Efforts to Improve Mathematics Teacher Competency Through Training Program on Design Olympiad Mathematics Problems Based on Higher Order Thinking Skills in The Junior High School

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Abstract. The goal to analyse a improvement of teacher competence after being trained in preparing high-order math olympiad based on high order thinking skills in junior high school teachers in Pesisir Selatan Regency. The sample of these activities are teachers at the MGMP junior high school in Pesisir Selatan District. Evaluation of the implementation is done by giving a pre test and post test, which will measure the success rate of the implementation of this activities. The existence of the devotion activities is expected to understand the enrichment of mathematics olympiad material and training in the preparation of math olympiad questions for the teachers of South Pesisir district junior high school, motivating and raising the interest of the participants in order to follow the mathematics olympiad with the enrichment of mathematics materials and the training of problem solving about mathematics olympiad for junior high school teachers, the participants gain experience and gain insight, as well as the ins and outs of junior mathematics olympiad and implement to teachers and students in olympic competitions. The result of that the post-test is better than the result of pretest in the training of mathematics teacher competence improvement in composing the mathematics olympiad problem based on high order thinking skills of junior high school (SMP) in Pesisir Selatan District, West Sumatra, Indonesia.

1. Introduction

Teacher professionalism is often associated with three important factors, namely competence, certification, and professional allowance. These three factors are predicted to affect the quality of education. Given the results achieved by teachers in Pesisir Selatan District of junior high schools due to the poor quality of the learning process experienced by post-certified teachers and the behavior of less professional teachers. This can be seen from the low level of teacher competence, especially the absence of teachers who can represent SMP mathematics teachers olympiad from Pesisir Selatan district to national level. This is also supported by the achievements of students who have also never represented the mathematics olympiad to the national scale.

Based on observations and interviews with partners, some math teachers in the Pesisir Selatan district, have difficulties in making mathematics olympiad questions related to the material learned in school. They are used to making routine questions. Teachers' reality, it seems that most other teachers in Pesisir Selatan District of SMP are simply composing questions, modifying existing questions,
making no questions from scratch. In terms of making the problem. It is not an easy job, at least for the mathematics olympiad. Even teachers cannot make things right, but surprisingly these teachers do not seem to have any problem with the problem-making technique. The teachers are calm, never bothered it. Indeed, there has never been a fuss about whether the teacher can make the Mathematics Olympiad question. But how can it be skillful if there is no right foundation on how to create a question, where it should be based on mathematics materials.

Currently there are many books available bank of the bank that is easily obtained by the teacher or if diligently can arrange it themselves. That way the teacher with arbitrarily arranged the question, but they are constrained to make a matter of mathematics olympiad. Teachers need to get the knowledge of how to make a good and right question it is not just making a routine matter, or modify it. But it can make a problem in accordance with the demands of the Mathematics Olympiad based on high order thinking skills (HOTS). Development of teacher competence and professionalism can be done through the effort of coaching and empowerment of teachers. Thus, it is necessary to improve the quality of service learning. So that the partner of mathematics teacher conclude need to improve its special competence in making math olympiad problem based on higher order thinking skills.

To facilitate the improvement of SMP teachers’ competence in Pesisir Selatan district, the researchers conducted research that could help the problems of teachers’ limitations in doing math problems for the HOTS-based Olympic level so they could provide briefings to their outstanding students. One of the programs that need to be done is the enrichment of mathematics learning materials for teachers in junior high schools, and training on making problems about mathematics based on HOTS. Thus, the improvement of teacher competence is expected to give implication to the students, namely the formation of students in the mathematics olympiad group so it is expected to carve the achievements in various mathematics events. The results of the evaluation conducted by the mathematics teacher of the SMP Pesisir Selatan district along with the research team of Mathematics Department of Universitas Negeri Padang, it is known that the weaknesses done by teachers concerning the main factors are the limitations of the Olympic material book, the lack of training on teacher competence improvement, especially in the preparation of Mathematics Olympiad.

Based on the above factors, then the problem formulated is "Is there a positive improvement of the competence of teachers after being given training in preparing math olympiad problems based on higher order thinking skills in junior high school teachers in Pesisir Selatan regency?". The materials that will be submitted related to the improvement of teacher competence in designing Mathematics based Mathematics based on HOTS are as follows: 1. Enrichment of mathematics learning materials that are very useful as a basis for problem solving equivalent of math mathematics olympiad problems. From the results of material enrichment produced a summary of mathematics olympiad material. This activity includes tutorials as well as discussions and explorations. 2. Training to make math mathematics olympiad problems, which emphasized more on strategies to make non-routine questions as well as on HOTS issues. From the results of training generated bank about mathematics olympiad. 3. Discussion of mathematical problem solving strategy that has been designed. 4. Implementation of the results of this training in the classroom by providing an example of the Olympic questions related to the given material.

1.1 The Olympiad of Mathematics Based High Order Thinking Skills (HOTS)

The Olympic materials are basically sourced from curricula applicable to mathematics, textbooks, supporting books and other relevant materials. For Mathematics, the materials tested are questions of exploration, reasoning, creativity and conceptual understanding through the use of props. Especially for math, the material tested is non-routine questions with a high degree of difficulty for the size of junior high school students. Non-routine questions are a) Unique issues that require creative thinking, logic, and in-depth analysis. b) Can not be solved only by using the formula alone. c) It takes longer to complete, compared to routine questions According to NCTM (National Council of Teachers of Mathematics), school mathematics standards include standard content or materials and process standards. Process standards include problem solving, reasoning and verification, interconnection,
communication and representation. NCTM suggests that both material standards and process standards are collectively the basic skills and understanding that students in this 21st century need. Therefore, it is necessary to refer to international standard problems as having: 1) measuring high-order thinking ability (HOTS); 2) based on contextual issues; and 3) using various test forms. These characteristics will be used as a reference for the preparation of problems at the level of educational unit. Characteristics of international standard questions are in line with the development of assessment models in the Curriculum 2013, which lead learners to have high-level thinking skills, intelligent, creative, and able to contribute in the world civilization.

1.2 HOTS Problem Development
The development of the HOTS problem requires various criteria in terms of both the content form and the subject matter content. The technique of writing HOTS questions either in the form of multiple choice or description is generally the same as writing low level questions, but there are some distinguishing features. There are several ways that authors can be asked to write items that require high-level thinking, that the material to be questioned is measured by behavior in accordance with Bloom's cognitive domain at the level of analysis, synthesis and evaluation, in which each question is given the basic question (stimulus) and the question of measuring the ability to think critically. To develop the HOTS problem the teacher requires a prior understanding in terms of high-level thinking in Bloom's Taxonomy and how to develop the HOTS problem. Indicators of high-level thinking skills are divided into five groups (Krathwohl, 2002) namely; provide a simple explanation, build basic skills, conclude, make further explanations and organize strategies and tactics. Skills in these five high-thinking groups are detailed again as follows: a). Providing a simple explanation consists of the skills of focusing questions, analyzing arguments, asking questions and answering questions. b) Building basic skills consists of adapting to sources, observing and reporting observations. c) Summing up consists of skill in considering conclusions, generalizing and evaluating. d) Make further explanations of the examples define the terms and make definitions. e) Setting strategies and tactics for example determines an action and interacts with others and communicates. High-level thinking skills, among others, can be trained through problem-solving in the form of a variety of questions.

1.3 Teacher Competency Improvement
The purpose of improving teacher competence through teacher training is to improve the teaching and learning process in which teachers and students are involved, through a series of actions, guidance and direction. Improvement of teaching and learning process through the improvement of professional teachers is expected to contribute to improving the quality of education (Mulyasa, 2009). In relation to the training program in preparing the problem, the writing about mathematics olympiad is one of the activities of teacher profession development, not as the final destination but is actually a vehicle to report the activities that have been done by teachers to improve the quality of education, especially the learning in school. MGMP (Deliberation Teachers Subject) is a forum or a forum of professional activities of teachers of similar subjects in the studio and in each school consisting of two elements of deliberation and subject teachers. In the MGMP is expected to improve the professional competence of teachers in implementing quality learning according to the needs of learners. The container of this profession is indispensable in contributing to the increased competence of its members. The enrichment and training model for improving teachers' competence in making mathematics olympiad problems is expected to be a better value so that this enrichment and training model can be replicated more widely to teachers in other districts / cities to be formed to optimize teacher activities in MGMP Mathematics. Furthermore, it is expected to make a summary of mathematics mathematics material of SMP and bank about mathematics mathematics junior high school that can be used in MGMP Mathematics junior high school activity at provincial level.
2. Methods
Implementation of research in the form of material enrichment training and workshop. Enrichment of material given about mathematics olympiad. Meanwhile, the training / workshop was used for the problem-solving activities by junior high school teachers in the MGMP Pesisir Selatan district. Implementation of the steps in conducting the research are as follows: 1. Initially, all participants are given an initial evaluation, with the quality of the matter equivalent to mathematical olympiad that has been prepared and compiled and has been tested. A preliminary evaluation of a pre-test is useful for exploring initial capabilities as a foothold to determine which materials should be given. 2. Based on the initial test, then investigated / analyzed which material material should be given intensive. 3. Based on the analytical results in step 2, the participants are given the enrichment of materials that are considered not to be mastered by the participants. 4. Furthermore, after considered sufficient enrichment of the material then the next step is to provide training in preparing math olympiad math problems. 5. To measure the success of the participants, the final evaluation will be given a useful post-test to see the level of progress after the participants have been given enrichment and training on the mathematics olympiad. The success indicators of this evaluation activity are: 1. The teacher's knowledge of mathematics mathematics material increases, with pay attention to the increase of pre test value to the test post 2. More than 75% of teachers who participated in this activity were able to compile the problem of HOTS-based mathematics. 3. The level of participants' satisfaction from the results of the activity questionnaire exceeds 3 on scale 4.

3. Results and Discussion
Description of data in mathematics teacher competence was obtained after being given pretest and postest on the sample, that is teacher of mathematics study of SMP Negeri as Pesisir Selatan Regency in Lesson Year 2017/2018. Pretest and Postest competence of math teacher as Pesisir Selatan Regency followed by 66 people. The results of pretest and postest analysis can be seen in Table 1 below:

| Test    | Number of Teacher | Max Score | Min Score | Mean  | Variance | Deviation Standar |
|---------|-------------------|-----------|-----------|-------|----------|-------------------|
| Pretest | 66                | 62.5      | 17.5      | 41.52 | 167.96   | 12.96             |
| Postest | 66                | 90        | 12.5      | 54.85 | 170.04   | 13.04             |

Table 1 shows that the highest value obtained from the pretest result is 62.5 while the highest value obtained from the postest result is 90. In addition, the average pretest result obtained is 41.52 whereas the average postest result obtained is 90. From the description, it shows that there is an increase of mathematics teacher competency of SMPN in Pesisir Selatan Regency after being given training. When viewed from the variance of pretest and postest results that the variance of postest results is greater than the variance of pretest results. This shows that postest result of SMPN Mathematics Teacher Competence in South Pesisir Regency is more varied than the result of pretest of SMPN Mathematics Teacher Competition in South Pesisir District. Thus it can be concluded that the postest result is better than the result of pretest on the competence of mathematics teacher of SMPN in Pesisir Selatan Regency in the academic year 2017/2018. Data analysis This analysis aims to test the hypothesis. To test the hypothesis first tested the normality and homogeneity test variance data pretest and postest results using minitab software. Test of Normality of Pretest and Postest Result Data The normality test of pretest and postest data is performed using Anderson-Darling test. The hypothesis used is as follows:

H₀: The data follows a normal distribution.
H₁: The data does not follow a normal distribution.

Based on normality test result that P value from pretest result and P value from postest result are 0.048 and < 0.005 respectively. Since the value of P obtained is smaller than the specified significant
level, i.e., $\alpha = 0.05$ it can be concluded that the pretest and posttest data are not normally distributed (reject $H_0$).

**Hypothesis testing**

Based on normality test results obtained that the data pretest and posttest results are not normally distributed. Therefore, hypothesis testing is done by nonparametric test, i.e., Mann-Whitney Test. The hypothesis used in the Mann-Whitney test is as follows:

- $H_0 : \tilde{\mu}_1 = \tilde{\mu}_2$
- $H_1 : \tilde{\mu}_1 > \tilde{\mu}_2$

**Information:**

- $\tilde{\mu}_1$ = Median from posttest result
- $\tilde{\mu}_2$ = Median from pretest result

Based on hypothesis test results obtained that the value of $P$ is 0.000. That is, the $P$ value is less than the specified significance level, i.e., $\alpha = 0.05$. This shows that with the result of hypothesis test that median value of result of postest is higher than median value of pretest result. Thus, it can be concluded that the posttest result is better than the result of pretest on the competence of mathematics teacher SMPN Pesisir Selatan.

**4. Conclusion**

There is a positive improvement of teacher competence after being trained in preparing high-order math olympics based on high order thinking skills in junior high school teachers in Pesisir Selatan Regency. This is indicated by the result of the hypothesis test that the median of postest result is higher than median of pretest result. So it can be concluded that the posttest result is better than the result of pretest in the training of mathematics teacher competence improvement in composing the mathematics olympics problem based on high order thinking skills of SMPN in Pesisir Selatan Regency.

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