Problem solving ability based on Newman procedure in Team Games Tournament learning

Zepta Habib Alhara*, Mohammad Asikin, Amidi

Universitas Negeri Semarang, D7 Building 1st Floor, Campus Sekaran Gunungpati, Semarang City, 50229, Indonesia

* E-mail address: zeptahabib@students.unnes.ac.id

Abstract

The purpose of this research were to describe about how was the learning quality of Team Games Tournament (TGT) in students' mathematical problem solving abilities, and to describe about how were students' problem solving abilities based on Newman's procedures. The research method used was a mixed method where students are subjected to TGT learning models. The population used in this study were students of class VIII in one of junior high school in Pekalongan in the even semester of the 2018/2019 academic year distributed in four classes and the sample used was class VIIIC. The subjects in this study was selected by using purposive sampling techniques with consideration that the selected subjects can represent each category of mathematical problem solving abilities. Based on the results of the analysis, it can be concluded that learning process of TGT that have been conducted in the research class is in accordance with the lesson plan and other support devices or tools that has been made by researchers. Based on observations made by the observer, the criteria obtained for students and teacher activities were very good. The average learning outcomes of class VIIIC students that were subjected to TGT learning model in students' mathematical problem solving abilities have reached mastery learning. Research subjects that have high problem solving ability generally know the location and cause of the error when working on a problem, research subjects that have problem solving ability are partially aware of the location and cause of the error when working on a problem, and research subjects who have low problem solving ability generally do not know the location and cause of the error when working on a problem.

1. Introduction

Education about the discipline of mathematics has been introduced and taught to children from an early age because mathematical knowledge has a close relationship in various aspects of human life. Various researches had been conducted to determine the level of students' mathematical and scientific knowledge. Some of them were the Program for International Student Assessment (PISA) which is an examination system initiated by the Organization for Economic Cooperation and Development (OECD) to evaluate the education system of 72 countries around the world every three years, and the Trend in International Mathematics and Science Study (TIMSS) which is an international study measuring students' abilities in the fields of mathematics and science which is held every four years by the International Association for the Evaluation of Educational Achievement.

According to the results of the Program for International Student Assessment (PISA), Indonesia has increased its achievements in the fields of mathematics and science from year to year, but these achievements are generally still below average (OECD, 2016). The latest result of the Trend in International Mathematics and Science Study (TIMSS) in 2015 for Indonesia was also still below average. The increase in achievements that occur must continue to be improved by improving the quality of education in Indonesia.

NCTM (2000) in the Principles and Standards for School Mathematics, stated that the purpose of mathematics learning consists of five basic mathematical abilities that are standard in mathematics learning, namely problem solving ability, reasoning ability, communication ability, connections ability, and representation ability. Therefore, problem solving ability is one important component of the basic abilities that must be possessed by students in learning mathematics (Sam & Qohar, 2016).

As a basis for knowing the level of problem solving ability of students one of them was by conducting a national exam. From the results of the national exam it can be seen how high the problem solving ability of each student is in solving a particular problem. Here are the results of the national examinations of students in 2012, 2013, 2015, 2016, and 2017 at one of the junior high schools in Pekalongan.

Table 1. Average National Examination Score for chosen junior high school's students

Study	Years				
	2012	2013	2015	2016	2017
Indonesia Language	77.10	78.90	72.25	74.03	65.51
English	55.70	64.00	51.28	47.04	40.78
Mathematics	59.20	59.70	42.56	38.93	44.23
Sains	63.70	62.20	47.54	51.28	48.02

Source: Ministry of Education and Culture.

Based on Table 1, it was known that the average value of the National Examination for students of chosen junior high school in each subject from years to years does not reach the value of 80. From these data it can also be seen that there had not been a significant improvement seen in the average national examination scores especially in mathematics study where the average score has not even reached 60. It is partly due to the lack of mastery of student about problem solving related to number patterns, Cartesian coordinates, functions, straight line equations, pythagorean, circles, geometrical shapes and statistics.

The following are the results of the national exams in mathematics for students of chosen junior high school in 2012, 2013 and 2015, especially in solving problems related to statistics.

Table 2. Mastery of National Examination material on Statistics of chosen junior high school's Students

Stage	Year 2012	Year 2013	Year 2015
National	77.12	68.48	57.30
School	48.61	65.85	44.54

Source: Ministry of Education and Culture.

Based on Table 2, it was known that there are still many students of for chosen junior high school who have not mastered statistics. Lack of mastery of student resulted in the ability to solve problems become so low that there's a need of a proper effort made to overcome these problems.

Basically there were many factors both internal and external factors that influence students to make mistakes in working on the problems and each individual student must have different learning difficulties, so it is necessary to take action to overcome this. There is a need for proper learning that thoroughly addresses the conditions in which students made mistakes in working on problems.

In the Republic of Indonesia Minister of Education and Culture Regulation (Permendikbud) No. 103/2014 concerning Learning in Basic Education and Secondary Education, explained that a learning model is a conceptual and operational learning framework in which the framework has names, characteristics, logical sequences, arrangements, and culture. Thus a professional teacher must be able to use the most appropriate learning model at teaching learning activities.

Cooperative learning model Team Games Tournament is one of the cooperative learning models that prioritizes cooperation to solve a problem (Slavin, 1980; Aristin & Abidin, 2013; Lestari, 2017; Sulistyaningsih & Prihaswati, 2014). Trianto (2010) stated that in the Team Games Tournament learning model, students are grouped into groups of 3 to 5 to play the game with other team members to earn extra points for their team's score. Huda (2011) also stated that through the use of the Team Games Tournament learning model students will enjoy how the tournament atmosphere is, and because they competed with groups that have equal abilities, in general it made the Team Games Tournament learning model felt fairer than competition in traditional learning.

Therefore, a research was conducted with the formulation of research problems (1) how was the learning quality of Team Games Tournament in students' mathematical problem solving abilities? And (2) how were students' problem solving abilities based on Newman's procedures?

2. Methods

Sugiyono (2010) stated that the research method is defined as a scientific way to obtain data with specific purposes and uses. Creswell & Creswell (2017) also stated that mixed research methods as a learning model for investigating an object by connecting or combining qualitative research forms and quantitative research forms. In this research, the research's type used is the mix methods research by combining the forms of qualitative research with quantitative research forms in which students were subjected to Team Games Tournament learning model.

This research was conducted at one of junior high school in Pekalongan. The population used in this study were students of class VIII of chosen junior high school in the even semester of the 2018/2019 academic year distributed in four classes. The Sampling was done by cluster sampling techniques, and by taking one of the class randomly, class VIIIC was selected as a research class. In this study, the research subjects were expected to be able to be sources of information that can represent each category of student's abilities to get a description of their mathematical problem solving abilities. Therefore, The subjects in this study was selected by using purposive sampling techniques with consideration that the selected subjects can represent each category of mathematical problem solving abilities that were high, medium, and low problem solving abilities. Three students were selected for each category, and then analyzed how the students' error based on Newman's Error Analysis (NEA) procedures (Clements & Ellerton, 1996; Junaedi, 2014; Irfan, 2017) in working on the test about mathematic problem solving ability on statistic study.

3. Results & Discussions

This research was conducted in class VIIIC of chosen junior high school. There were total 24 students in class VIIIC. The research was carried out 3 times using the Team Games Tournament learning model in statistic study. During the research, researchers was assisted by an observer whose task was to observe and assess the quality of researchers during learning process. Observations were made by observer using teacher activity sheets and student activity sheets. The indicators used include aspects such as the ability to open a lesson, convey material, condition and guide students, close the lesson and so on.

Following are the results of the recapitulation of observers' assessments for researchers during the implementation of learning.

Table 3. Recap of Teacher Activity Evaluation Results

Meeting, date	Assessments Percentage	Description
1st meeting, 19 March 2019	87.5%	Very good
2nd meeting, 21 March 2019	89%	Very good
3rd meeting, 26 March 2019	90%	Very good

Based on observations of teacher activities presented in Table 3, found that the researchers had implemented the learning very well. The following are the results of the recap of the observer's assessment for students during the learning process.

Table 4. Recap of Student Activity Assessment Results

Meeting, date	Assessments Percentage	Description
1st meeting, 19 March 2019	87.5%	Very good
2nd meeting, 21 March 2019	87.5%	Very good
3rd meeting, 26 March 2019	87.5%	Very good

Based on observations of student activities presented in Table 4, found that students have carried out learning activities very well.

Normality Tests was carried out on all classes VIII to determine whether the data from the population are normally distributed or not, and if so then one class can be chosen randomly as a sample class for research. The normality test in this research used the Kolmogorov-Smirnov Test. From the results of the study it was found that the significance value of more than 5%, so that H$_0$ was accepted. So it can be assumed that the data from the population used in this research normally distributed. Homogeneity Test in this research uses the Levenne Test. From the results of the research it was found that the significance value of more than 5%, so that H$_0$ was accepted. So it could be assumed that the population used in this research has the same or homogeneous variance. Before the student learning completeness test was carried out, Normality Test was done again. This test was performed to determine whether the sample class data is normally distributed or not. From the results of the study it was found that the significance value was more than 5%, so that H$_0$ was accepted. So it can be assumed that the data is normally distributed.

Table 5. Grouping Levels of Students' Problem Solving Ability

No	Name	Value	Ability Category
1	KS	88,33	
2	LK	88,33	Upper
3	RJ	86,67	(High)
4	TS	85,00	
5	AF	78,33	
6	DN	78,33	
7	GB	78,33	
8	ZM	78,33	
9	DM	76,67	
10	VD	76,67	
11	AM	75,00	Middle
12	FA	75,00	(Medium)
13	AE	73,33	
14	DS	73,33	
15	K	73,33	
16	AK	71,67	
17	NA	71,67	
18	DPU	70,00	
19	DPR	70,00	
20	MB	70,00	
21	NF	70,00	Lower
22	RS	70,00	(Low)
23	TN	61,67	
24	LA	56,67	

The test was carried out for 70 minutes on Thursday, 28 March 2019 at 08.20-09.30 AM, with time allocation of 2 x 40 minutes. Based on the results of tests carried out, an average of 74.8611 was obtained with the lowest value of 56.67 and the highest value of 88.33. The hypothesis that has been made was carried out, whether The average learning outcomes of class VIIIC students that were subjected to Team Games Tournament learning model in students' mathematical problem solving abilities have reached minimum completeness criteria or not. Obtained t_{count}=3.1547. With α = 0.05 obtained t_{table} = 2.069.

Because $t_{count} = 3.1547 > 2.069 = t_{table}$, then concluded that the average learning outcomes of class VIIIC students that were subjected to Team Games Tournament learning model in students' mathematical problem solving abilities have reached minimum completeness criteria value of 70.

After testing individual completeness, classical completeness was also tested to find out how learning outcomes were carried out. Tested whether the percentage of students' completeness who reach the minimum completeness criteria classically reaches more than 75% or not of all students in the class. Obtained $z_{count} = 1.8856$. With $\alpha = 0.05$ obtained $z_{table} = 1.65$. Because $z_{count} = 1.8856 > 1.65 = z_{table}$, then concluded that the percentage of students' completeness who reach the minimum completeness criteria classically reaches more than 75% of all students in the class.

Based on the grouping of students put forward by Budiyono (2003), obtained that there were 4 students of upper groups (high ability), 13 students of middle group (medium ability), and 7 students of lower group (low ability) respectively from a total of 24 students of VIIIC grade. The grouping can be seen in Table 5.

Based on Table 5, the researcher randomly chooses 3 students from each category of problem solving abilities as the subject of the research and to be interviewed and analyzed the results of his work. Subject KS, LK, TS, FA, K, AK, RS, TN, and LA were chosen as research subjects. Interviews were held on 13rd and 14th April 2019. From the results of the research that has been carried out, it can be seen that each subject from both the upper (high ability), middle (medium ability), and lower (low ability) groups make mistakes or error on answering the questions of the test, be it in reading, comprehension, transformation, process skills and encoding. The researcher then grouped the errors of selected subjects consisting of 9 students with the aim to find out the type of error in solving test problems based on NEA based problem solving.

Table 6. Recapitulation of Error Types of 9 Selected Subjects

Group	Ability	Error Type				
		R	C	T	P	E
Upper	*High*	√			√	√
Middle	*Medium*	√			√	√
Lower	*Low*	√	√	√	√	√

Based on Table 6, subject KS, LK, and TS belong to the upper group experienced a type of R-P-E error. The three research subjects know the location and cause of the error when working on a problem that can be seen in the results of the interview. Subject FA, K, and AK that belong to the middle group experienced a type of R-P-E error too and some know the location and cause of the error when working on a problem but there was that couldn't. While the subject of RS, TN, and LA belonging to the lower group experienced a type of R-C-T-P-E error and had lack of knowledge of the location and cause of errors when working on a problem related to mathematical problem solving ability tests.

4. Conclusion

Based on the discussion that has been conducted by researcher on 9 research subjects, a conclusion was obtained about how was the learning quality of Team Games Tournament in students' mathematical problem solving abilities, and about how were students' problem solving abilities based on Newman's procedures was follows. (1) The learning quality of Team Games Tournament in students' mathematical problem solving abilities. The quality of a learning could be seen from the planning, implementation and learning outcomes, where planning could be seen from how the learning support devices or tools that are made, the implementation can be seen from the suitability between the activities of the teacher and students with the learning steps used, and outcomes could be seen from the mastery of student learning. The learning of Team Games Tournament which was conducted in the research class for three meetings was according to the plan that researcher made, both with the lesson plan or the other support devices or tools that the researcher had made on the guidance of the supervisor and the direction of the class teacher where the research was conducted. During the implementation of learning takes place, researchers assisted by an observer whose task was to observe and assess the quality of researchers during learning by using teacher activity sheets and student activity sheets. Based on observations made by the observer, the criteria obtained for student and teacher activities are very well. The average learning outcomes of class VIIIC students that

were subjected to Team Games Tournament learning model in students' mathematical problem solving abilities have reached minimum completeness criteria and the percentage of students' completeness who reach the minimum completeness criteria classically reaches more than 75% of all students in the class. (2) Students' problem solving abilities based on Newman's procedures. Based on research results from 24 students in class VIIIC of chosen junior high school's, obtained 4 students have a high problem solving ability, 13 students have a medium problem solving ability, and 7 students have a low problem solving ability. In this case students who have medium problem solving ability are more numerous than students who have high or low problem solving abilities. The causes of various types of errors made by research subjects include: R type errors (Reading) were caused by students were unable to know symbols, terms, tables, and diagrams on statistical material. Errors of type C (Comprehension) were caused by students don't understand the understanding or the formulas such as how to look for averages. Error type T (Transformation) was caused by students were unable to make plans or strategies to solve problems. Type P (Process Skill) errors are caused by students didn't count properly and carefully. Error type E (Encoding) was caused by students were unable to deduce the answers correctly and didn't checking the results of their work again properly.

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