THE IMPLEMENTATION OF COOPERATIVE LEARNING BASED ON NEWMAN'S ERROR ANALYSIS PROCEDURES IN MATHEMATICAL STATISTICS II COURSE

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Abstract

The present study focus on describing the undergraduate students' error in solving mathematical word problems through the implementation of the cooperative learning based on Newman's Error Analysis procedures. The subject of this research is second-year Mathematics Education students (student of class 4A). According to the aims, the type of the research is a classroom action research whose each cycle consists of four phases: planning, action, observation, and reflection. The action is held through the implementation of the cooperative learning based on Newman's Error Analysis procedures which included five phases that were reading, comprehension, transformation, process skills, and encoding. The research is done in one cycle as the time limitation of the research then the researcher can't continue to the next cycle. The collected data shows that the students' errors in solving mathematical problems based on the Newman's Error Analysis phases are encoding as much as 32.5%, process skills stands on 26.2%, transformation for 20.8%, comprehension as 12.6%, and reading as 7.9%. The other result is the average of students' final score is 75.73 yet only 65.38% students who pass the minimum score, 65.

Key Words: *Cooperative Learning, Newman Error Analysis, Word Problems, Statistics*

I. Introduction

Statistics is an applied of mathematical science that is taught in university level. Two types of statistics are descriptive and inferential statistics. Undergraduate students should master those two kinds of statistics that deals with collection, organization, analysis, and interpretation of numerical data. In second year of academic year of 2015/2016, students of mathematics education program receive a course namely Mathematical Statistics II. In this course, students are engaged to understand the use of inferential statistics to analysis data. Thus, students are required to understand the statistics.

Based on the teaching experience of the researcher, it can be known that students have difficulties in solving mathematical word problem on mathematical course. This is due to several things, one of which is their inability to understand the meaning of the problems. Yushau (2010) revealed that students response to word problem is one of the most problematic issues in mathematics teaching and learning. Moreover, Yushau (2010) described students encounter difficulties in

solving mathematical word problems when (1) they can not figure out the keywords of the question, (2) they do not understand the problem, and (3) they can not determine the mathematical procedure.

A certain method is needed to implement the appropriate learning dealing with students' matter in solving mathematical word problems. Previous studies insisted that students will achieve a success in mathematical learning by giving an opportunity to communicate mathematical ideas and thought and developing self confidence to solve mathematical problems through the implementation of cooperative learning or small group of peers (Snyder, 2006; Zakaria, 2010). Therefore, the implementation of cooperative learning is expexted to create a learning atmosphere which support students to think creatively by sharing their ideas and opinions with their peers in groups.

In particular, a way is needed to improve students ability in solving mathematical word problems. One of the methods is Newman Error Analysis procedures (Prakitipong & Nakamura, 2006; White, 2010). There are five procedures of Newman's Error Analysis (NEA) namely reading, comprehension, transformation, process skills, and encoding (Clarkson, 1991; Prakitipong & Nakamura, 2006). Thus, by determining the students' difficulties in solving the mathematical word problems educators are expected to help them to avoid similar difficulties. Consequently, this study aims to know students' error in solving statistical word problems through the implementation of cooperative learning based on NEA procedures.

II. Method

The type of the research is a Classroom Action Research (CAR). The four phases implemented in CAR are are planning, action, observation, and reflection. The subjects of this research are second year students of class A of academic year 2015/2016 during a month, from May 4th to June 1st, 2016. Later, the data collecting are observation, interview, test and quiz items of statistical word problems. In this research, a cycle will be passed if 70% of students have been gain minimum score 65.

III. Result and Discussion

This study will describe the result of the first cycle. In the first phase of the cycle, planning, the researcher developed the lesson plan on the subject of "probability distribution and normal distribution" based on the NEA procedures, prepared the worksheet that contains the summary of the material and some items of exercises relating to the material, developed the research instruments, validated the research instruments.

In the second phase, action, the cycle was conducted in 3 meetings. And, the topics were about 1) introducing the probability distribution and its type and 2) determining the solution of probalbility distribution and normal distribution by implementing the cooperative learning based on NEA procedures. Each meeting consist of four steps of cooperating learning that were description of information, students organization, learning group guidance, and evaluation.

The lecturer introduced five NEA procedures to solve statistical problems in the first meeting. All steps of cooperative learning were done well. In particular, the researcher found that students did mistakes when they solved statistical problem; comprehension error, transformation error, processing skills error, and encoding error. Two of 8 groups could not write well what was asked from the question (comprehension error). One group wrote "z > 90" whereas they should write correctly of the problem "probability of sand weight at least 90 quintal". Other mistake were found when students could not find a proper way to solve the problems (transformation error). To cope the problem, researcher gave a question to remind them about the concept of probability distribution. Students also did error in processing skills namely misscalculating. Consequently they also did error in encoding.

For the third phase, observation, the data collected during the learning activities (lecturer and students activities) and test score. The leacturer had applied the cooperative learning based on NEA procedures with the average of percentage of the implementation level was 100%. It means that the level of the learning implementation during the first cycle included in the category "done very well" but the ability of teacher in time management needs to be improved. Meanwhile, the observation result of students activities were described in the table below.

Table 1. Observation result of students activities during learning process

Observer notes	First Meeting	• The students in groups were seen to be cooperate to solve the statistical problems • Students had difficulties in each phase of NEA so that each group actively asked to the lecturer
	Second Meeting	• Each group were enthusiastic indicated by many groups asked a help to the lecturer • Students had difficulties in comprehension steps and determine the appropriate method or procedure

Based on the data above, students still had difficulties in comprehension, transformation, and processing skills of NEA procedures. Other collected data was taken from test score. The result showed that 17 of 26 students had reached minimum score, 70. Meanwhile the average test score of the class was 75.73. In addition, the percentage of students errors in solving statistical word problems can be seen in table 2.
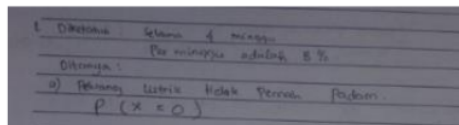
Table 2. The percentage of students errors in solving statistical word problems (test)

| Steps	Percentage of error
Reading	7,9%
Comprehension	12,6%
Transformation	20,8%
Process skills	26,2%
Encoding	32,5%

While the findings of the students' errors in solving quiz II was shown in the following table.

Table 3 The example of students error during solve test problems

Steps	Error
Reading	1. Students could not write the keywords
Comprehension	1. Students did not write completely what was given and asked from the problem
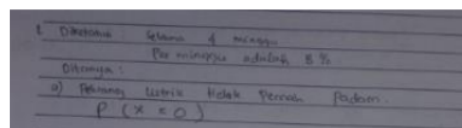
	2. Students did not write what was given and asked from the problem
Transformation	1. Students were less precise in determining the appropriate way to solve word problems 2. Students were wrong in determining the appropriate way to solve the problem

It should be

	3. Students could not determine the appropriate way to solve the problem
Process Skills	1. Students were inaccurate in performing calculations Example 1

Example 2
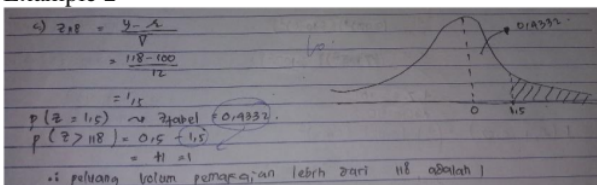
	2. Students determined the wrong ways to solve the problem
Encoding	1. Students wrote the wrong answers because of the errors did in the previous steps 2. The students did not write the final answer

In the last phase, reflection, the researcher got the following data.

Table 4. The Stabilization and Refinement of The Deficiencies of The Learning that Occurs in Cycle I that Had Been Done on the Action of Cycle II

The Deficiencies of Cycle I	The Stabilization and Refinement that should be done in the action phase of cycle II
Time management was not going well because the students were still not familiar with the learning model	1. During the class discussions, the lectured should point one group to present a certain number which need to be discussed together in class.
The average of students' final score was 84.61 and the greatest error percentage were on encoding phase and process skills	1. Lecturer should inform students about the NEA procedures 2. Lecturer should encourage students in order to accurate in doing calculation because there were still students who did error on process skills steps 3. Lecturer should give more exercises related to statistical word problems and encourage them to solve it by employing NEA procedures

The results of first cycle showed that only 65.38% students accomplished the minimum standard score. It can be said that students achievement in solving statistical word problems was not increased. Susilo, et.al. (2008) asserted that in CAR, the number of cycle can not be assigned and depended on research needs and accomplishement of problem solving. Based on the result of the first cycle and the deficiencies of the first cycle, researcher should conduct second cycle. However, because of the time limitation of the research, the second cycle can not be implemented.

According to the aim of this research, students' errors in solving statistical word problems were described in table 5. Table 5 depicts students errors in solving statsitical word problems and it is important to know the students difficulties when they solve statistical word problems (White, 2009).

Tabel 5. Students error in solving problems based on NEA procedures, cause of errors, and lecturer's support

No	Step	Error	Cause	Support
1.	Reading	• Do not write the keywords	• In a hurry to solve the problems	• Encourage students about NEA procedures
2.	Comprehension	• Determine what is given and asked but it is not well define	• Less careful in reading problem	
		• Cannot determine what is given and asked	• Limitation of time • Cannot understand the context	• Ask students to review the material
3.	Transformation	• Determine the way to solve problem but it is not correct • Do not write the proper way to solve the problem	• Students cannot connect the information and concept • Time limitation	• Asking question to remind them about the concept
4	Process skills	• Inaccurate in doing calculation	• Choose a wrong way to solve the problem	• Remind students to do calculation with a full of thoughtfulness
5.	Encoding	• Inappropriate in writing the final and conclusion of the final answer • Do not write the final answer and its conclusion	• Do an error in previous step • In a hurry	• Remind students to do calculation with a full of thoughtfulness • Remind students about the NEA procedures

This research had been conducted by implementing cooperative learning based on NEA procedures. During the learning process, students shared and discussed in a small groups or peers in which each group consists of students with different level of thinking. Based on the results, students can understand the problem by implementing NEA procedures (i.e. reading, comprehension) even

though they still have difficulties in processing skills. It can be said that NEA procedures can support students in solving mathematical problem (White, 2010).

IV. Conclussion

The NEA procedures can support students in solving statistical word problems. It was shown that students can understand the problem by implementing NEA procedures (i.e. reading, comprehension) even though they still have difficulties in processing skills. Besides, the results of the research revealed that 65.38% students accomplished the minimum standard score. It implies that students achievement in solving statistical word problems was not increased. However, because of the time limitation of the research, the second cycle can not be implemented.

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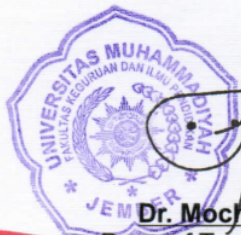
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