THE ABILITY OF MATHEMATICAL CONNECTIONS ON THE SUM OF TRIANGLE ANGLES BY USING PROBLEM-BASED LEARNING FOR JUNIOR HIGH SCHOOL STUDENT

Archangelia Maria Lelu[1, a)] and Chintya Kurniawati[2, b)]

[1,2] *Department of Mathematics Education, Faculty of Teacher Training and Education, Sanata Dharma University, Mrican, Tromol Pos 29, Yogyakarta 55002, INDONESIA*

[a)]Archa.lelu1@gmail.com
[b)]Chintya.kurniawan25@gmail.com

Abstract

Mathematical connection ability has a strong relation in connecting mathematics problem with our daily life. For an example, the students will be asked to recalling the previous topic to understand the recent topic.In fact, some of them still have a low understanding in connecting mathematics. Based on the researcher's teaching practice experience, 13 out of 32 students have not understood in connecting to topic with other topics in mathematics. Therefore, the researchers want to know students' mathematical connection ability toward the sum of angles in a triangle by using problem-based learning models. In this research, the researchers used a qualitative descriptive method. Then, the research participants were 5 students of academic year 2016/2017 from SMP BOKPRI class VII A. Furthermore, the researchers used three instruments such as learning achievement test, observation and interview. The learning achievement test was used to know the student's mathematical connection ability. Then, observation and interview were used to reinforce the results of the analysis. Based on the results of this research, the researchers concluded that 2 out of 5 students have a good mathematical connection ability. In the other hand, the 3 of 5 students have a bad mathematical connection ability.

Keyword: connection ability, problem-based learning.

Introduction

National Council of Mathematic Teachers (NCTM, 2000) formulate that the purpose of mathematics learning consists five basic mathematics skills such as the standard of problem solving, reasoning and proofing, communicating, connecting, and representing. Kusuma (2008) said that the mathematical connection ability is one of the internal and external relationships in mathematics, connections between mathematical topics, connections with other disciplines, and connections in our daily life. Therefore, it can be said that one of the mathematics objectives subject is students are able to explain the interconnection between the concept and applying the

concept appropriately to solve the problems in our daily life. Nevertheless, the problem that happened in the school environment is students had difficulty in learning a material. It is because, they are unable to connect the materials that they have learned.

Based on the researcher's teaching practice experience, 13 out of 32 students have not understood in connecting to topic with other topics in mathematics. Astiati (2016) suggest that students' mathematical connection ability still need to be improved. However, Permana and Sumarmo (2007) solved the problems how to make a simple way for the students in mathematical learning ability by using problem-based learning.

According to Fathurrohman (2015: 113), Problem-Based Learning (PBL) is a learning model that involves learners to solve a problem through the stages of scientific method so that learners can learn the knowledge related to the problem and also have the skills to solve problems. Therefore, PBL has strong relation to the mathematical connections ability, because mathematical connection ability has a strong relation in connecting mathematics problem with our daily life. In this case, the researchers want to know the students' mathematical connection ability. The researcher will use a topic about the sum of angles in a triangle and PBL models.

Theory

A. Definition of Mathematical Connections Ability

Mathematics consists of various topics that are related to each other. These linkages is not only between topics in mathematics, but also the relationship between mathematics with other disciplines and the relevance of mathematics in everyday life. One's ability to relate between topics in mathematics, associate mathematics with other sciences, and the daily life of so-called mathematical connection ability. This is in accordance with the opinion of Kusuma (2008) said that the mathematical connection ability is the ability to show the internal and external relations

of mathematics, include: the connection between math topics, connections with other disciplines, and connections with everyday life. The connections of this aspect are also reinforced by the opinions Mikovch and Monroe (1994), which states that *"In mathematics, at least three kinds of connection are particularly subject to benefical: connection within mathematics, across the curriculum, and with real world Contexts"*.

According to the NCTM (2000: 64), mathematics is not a collection of topics and ability of separate, despite the fact that math is often partitioned and taught in several branches. Some people say that mathematics is an integrated science. In fact, the students still difficult to connect the materials that they have learned.

B. Forms of Mathematical Connections

According to the National Council of Mathematics Teachers (NCTM) (in Rendya Logina, 2012), the mathematical connection is an important part that must get the emphasis on every level of education. Herdian (2010) states that the purpose of the connection of mathematics given the students in secondary schools. The students will be able to: (1) Recognize representation equivalent of a similar concept, (2) Recognize the relationship procedures on representing to procedure of equivalent representation, (3) Use and assess some mathematical connection topics, (4) Use and assess the connections between mathematics and other disciplines.

Based on some statements above, mathematical connections can be grouped in three aspects: the connection between multiple topics of mathematics, mathematical connections with other disciplines, and mathematical connection with the real world in everyday life.

Table 1. NCTM's Indicators of Mathematical Connection

Ability Mathematical Connections:
1. Mutually connect various representations of concepts or procedural
2. Recognizing the relationship between topics in mathematics
3. Using mathematics in everyday life
4. Seeing mathematics as a unified whole.

Ability Mathematical Connections:
5. Applying mathematical thinking skills and create a model to solve problems in other subjects such as music, science, art, psychology and business.
6. Using mathematical ideas to understand other mathematical ideas are further
7. Aware that an equivalent representation of the same concept.

Coxford (in Sugiman) suggested that indicators mathematical connection capabilities include:

Table 2. Coxford's Indicators of Mathematical Connections Ability

Mathematical Connections Ability:
1. Connecting the conceptual and procedural knowledge.
2. Using math on another topic.
3. Use mathematics in everyday life.
4. See mathematics as an integrated whole.
5. Applying mathematical thinking skills and create a model to solve problems in other subjects such as music, science, art, psychology and business.
6. Knowing the connections between topics in mathematics.
7. Know the various representations of the same concept.

Based on the table 2 above, researchers used indicators math skills of students in solving the problem as follows:

Table 3. Mathematical Connections Indicators

Mathematical Connections Indicator:
1. Recognize and use connections among mathematical ideas
2. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
3. Using mathematical ideas to understand other mathematical ideas are further

Methodology

In this research, the researchers used a qualitative descriptive method. The research participants are five BOPKRI junior high school students' grade VII A. The object of this research is the ability of mathematical connections using problem based learning. In order to determine instrument research, the researchers used three instruments. Those were achievement

test, observation and interview. Learning achievement test was used to know the student's mathematical connection ability. Then, observation and interview are used to strengthning the results of the analysis.

Result and Discussion

In this section, researchers do an analysis of student result test. The results of the analysis are strengthning by interviews and observations. At the time of the study, researchers use problem-based learning models. In the first activity, the teacher asks the students to show that the sum of the angles inside the triangle is $180°$. On this activity students show it by using a bow. Some error occurred due to lack student drawing skills. Then, on the second activity the teacher asks the students to prove that the sum of the angles inside the triangle is $180°$. On this activity students should strive for connecting materials previously they have learned. But not all students able to connect the material well.

A. The First Student

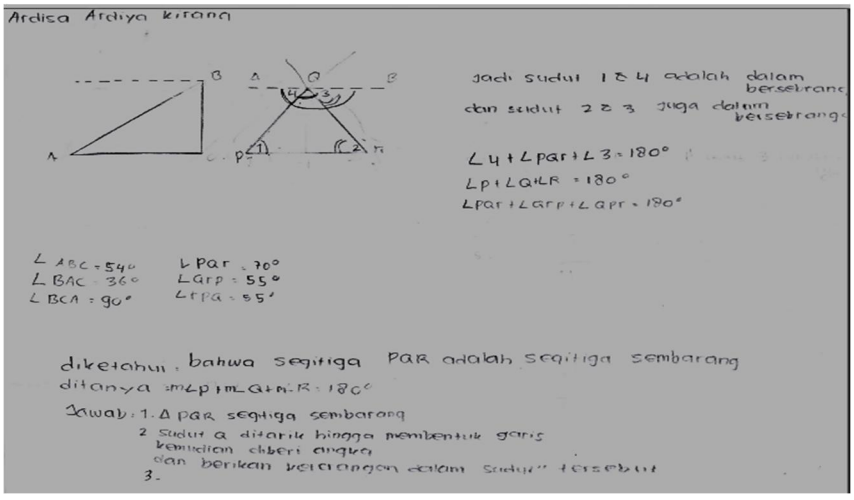

Figure 1. First Student

- **Recognize and use connections among mathematical ideas**

This student were able to connect various representations of concepts. She immediately understood the first given problem, and then answered correctly. Then for the proof, the researcher gave a support by asking her to draw a line, parallel to one side of the triangle. After that, she could solve the problem in a structured manner, started from seeing which angles have the same size. At the end, she can answer the second problem. Thus, this student was able to use her conceptual and procedural abilities.

- **Understand how mathematical ideas interconnect and build on one another to produce a coherent whole**

  This student already knew and therefore able to connect topics in mathematics. This is the evident for how she can use angular properties to prove the sum of angles inside the triangle.

- **Using mathematical ideas to understand other mathematical ideas are further**

  This student already used her mathematical ideas to understand other mathematical ideas further such as using angular properties to understand further mathematical idea, about angles inside triangel. She can prove that the sum of angels inside triangle is 180°.

B. The Second Student

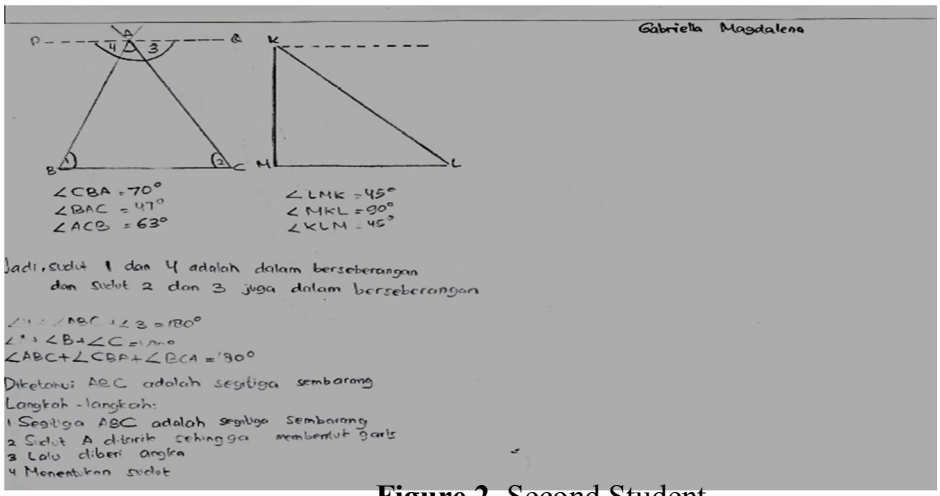

Figure 2. Second Student

- **Recognize and use connections among mathematical ideas**

  This student was able to connect various representations of concepts. At first, this student did not know what to do or understand the problem, but when she received some support, she could understand the first problem and answered correctly. For the proof, the researcher gave same support to this student by asking students to draw a line parallel to one side of the triangle and description of angular properties. After that, this student can solve the problem in a structured manner. Finally students can answer the second problem. Thus, these students are able to use their procedural abilities.

- **Understand how mathematical ideas interconnect and build on one another to produce a coherent whole**

  This student already knew and therefore able to connect topics in mathematics. This is the evident for how she can use angular properties to prove the sum of angles.

- **Using mathematical ideas to understand other mathematical ideas are further**

  This student already used her mathematical ideas to understand mathematical ideas further such as using angular properties to understand further mathematical idea, about angles inside triangel. She can prove that the sum of angels inside triangle is $180°$.

C. The Third Student

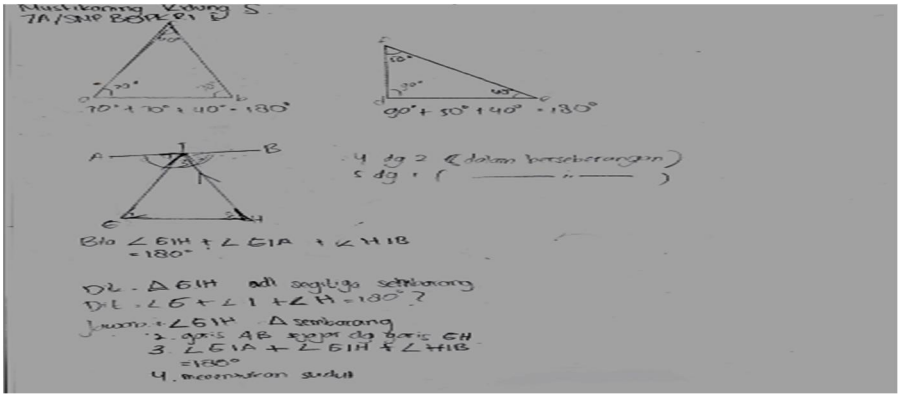

Figure 3. Third Student

- **Recognize and use connections among mathematical ideas**

  This student was able to connect various representations of concepts. This student immediately understood the first given problem, and then she answered correctly. This student also received the same support. After that this student can solve the problem in a structured manner, see which angle is the same. Finally, she can answer the second problem. Thus, these students are able to use her conceptual and procedural abilities.

- **Understand how mathematical ideas interconnect and build on one another to produce a coherent whole**

  This student already knew and able to relate topics in mathematics. This is the evident for how she can use angular properties to prove the sum of angels inside triangle.

- **Using mathematical ideas to understand other mathematical ideas are further**

  This student already used her mathematical ideas to understand other mathematical ideas further such as one student using angular properties, parallel lines to prove that sum of the angels inside triangle is 180°.

D. The Fourth Student

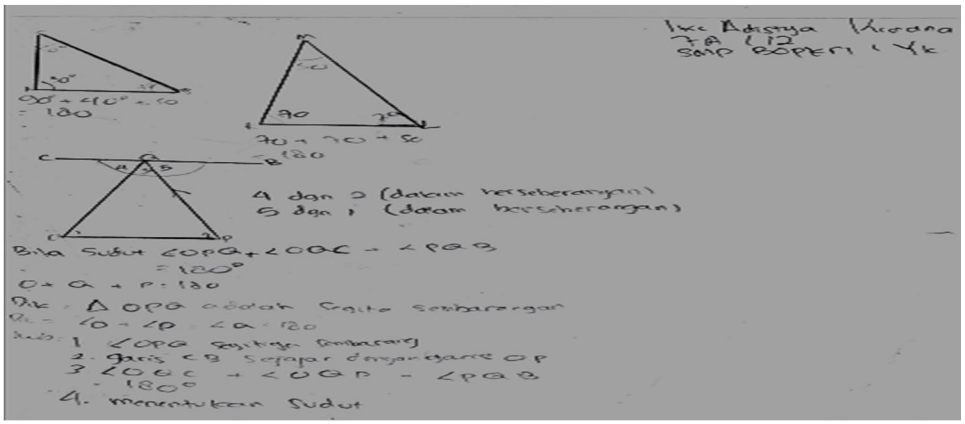

Figure 4. Fourth Student

- **Recognize and use connections among mathematical ideas**

  This student was able to connect various representations of concepts. This student immediately understood the first problem given, then answered correctly. Then to prove, the researcher gives more support to this student by asking students to draw a line parallel to one side of the triangle and description of angular properties. After that this student can solve the problem in a structured manner. Finally students can answer the second problem. Thus, these students are able to use their procedural abilities.

- **Understand how mathematical ideas interconnect and build on one another to produce a coherent whole**

  This student is already aware and able to relate topics in mathematics. This is evident from how he can use angular properties to prove the sum of angles inside triangle.

- **Using mathematical ideas to understand other mathematical ideas are further**

  This student already used her mathematical ideas to understand further mathematical ideas such as using angular properties and parallel lines to prove that sum of the angels inside triangle is $180°$.

E. The Fifth Student

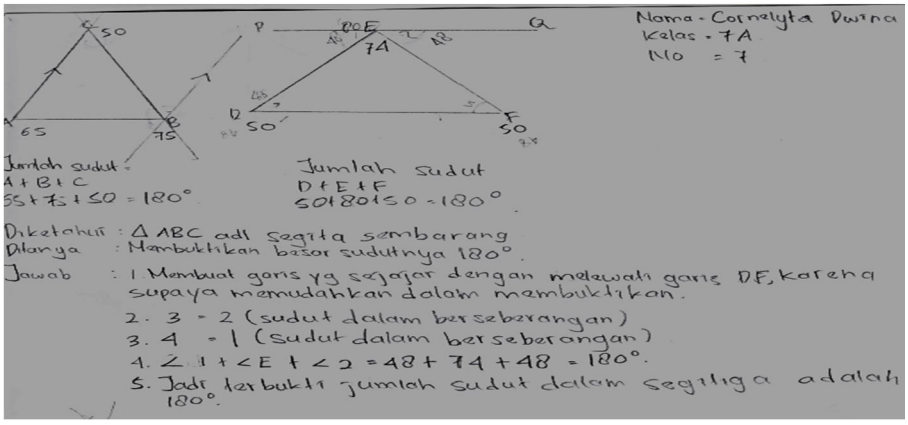

Figure 5. Fifth Student

- **Recognize and use connections among mathematical ideas**

  This student could not connect the various representations of the concepts. This student did not understand the first problem, so it requires much more support from the researchers. About the proofing problem, the researcher gives more support to this student by asking the students to draw a line parallel to one side of the triangle and determine the angular properties. After that the researcher still gave her many support step by step so this student can solve the problem.

- **Understand how mathematical ideas interconnect and build on one another to produce a coherent whole**

  This student is not yet aware and has not been able to relate topics in mathematics. There were so many supports given by researchers. By the help of supporter, this student can use angular properties to prove the sum of angles inside the triangle.

- **Using mathematical ideas to understand other mathematical ideas are further**

  The fifth student used mathematical ideas to understand other mathematical ideas further even though with so many support. This fifth student still needs extra help and guidances.

Conclusion

Based on the result and discussion above, 2 of 5 subjects already meet the indicators of mathematical connection abily. Another 2 subjects also meet the indicators, but they still need more support to reach indicators and the last subject has not yet to reach the three indicators. This subject needs many more support from researcher to solve the problem.

References

Astiati Putri, dkk. 2016. *Pengaruh Pendekatan Realistic Mathematics Education Terhadap Kemampuan Koneksi dan Pemahaman Matematis Siswa pada Materi Perbandingan*. Vol (1), No (1), Pages (1013).

Fathurrohman. 2015. *Model-model pembelajaran inovatif.* Yogyakarta: AR-RUZZ.

Herdian. 2010. Kemampuan Koneksi Matematik Siswa. Retrieved from : https://herdy07.wordpress.com/. [3 Mei 2017].

Kusuma, D.A. 2008. *Meningkatkan Kemampuan Koneksi Matematik dengan Menggunakan Pendekatan Konstruktivisme*. [online]. Retrieved from : http://repository.unpad.ac.id/2292/1/meningkatkan-kemampuan-koneksi-matematik.pdf . [12 September 2017].

Logina, Redya. 2012. *Kemampuan Konenksi Matematis dan Metode Pembelajaran Quantum Teaching dengan Peta Pikiran*. Vol (1), No (1), Pages (83).

Maulana, Ady.S. 2013. *Penerapan strategi react untuk meningkatkan kemampuan koneksi matematis siswa smp*. [online]. Retrieved from http://repository.upi.edu/9693/10/s_fis_0800421_chapter2.pdf. [2 April 2017].

Milkovch, A.K and Monroe, E.E. 1994. "*Making Mathematical Connection Across The Curriculum : Activities to Help Teachers Begin*". School Sicience and Mathematics. Reston. Vol (94), No (7).

NCTM 2000. *Principles and Standards for School Mathematics.* Reston, VA: NCTM.

Permana Yanto, Sumarmo Utari. 2007. *Mengembangkan Kemampuan Penalaran dan Koneksi Matematik Siswa SMA Melalui Pembelajaran Berbasis Masalah*. Vol(1), No (2), Pages 112.

Sugiman. 2008. *Koneksi Matematik dalam Pembelajran Matematika di Sekolah Menengah Pertama*. Yogyakarta. Universitas Negeri Yogyakarta.

Warih Dwi Pratiwi, dkk. 2016. *Analisis Kemampuan Koneksi Matematis Siswa Kelas VIII Pada Materi Teorema Phytagoras*. (Lecture Note).