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Mathematical Problems Posing Ability Among Form 4 Students: A Survey

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Abstract: **Mathematical problems posing is an approach of learning that have less attention by teachers to apply to the students. This survey aims to identify the level of abilities to pose problems in mathematics by form 4 students by using the strategy of "What If Not" (WIN) and identify the types of problems generated by students. Simple random sampling technique were used to select the respondents. Respondents consisted of 35 form 4 students from a school in Kuala Lumpur. Mathematical problems posing test was used as an instrument and students need to use WIN strategies to generate new mathematical problems. Four levels of students' generation mathematical problems had been measured (featured properties, manipulate properties, generate new problems, solve new problem). The findings were analysed by using descriptive statistics, which is frequency and percentage. Findings of the study shows that the students' abilities in posing mathematical problems are higher but there is no quality in new problems posed by them. For the types of problems generated by the students, the findings showed 74% of students choose to change the number as compared to other methods. Students are more likely to change the number to generate new problems as a result of manipulative attitude. The mathematical problems posing is an acceptable learning strategy by students although it's a new thing for them. Teachers need to evaluate and plan the use of the problem posing in the classroom as well as other teaching methods.**

Keywords: **form 4 students, mathematics learning strategy, mathematic problem posing, problem posing abilities, type of problem, WIN strategy.**

I. INTRODUCTION

Mathematics is one of the important subjects and its achievements has always been the attention of various parties (Nurul Nashrah et al., 2015). Mathematics not only helps students to acquire a good education and a good career, but also help in advocating a balanced and human capital. However, students show less interest to mathematics due to the negative perception of mathematic. They do not see the relevance of mathematics in everyday life led to the assumption that mathematics is boring, difficult to understand and apply in their daily life. This perception led to a number of students continue to be left out in mastering Mathematic even for simple subtopics. This is proven through the declining performance of the Malaysian students in Trends Test in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) where the level of higher order thinking among students has been in testing (Abdul Halim Abdullah et al., 2017).

The ability to think at high levels requires mastery of cognitive skills in a variety of fields by the students. Therefore, cognitive skills had turned into one of the student's aspirations in Pelan Pembangunan Pendidikan Malaysia 2013-2025. Cognitive skills include reasoning and the ability to think critically, creative, and innovative can be mastered through learning Mathematics. By learning mathematics students can enhance their thinking ability because mathematics concepts are related and students need to think rationally to connect each concept (Rohani & Effandi, 2016). The demands of today's world require creative and critical thinking individuals (Arikan & Unal, 2014). Higher order thinking skills among students have always been a main goal our education system (Ngah et al., 2017).

One of the new approaches that can use by teachers in the classroom, which involves active cognitive problem posing because it is considered to be an important mathematical activity to demonstrate students' understanding of mathematics, skills and belief in mathematics through the problems posed (Silver 1994). Problem posing is an important activity for developing creative and critical thinking skills in solving problems (Arikan & Ünal, 2015). Problem-posing activities provided creative and creative space for teachers and students where this space cannot be obtained during the problem-solving process (Kopparla & Capraro, 2018). The problem posing activity not only involved the memorizing the formula and the procedures but also requires high level thinking skills to enable them to explore the various patterns and solutions (Siti Mistima, 2016).

In teaching and learning mathematics, mathematical problems are important components that students should be master (Rohani & Effandi, 2016). Mathematical problem solving and problem posing are two important components of mathematical problems in mathematical education around the world (Arikan & Ünal, 2015). Both help students to develop their mathematical understanding (Kopparla & Capraro, 2018). Although problem posing had been accepted by researchers and educators as part of an important scientific process, but in mathematics the problem solving process is considered more important than problem posing (Cankoy, 2014). Our education system is now more focused on problem solving activities where it is important for students to find the right solution to the given problem (Ngah et al., 2016). Many researchers have suggested that problem solving is used as a teaching activity to help students engage in mathematical learning (Chang et al., 2012). Therefore, the objective of this study is to; (a) Identify the ability of mathematical problems posing among Form 4 students based on "What If Not" strategy (b) Identify the types of problems posed by form 4 students

II. LITERATURE REVIEW

Mathematical Problem Posing

The term problem posing refers to the construction of a new problem or remodelling of a given problem where the formation can occur before, during or after the problem had been solved (Silver, 1994). The problem posing is a method of learning that requires students to build problems and change the problem given by the teacher (Rohani & Effandi ,2016). While Kilpatrick (1987) said problem posing is the method of formulating the problem. A solution for the problem that generated are being observed when a problem is given to the student, they generated new problems either by changing the part or the whole of the problem or enact the new problem. In summary, the problem posing is the process of formation of new problems from the original problems.

Mathematics problem posing activities is a process of reinforcing and conceptualizing concepts taught and enhancing students' ability to solve problems (English, 1997). It is supported by Da Ponte and Henriques (2013), where problem posing is a consistent process of formulating questions to enable mathematical activities that contain the formulation of main questions and additional questions.

Mathematical Problems Posing Activity

Study on the mathematical problem posing among students has been done a lot of previous researchers either locally or abroad. Among the overseas study was (Arikan & Ünal, 2014; Ghasempour et al., 2016; Guvercin & VerbovskİY, 2014; Van Harpen & Presmeg, 2013). In Malaysia there are also studies on the student's ability in posing mathematic problems done by the researchers (Ilfi Norman et al., 2011; Norulbiah & Effandi, 2016; Rohani & Effandi, 2016; Siti Mistima, 2016).

Most researchers study on the student's ability to pose mathematical problems. According to Rohani and Effandi (2016), students have a high level of ability to generate new problems by converting or manipulating data from a given problem. This study used the strategy of "What If Not" to test the ability of the students in posing the problems. However, this finding contrasts with the results of Norulbiah and Effandi (2016), which is the level of ability to pose mathematics problems among students through activities "Uno Problem" and "Due Problem" is average. This outcome may be different due to different problems posing strategies used by researchers. In addition to different strategies to generate problems, Yeo and Yeap (2009) also stated that the failure of the student to understand the generating problem activities and do not know what to do for these activities also affect the ability of the students in generating mathematical problems. In addition, Rohani and Effandi (2016) also found there are students who are unable to generate the problem because they

don't understand the mathematics concepts that were taught and also do not have enough skilled to use the "What If Not " to pose new problems. The understanding of the learning content or mathematics concept influences the student's ability to generate new mathematical problems (Van Harpen & Presmeg, 2013). Students need to understand certain concepts or content before they can generate problems.

Problems posing can help students achieve a better understanding on the topics taught by the teachers because they are able to explore the topic of its own (Rohani & Effandi, 2016). These activities encourage students to think at a high level because they need to produce a new problem, thus reaching the highest level in the cognitive domain that is created. But according to Siti Mistima (2016), students only able to create problems in 3 low order categories in Bloom Taxonomy that is, knowledge, understanding and application. Therefore, teachers should encourage students to engage in problems posing activities to help them increase their understanding and creativity in mathematics. Some of the steps proposed by Norulbiah and Effandi (2016) to implement mathematical problem posing activity in school are: provide opportunities for students to generate mathematics problems, mathematics learning process began with a simple mathematics problem as exposure to students, various strategies to pose mathematics problems exposed to the students, as well as encouraging the process of problems posing done in groups with the guidance of teachers.

III. METHODOLOGY

The design of this study is a survey study using a quantitative research approach which aimed at identifying the level of problem posing ability among Form 4 students based on the "What If Not" strategy. This study is an adaptation from Rohani and Effandi (2016) study renewed in terms of location, sample and instrument. The study is being carried out in a secondary school in Kuala Lumpur. 35 students were selected as respondents consists of 14 boys and 21 female students. The respondent consists of students who have average Mathematics achievement. Form 4 students were chosen because the item tested is related to the circle where they have all the basics about the circle. Form 4 students were learning all the properties of the circle while in form 2, 3 and 4. Mathematical problems posing test is being used as instruments to get the data of the study.

This instrument was the adaptation question from mathematics textbook form 4 (Siow et al., 2005). Questions are selected based on study of Ilfi Norman et al. (2011) the mathematical problem of textbooks used to pose new problems. Questions posed are from chapter Circle III. Students are requested to generate new problems by using the strategy of "What If Not". Researchers will explain to the students on the problem posing steps that will be done by students. Students just need to pose a new mathematics problem only.

According to Brown and Walter (2005), students will go through 5 levels to pose new mathematical problems. But in the context of this study, level 0 which is problems selections for problem posing does not occur because the problem had been prepared by researchers. Analysis of student's ability in posing new mathematics problems will be started at level 1 which is to characterize the properties of mathematical problems given. Students are required to list all properties that can be observed in the problems addressed by researchers. Next is level 2 "What If Not" strategy, students have to manipulate the properties listed above. The question "What If Not?" used to manipulate properties listed in level 1. Level 3 is the student generate new problems from the manipulation performed at level 2. Next in level 4, is where the students solve new problem that they generate. To answer the second question of the study, the result of student's manipulation obtained at level 2 will be used and will be analysed accordingly to two categories which is change one component data problems or change the problem (Lavy & Bershadsky, 2003).

A. Categories of Types of Problems That Been Manipulated (Lavy & Bershadsky 2003)

TABLE: I

Category	Subcategory
Changing one component data problem	Change the number
	Change the type of data
	Eliminate one of data problem
Change question	Switch to another specific question
	Reverse question (prove)

All student work will be analyzed by the researchers according to the limits stated above. A descriptive statistic in the form of frequency and percentage used to analyze the data obtained.

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IV. RESULTS

Student's Mathematical Problems Posing Ability Using WIN Strategies.

At level 1, students have to characterize properties found in problems provided by the researchers. There are 6 properties that included in the given problems. The following is the result of the student's ability in characterize the properties of the problem asked by researchers.

B. Level 1: The number of properties that successfully listed/is characterized by students

TABLE: II

The number of properties	Frequency	Percentage
2	2	6
3	4	11
4	1	3
5	6	17
6	22	63

Table II shows that 22 students, which is 63% of the total students can identify all the properties of the problem provided by the researcher. While 13 students (37%) were only able to list some of the properties of the problem.

C. Level 2: Number of students who successfully manipulating the properties/data

TABLE: III

Level 2	Frequency	Percentage
Successfully manipulate the data	35	100

Table III shows that 35 students (100%) were able to manipulate data to generate new mathematical problems.

D. Level 3: Students generate new problems

TABLE: IV

Level 3	Frequency	Percentage
Managed to generate mathematical problem by manipulating data	35	100

In Level 3, which students use the manipulated data to generate new problems. The findings show that 35 students (100%) able to generate new mathematical problems from the data that has been manipulated.

E. Level 4: Students solve new generated problem

TABLE: V

Level 3	Frequency	Percentage
Problem solved	24	69
Problem unsolved	11	31

Table V shows the number of students who can solve generated problems which is 24 people (69%) while 11 people (31%) unable to solve problems that generated by them.

Type of Problem Pose by Students

The second research question is to identify the types of problems posed by students. To answer this question problem posing categories by Lavy and Bershadsky (2003) are been referred. Findings of the research use descriptive analysis which is analysed using frequency and percentage.

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F. Type of problem posed by students

TABLE: VI

Category	Subcategory	Frequency	Percentage
Changing one component data problem	Change the number	26	74
	Change the type of data	3	9
	Eliminate one of data problem	4	11
Change question	Switch to another specific question	2	6
	Reverse question (prove)	-	-

Table VI shows 26 students (74%) pose new problems by changing the numbers. 3 students (9%) change the type of data which is to change the radius and diameter for a given problem. While the 4 students (11%) eliminate data problem and 2 students (6%) convert problem posed to other questions. And for the category on which reverses the question, there are no students pose any problems.

G. Example of problems generated by students

TABLE: VII

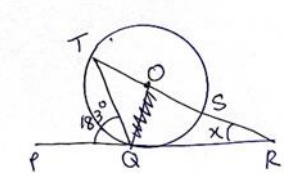
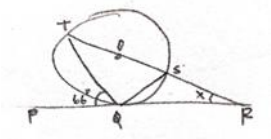
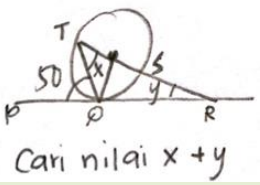
Category	Subcategory	Examples
Changing one component data problem	Change the number	
	Change the type of data	
	Eliminate one of data problem	
Change question	Switch to another specific question	
	Reverse question (prove)	

Table VII shows examples of problems posed by students. For the subcategories changing the number are the most popular choice by the students. However, there are some students who simply place any number regardless to the angle region that they covered. For example, the problem of student generated in table VII, the value of the angle is changed to 183^{o}, a unreasonable value. The concept of angles for a straight line is ignored by students. For change the type of data category, 2 data that are preferred by the students to be changed is radius OQ and alphabet X. Next category is eliminating one component of the problem data, students removes a property in a circle which cause the problem incomplete and cannot be solve. Students are not adding new information to replace the deleted properties. Only one quality problem that have been obtained from this study which is in the subcategories, change to other questions as in table VII. Students add new information and change the question to other operations.

V. DISCUSSION

Student's Mathematical Problems Posing Ability Using WIN Strategies.

The findings of this study indicate that 63% of students are able to list all the properties of the given problem. This shows that students are able to identify the properties of the circle that they have learned. But there are 6% of students who can only characterize 2 properties only, which are clearly shown in the diagram. Level 1 WIN strategy requires a good understanding of the concepts in mathematics among students in order to characterize each of the properties of the problem given either implied or explicit properties. Good mathematics content knowledge has influenced a significant ability of mathematic students to generate problem (Van Harpen & Presmeg, 2013). Mathematical problem posing activity involves and requires a lot of understanding, skills and positive attitude from the students to generate the problem according to the given situation. Understanding that been built directly by the students will help them to understand better and remember all concept.

In level 2, all students can manipulate the properties of the problem assigned to them. This finding is supported by Rohani and Effandi (2016) that says students are more likely to manipulate the facts of a given problem. There are several methods and properties that have been done by the students to manipulate properties listed on level 1. Students can change the properties of the problem given to new problems by changing the numbers, types of data, delete data and also build other problems. The findings show that the students tendency to change numbers are higher than other properties. The next level is level 3, which is students can generate problems from the manipulated data. The findings show that 100% of the students can posed problems from the properties of the circle that had been manipulated. This finding is supported by the study of Norulbiah and Effandi (2016) indicating that the student can pose mathematics problems even though they never been exposed to this activity.

Solving the problems that had been posed was a final step in measuring student's ability to in posing mathematical problems. Only 69% of the students can solve their own posed problems while others students can't solve the pose problems. This may occur because students don't understand the mathematics concepts for the problems that they pose and this may contribute for them to pose an unsolved problem. Student only copies their friends works to generate new problems (Rohani & Effandi, 2016). Therefore, the teacher should encourage students to pose more mathematic problems as there is a relationship between a solving and posing problems (Arikan & Ünal, 2014). Students should be encouraged to solve their generated problem on their own not only by using strategies to solve the problem but also through their creativity. If the problem generated by themselves do not have a solution, then the teacher should guide the students to change the structure of the problem so that the problem can be solved.

Type of Problem Pose by Students

Students have higher tendency to change the number while they pose new problems. There are 74% of students changed the original problem by changing the numbers on the diagram. However, a new mathematics problem posed by the student is less quality and incomplete. Students only change the problem without understanding the concept of properties that changed. This causes the problems posed by them are unsolved. 11% of students change the problem by removing one of the data from the problem component, that causes the problems are not complete because they do not add other data to replace the data that was removed.

VI. CONCLUSION

In conclusion the study found that the ability of mathematical problems posing in form 4 students is very high which is 100%. But the problems generated by the students could not be solved by them. This shows that there are students who generate mathematics problems without understanding the concept of the problem that they posed. Mathematical problems posing can help students achieve a better understanding of a wide range of topics taught by teachers because they are able to explore the topic of its own (Rohani & Effandi, 2016). In addition to assessing student understanding in a given mathematical concepts taught, the problems posing activity can also help teachers in evaluating their teaching.

Through new problems posed by the students, teachers could assess the level of understanding and the strength of each student (Lowrie, 1999). Thus it will help teachers to plan the next lesson with more suitable and interesting activities which can help students to improve their understanding. Teacher teaching approach can be diversified once teachers

understand their students ' level of understanding. In addition, teachers can provide a variety of quality mathematics problems and different levels to encourage pupils to think critical and creative. Therefore, the diversity of students ' cognitive level can be satisfied by the teacher after understanding the weaknesses and strengths of their students.

Students also can have a meaningful learning process through the mathematical problems posing activity because they can generate their own problems and their friend can solve the generated problems by them. They will feel fun and feel proud when their friend was able to solve the problems generated by them. Students can generate problems that fit the desired situation when they can understand something the concept well (Lowrie, 2002). Therefore, the opportunity should be given to the students to produce their own ideas to make the generating of mathematical problem more meaningful.

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