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STUDENTS' MATHEMATICAL CONNECTION IN PROBLEM POSING

Himmatul Asfaroh
Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, e-mail : himmatulasfaraoh@mhs.unesa.ac.id

Rooselyna Ekawati
Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, e-mail : rooselynaekawati@unesa.ac.id

Abstract

Mathematics is a complex discipline, while in the learning process mathematics is taught to students in stages and divided into several chapters. Therefore, it requires mathematical connection skills to connect the concepts that have been learned to obtain meaningful knowledge Mathematical connection is students' ability to use connection on inter-concepts in mathematics, connection with other disciplines, and apply mathematical ideas in the context of everyday life. Problem posing is an activity that can be used to see students' mathematical connection. Problem posing is an activity to formulate or to make a question of the given situation and then try to solve it. One of the types of problem posing is pre-solution posing, which focuses on making questions based on the situation or information that will provide an open problem that can develop students' mathematical connections. Semi-structured situation is one of the situations on problem posing that ask students to pose a problem from open condition which has chance to be completed by applying prior mathematical knowledge or concepts. This study is a qualitative descriptive research with two subjects which representing each category. This study used mathematical abilities test, mathematical problem posing test and interview to obtain the data. After that, The data obtained were analyzed by doing data condensation, data display and then drawing and verifying conclusions based on mathematical connection indicators. The results of the study has shown that each subject uses different connections in each aspects of. Students' mathematical experiences influence the mathematical connections that students use in problem posing.
Keywords: Mathematical Connection, Problem Posing

INTRODUCTION

Mathematics as one of subjects in curriculum 2013 that has characteristics of abstract objects. This characteristic distinguishes mathematics from other disciplines. Mathematics is a subject that has been taught to students from an early age. In the learning process, mathematics is taught in stages and divided into several chapters. Separate knowledge having some difficulties for students in connecting the material that has been understood previously with the material to be studied, or connecting material that has been received with problems in everyday life and with knowledge outside of mathematics. In addition, Gagne (1983) divides mathematical objects into direct objects and indirect objects. Whereas Mathematics itself is a complex scientific discipline (Nurdiyah, et al, 2018) therefore, an ability called as mathematical connection is needed in order to obtain meaningful knowledge.

There are several definitions of mathematical connections, according to Saminanto & Kartono (2015), mathematical connections are the ability to connect between concepts in mathematics and non-mathematical concepts. While Haji, et al. (2017) said that mathematical connections are the ability of students to connect various problems related to mathematics. So based on the description of some experts' opinions it can be concluded that mathematical connections are the ability of students to use the interrelationships of ideas in mathematics, connection with other scientific disciplines and apply mathematical ideas in the context of everyday life.

Siregar and Surya (2017) said that without mathematical connections, students would have difficulty in learning mathematics. NCTM also said "without connections, students must learn and remember too many isolated concepts and skills. With connections, they can build new understandings on previous knowledge" (NCTM, 2000: 274). Linto, et al. (2012) also revealed that students' mathematical connection skills are important for students to be able to connect between one material and another. Mathematical connection itself is one of the standard mathematical learning processes initiated by NCTM. In addition, in the Minister of Education and Culture Regulation No. 20 Years 2016 concerning standard of competences for junior high school / Mts mention that.

> "Students are able to connect factual, conceptual, procedural and metacognitive knowledge in the context

of themselves, family, school, society and the surrounding natural environment, nation, state, and regional region".

The stated goals require students to be able to understand a mathematical problem in the context of everyday life. NCTM (2000) mentions three aspects of mathematical connections, there are: (1) inter-connections in mathematics, (2) connections with other disciplines, and (3) connections with everyday life.

Based on a research by Rohmatullah (2018) revealed that, mathematical connections can be seen in the problem posing activities. The importance of problem posing is mentioned in Christou, et al. (2005) said "Problem posing is an important aspect of both pure and applied mathematics and an integral part of modeling cycles which require the mathematical idealization of real world phenomenon". Problem posing is seen as an important component of the mathematics curriculum and also the center of mathematical activities (Crespo, 2003).

There are several definitions of problem posing, one of them according to Siswono (2017) problem posing is a task that asks students to submit or make mathematical questions or problems based on the given information, while solving problems or problems made. While according to Christou, et al. (2005) is to reformulate the given problem or to create new problems according to the given situation. Thus, from those definitions above it can be concluded that the problem posing is to formulate or to make a question out of the given situation and solve it.

According to Stoyanova and Ellerton (1996), problem posing consists of three situations, they are: (1) free situations, (2) semi-structured situations, and (3) structured situations. To propose a mathematical problem, Siswono (2017) describes the steps for problem posing as follows: (1) Understanding the information provided, (2) Preparing a problem posing plan, (3) Making a problem, and (4) Checking questions, strategies, solutions, and answers. Silver and Cai (1996) provides problem posing was applied to three different forms of mathematical cognitive activity:

1. Pre-solution posing is posing that may occur before the problem is resolved. Problems can be generated from information provided in the form of stories, drawings, diagrams, and more.
2. Within-solution posing occurs when students solve complex problems. In order to solve complex problems, students pose simpler new problems that can lead to solving the complex problem.
3. Post solution posing is posing occurs when the student has solved the problem. Students pose a new problem similar to the problem that has been resolved.

Rahmawati (2015) said that pre-solution posing focuses on making questions based on the situation or information that will provide an open problem that can develop students' mathematical connections. The results of the study by Rohmatullah (2018) stated that all of the 6 selected subjects had different mathematical connections. In a semi-structured situation, students were asked to make mathematical questions from open situations and to explore the structure of the situation and complete it using the knowledge, skills, concepts, and relationships of the mathematical experiences that they already have. So that in this study will be using a pre-solution posing type in the semi-structured situation.

Furthermore, an indicator is needed to measure the mathematical connections. NCTM (2000) mentions the indicators used in observing the mathematical connections are: (1) recognize and use connections among mathematical ideas, (2) understand how mathematical ideas interconnect and build on one another to produce a coherent whole, and (3) recognize and apply mathematics in contexts outside of mathematics. Based on the connection aspects of mathematics, mathematical connection indicators were delivered by several experts and there are some steps to pose problem according to Siswowno (2017), the mathematical connection indicator in problem posing used in this study are:

(1) Identifying concepts and the connection of mathematical concepts of problems or given information
(2) Identifying the connection of mathematical concepts given with other disciplines
(3) Identifying the connection of mathematical concepts given with everyday life
(4) Plan the problem posing using the connection of mathematical concepts to the given information
(5) Plan the problem posing using the connection of mathematical concepts given with other disciplines
(6) Plan the problem posing using the connection of mathematical concepts given to the problems of everyday life
(7) Using the interrelationships of concepts in mathematics to make questions
(8) Using the interrelationships of concepts in mathematics to make questions related to other disciplines
(9) Using the interrelationships of concepts in mathematics to make questions related to everyday life.

METHOD

The method of this study is the descriptive qualitative research which has been done on the VIII-I class of SMP Negeri 3 Gresik school year of 2018/2019. The subjects of

this study consist of two students. Methods of data collection were done by giving mathematical abilities test and mathematical problem posing test to all students and interview to the chosen subjects. The mathematical abilities test was used to measure students' mathematical ability and used as a consideration in choosing the subjects. The mathematical problem posing's test was used to figure out the students' mathematical connection and also used to determine the subject of the research. On the other hand, the interview was done to obtain and to clarify information that are related to the results and also the students' rational that cannot be obtained from the written test. The data obtained were analyzed by doing data condensation, data display and then drawing and verifying conclusions based on mathematical connection indicators.

FINDING AND RESULT

Students were given a problem posing test. The results of the problem posing test were analyzed to categorize the results. The results of the problem posing test are categorized into students who posing the problem correctly and solving the problem correctly (BB), students who posing the problem correctly but solving incorrectly (BS), students who posing the problem incorrectly but solve the problem correctly (SB), and students who posing the problem incorrectly and solving the problem incorrectly (SS).

Based on the results of the problem posing test which was given, has shown that 15 (51.72%) of 29 students were categorized BB and 14 (48.28%) of 29 students categorized BS, and 0 (0%) of 29 students categorized SB and SS. Based on the results of two selected category, 2 research subjects that appear is 1 subject category BB and 1 subject category BS.

Research subjects given code ST1 for students who are categorized BB and ST2 for students categorized BS. Here the results of problem posing analysis and interview analysis for subject ST1 and ST2.

Students' Mathematical Connection in Problem Posing for Category BB

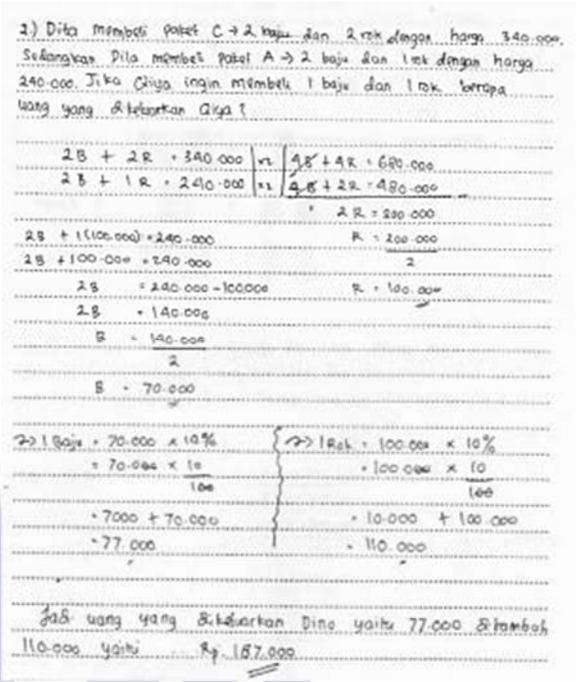

Figure 1 The result of problem posing by ST1

After receiving the worksheet the first thing to do by ST1 is reading the instructions and see each picture given. At first, ST1 felt difficulty in understanding the purpose of the situation given. Reading repeatedly helps ST1 in identifying the mathematical concepts of the problem or information provided so that after that ST1 can mention and explain mathematical concepts and their relevance. They are SPLDV concept and tax concept. These results are in line with the opinion of Stoyanova and Ellerton (1996) that in semi-structured situations give students the structure of unfinished problems and ask them to describe what problems are made from given information. In identifying the relevance of mathematical concepts given with other disciplines ST1 states that the concepts given in this situation also have concepts learned in other subjects (other disciplines). Although at first ST1 was difficult to understand the words that showed the relationship between mathematical concepts found and the concepts of other disciplines, but finally ST1 was able to explain the relevance of the concept. The tax concept will be use if she make a separate purchase question. While in identifying the relevance of mathematical concepts given with everyday life ST1 can easily explain the relevance of concepts found with everyday life. This is because ST1 feels that she has found information such as the given situation in everyday life. This is in line with the study of Rohendi and Dulpaja (2013) that Mathematical concepts has links with the real world in everyday life.

In planning the problem posing using the connection of mathematical concepts with the given information ST1 obtained the idea to make such questions from his previous

experience in working on questions about SPLDV. This result is in line with Stoyanova & Ellerton (1996) that the students' mathematical experience is needed in pose a problem. From her experience, ST1 only chose to use two packages that will be used in making the question, it is because when she working on the SPLDV problem only two equations were given. In addition, another reason to choose only two packages because with two equations derived from two packages, it is enough to make a question that contains SPLDV material. Furthermore, in planning the problem posing using the connection of mathematical concepts given with other disciplines ST1 plans to use information about 10% tax by making story questions that use a separate purchase. This is said because tax information can be used when the questions made also contain separate purchases. While in planning the problem posing using the connection of mathematical concepts given with everyday life problems ST1 chooses to make a story question because if it is made a matter of stories it will be easier to connect with everyday life.

After that, in using the interrelationships of concepts in mathematics to make questions ST1 after planning to use only two packages or two equations, ST1 randomly selects the package to be used. It is used because ST1 said using any package the result will be same, because the value of the item (variable) given will be the same in each package. In using interrelationships of concepts in mathematics to make questions related to other disciplines ST1 makes questions by adding questions if one shirt and one skirt are bought. This is used by ST1 to use the tax information given, another reason because based on the understanding of ST1 separate purchases means that the purchase must be one shirt and one skirt. Make question separated purchases will use the tax information given. While in using the interrelationships of concepts in mathematics to make questions related to everyday life ST1 makes the storyline on the questions that will be made in accordance with everyday life. ST1 chooses two people who will buy each one different packages, it is used so that the two packages purchased by the two people can be used as information in solving the problems made by ST1.

Students' Mathematical Connection in Problem Posing for Category BS

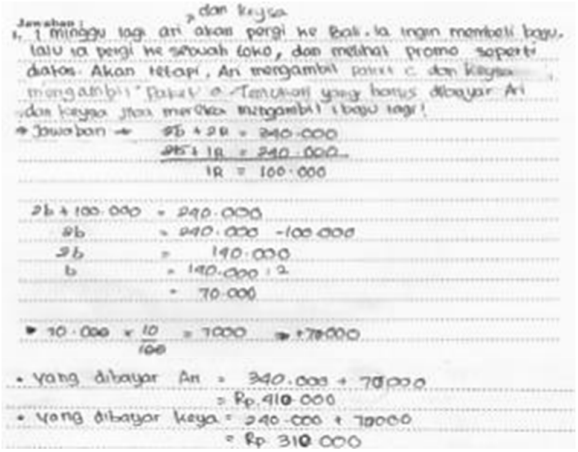

Figure 2 The result of problem posing by ST2

The first step chosen by ST2 after receiving the worksheet is to read the command and understand the brochure given. By reading the command and understanding the brochure given it helps ST2 in identifying the mathematical concepts of the problem or information given. ST2 is directly able to mention and explain the mathematical concepts and the connection given to the situation. The concept is SPLDV concept, because on the brochure are given two items that will use as two variables and given three packages as equations. These results are consistent with the opinion of Stoyanova and Ellerton (1996) that in semi-structured situations give students the structure of unfinished problems and ask them to describe what problems are made of that information. In addition to explaining the mathematical concepts given, ST2 is also able to directly mention other concepts learned in other subjects (other disciplines). But at that time ST2 still had difficulty in understanding information that showed a connection with the concepts of other disciplines. So that ST2 reads the information repeatedly. Reading repeatedly helps ST2 to identify the connection of mathematical concepts given with other disciplines. While in identifying the connection of mathematical concepts given with everyday life, ST2 can directly explain the usability of mathematical concepts given in everyday life by giving examples of events similar to the information in the brochures given in this situation. The example of activities similar to the brochure information is the buy 2 get 1 free promo that is often found in mall. This is in line with the study of Rohendi and Dulpaja (2013) that Mathematical concepts has connection with the real world in everyday life.

In planning the problem posing using the mathematical concepts related to the information given, ST2 chose to use only two packages of three packages given and then add one more shirt to each package that will be purchased. The reason stated by ST2 when choosing only two packages is because the SPLDV problem that she has ever worked on

requires only two equations and according to ST2 the two packages chosen will be converted into two equations. This result is in line with the opinion of Stoyanova & Ellerton (1996) that the mathematical experience of previous students is needed in raising problems. In planning the problem posing using the connection of mathematical concepts given with other disciplines ST2 plans to use information from concepts in other disciplines given there are tax concept by adding one shirt to each later purchase. ST2 said by adding one shirt to each purchase it means that later it will use separate purchase information so that it uses the concept of tax given. While in planning the problem posing using the connection of mathematical concepts given to everyday life, ST2 will make a story question that refers to the information given on the brochure. This was said by ST2, because by making a story question it would be easier to connect with everyday life and be easier to understand when solve it.

After that, ST2 in using the interrelationship of concepts in mathematics to make questions, after decided to choose only two packages, ST2 also randomly selects the packages to be used. ST2 explains that using any package the results given will be same. In using the interrelationship of concepts in mathematics to make questions related to other disciplines, ST2 chooses questions if one shirt is added to each person who will buy a different package how much money should be spent. The reason for choosing by adding one shirt to each package that will be purchased is because of ST2's understanding of separate purchase words. According to ST2 a separate purchase is just buying clothes or skirts. However, ST2 is still able to use the connection of mathematical concepts to concepts in other disciplines. But when solve the problem she made, ST2 made a mistake because she forgot to add the tax to be paid. Whereas in using the interrelationship of concepts in mathematics to make questions related to everyday life ST2 makes a story question that relates to the information given in this situation. ST2 makes a story question that comes from the information given by using all the related concepts found. The story matter that is made must fulfill the story questions in the SPLDV and contain separate purchase information so that it can be using tax information that is also given.

CONCLUSION

Based on the result of this research, we have conclusions that students' mathematical connection in problem posing in semi-structured problem posing as follow.

On the aspect of connection between mathematics, subject identified the mathematical concept given, namely SPLDV because the brochure are given consist of two items that will be as variables and given three packages that can covert to equation. Subjects explained that they only use two of three packages given because in linear equation system minimum consist of two equation were equation in here from the packages were given. They didn't choose more than two packages because two equation (packages) are enough to solve the question. So the subject uses the relationship between coefficients, constants and variables to make an equation and to make SPLDV problem.

In the aspect of mathematical connections with other disciplines, the subject knew there was a concept in another lesson given, but the subject felt confused to connect SPLDV with the concept of tax. After reading repeatedly the subject can understand the relationship between tax and SPLDV were given. The subject said if they should make a question with a purchase separately because it will be use the relationship between the two concepts given. Each subject used different purchase separately based on their mathematical experiences.

On aspects of mathematical connection with everyday life. The subject said that SPLDV was closely related to everyday life because the brochures given have been found by subjects in everyday life. In addition, the subject also said that the concept of SPLDV and tax are often used in everyday life. To make SPLDV problems related to daily life the subject chooses to make story questions based on the information in the brochure. They represent pictures of brochures given into buying and selling activities in everyday life.

SUGGESTION

Based on the results of the study that have been obtained, we have some suggestions as follows.

a. Based on the results of the study it was found that students' mathematical connections can be seen from the problem posing activities. So that it can be examined further the students' mathematical connections in problem posing on another situation.
b. Based on the results of the study it was found that mathematical connections each student in semi-structured situations are different. So that more research can be done about mathematical connections in semi-structured situations.

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