the mathematical connection ability of most students in class IX SMP Muhammadiyah-22 Kisaran is still very low. Most students have not understood the relationship between objects with mathematical concepts to meet the indicators of mathematical connection ability. Mathematical connection ability can be showed with The ability to associate the basic concepts or knowledge possessed with other concepts or acquired new knowledge, according to the theory by Jean Piaget in [20] which reveal that all experiences involving two equal processes are equally important: recognition or knowing, which relates to the process of assimilation and accommodation, and resulting in modification of cognitive structures. This modification can be likened to the learning process.

The Relevant research with this paper is a study conducted by [21] states that students' mathematical connection ability is in accordance with the level of basic ability of mathematics that is for the students who are in the group on the students' connection ability is high (86%), the students are in the middle group the ability of students connection is moderate (74%), and the students Which is in the group below the ability of mathematical connections are very low (32%).

Likewise with research [22] authors said that students with high mathematical ability has a very good connection to meet the four indicators of mathematical connections, students with medium mathematical ability are meeting three mathematical connection indicators well and students with low mathematical ability meet two indicators of mathematical connection well.

From the above description according to the theory by Jean Piaget and relevant research, this study has analyzed the mathematical connection ability with these indicators and the result, the ability of class IX students SMP Muhammadiyah-22 Kisaran was still very low by using the method of Indicator of mathematical connection ability.

7. Conclusions and Recommendations

7.1. Conclusions

From the results of analysis and discussion of research results, it can be concluded that the percentage of students' mathematical connection ability on the first indicator is 51,11%, and the second indicator is 17,78%. Based on the research that students' mathematical connection ability in the case of indicators is not yet complete.

7.2 Recommendation

Based on the results of research can be given suggestions as follows:

- Since the level of mathematical connection ability of most students is in the category of "Not Enough", it is necessary deeper teaching by teachers relating to mathematical connections on learning mathematics in the classroom.
- Further research is needed as to what causes the lack of mathematical connection ability of junior high school students.
- There should be further research to find out how to improve mathematical connection ability of junior high school students.

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