

## Effectiveness of Problem Solving-based Training to Improve Teachers' Higher Order Thinking Skills

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### Abstracts

Educational institutions in the 21st-century era need to strengthen students' abilities in critical thinking and find solutions to problems faced by students. Students need to be able to conclude and decide things related to their future. The provision is believed to be effectively done through habituation to help students to face high-level reasoning questions. The problem is that many teachers still need to improve their ability to develop high-level reasoning questions. For this reason, training is required to create high-level reasoning questions for teachers. The purpose of this study was to improve the ability of teachers to develop high-level reasoning questions. The training was conducted in Muara Gembong District, Bekasi Regency, through the Community Service Program (P2M) scheme of Universitas Negeri Jakarta. Respondents involved were 30 teachers consisting of 10 elementary school teachers, ten junior high school teachers and five senior high school teachers. The training method used was hands-on learning. The results showed that the average Pre-Test score was 39.5 and the average Post-Test score was 64.6 points. So that this training can increase the average value of participants by 28.7 points or improve from the category of less to enough. Recommendations for developing High order thinking Skill questions for teachers need to be carried out with more participants with methods that follow the number and conditions of the participants. Based on the discussion and data analysis of the research results, it can be concluded that with the proper training, the problems of teachers who are still constrained in developing questions about High order thinking Skills (HOTS) can be reduced, so that training in developing HOTS questions for teachers can be used as a solution.

**Keywords:** Problem-solving, improve teacher, Higher order thinking skill

### INTRODUCTION

The development of information technology is a challenge for the world of education. As a result of technological developments, primarily digital technology, human interaction has changed a lot. Transactions that were initially carried out by meeting face to face are now done with digital-based communication tools, as well as production systems in the industry using machines that are no longer controlled analogously by humans but are controlled by devices that work autonomously. The learning process in which there is a process of assessing learning outcomes contextually aims to equip students with several competencies that are the demands of 21st-century skills. There are at least three groups of skills that are the demands of 21st-century skills, namely: a) having a good character (religious, nationalist, independent, cooperation, and integrity); b) having 4C abilities (critical thinking, creativity, collaboration, and communication); and, c) mastering literacy includes thinking skills using knowledge sources in print, visual, digital, and auditory forms (Boholano, 2017; Chu et al., 2016; Treffinger; & Isaksen, 2013; Treffinger, 1995).

Some previous research on HOTS is high-level thinking will occur if a person has information stored in memory and obtains new information (Cowan, 2014; Morrison, 2005; Storm & Soares, 2021). Someone who can connect, organize and develop this information to achieve a goal. The ability to receive answers and high-level thinking skills (HOTS) includes critical thinking, creative thinking, problem-solving, and decision-making (Aizikovitsh-Udi & Cheng, 2015; Güney, 2019; Kaya & Acar, 2019). HOTS has three aspects namely: 1) transfer of knowledge (Anderson, L.W. & Krathwohl, 2001), 2) problem-solving (Bransford & Stein, 1993), and 3) critical and creative thinking (Smeyers et al., 2006). Critical thinking generates logical ideas, views, and perspectives to solve problems, while creative thinking generates new ideas and perspectives to solve problems (Birgili, 2015; Ülger, 2016).

HOTS questions are instruments used to measure high-level thinking skills, including cognitive levels of analysis, evaluation, and creation (Monrat et al., 2022). (Ku et al., 2017) divides the Taxonomy of Thinking Skills (TOTS) into three classes, namely: Lower Order Thinking Skills (LOTS), Middle Order Thinking Skills (MOTS), and High Order Thinking Skills (HOTS). Lower Order Thinking Skills (LOTS) are functional thinking skills, where information is obtained through copying, imitating, mimicking, following rules and directions, memorization, remembering, retrieving information, knowing or doing through memorization, identifying and quantifying something (Tikhonova, 2015). Middle Order Thinking Skills are logical thinking skills, where data is used to characterize, associate, differentiate, categorize, sort, graph, calculate, connect cause and effect, represent, and infer (Barut & Wijaya, 2021). HOTS consists of two thinking skills, namely: critical thinking skills and creative thinking skills.

High order thinking Skill (HOTS) questions in learning and during the assessment process are an effort to familiarize students to hone the basic skills needed in this digital era life. By using HOTS questions, we will get an overview of the Test Participants' abilities in terms of; (a) critical thinking, (b) creativity, and (c) learning self-reliance in making decisions. These skills can be mastered through practice in solving real problems in problem-solving-based daily life. To deal with the changes that occur, it is required to have sufficient digital literacy. As individual learners, we must continue to update our skills and develop our careers during current changes. Teachers must think critically to analysed every change and find solutions to every problem in everyday life. Teachers must be able to make quick and careful judgments to make the right decisions quickly. All of these are challenges for every education provider. Educational institutions are challenged to produce graduates who can adapt to changes due to technological developments. The world of education must produce graduates who can think critically and creatively and find solutions to the problems they face.

The 21st-century Learning Paradigm is (1) Learning to Know something, (2) Learning to do something, (3) Learning to be something, and (4) Learning to build a life together. It was developed by implementing a learning system and contextual assessment. Contextual assessment using instruments designed to measure high-order thinking skills. The problem felt in the field is that many teachers are still constrained in developing Hots questions, so special training is needed on how to develop HOTS questions.

**RESEARCH METHODS**

**Sample**

The research was conducted in Muara Gembong District, Bekasi Regency. The study focused on elementary, junior, and senior high school teachers. These characteristics were determined based on the consideration that these teachers need to develop questions with higher-order thinking. This study involved 30 people. It comprised 15 elementary school teachers, ten junior high school teachers and five senior high school teachers. The sampling technique used was the purposive sampling method. Sampling is based on the researcher's most practical consideration and representative (Sugiyono, 2016).

**Data Collection Technique**

The data collection technique in the study was designed with a Likert scale questionnaire. Information to assess the level of higher order thinking skills was developed based on the scoring rubric. The scoring rubric for the scores can be seen in table 1.

Table 1. Assessment Rubric

Indicators of answer	Score
The content of the answer is correct, showing at least four indicators of higher-order thinking (critical thinking, creative thinking, problem-solving, decision-making/conclusion).	5
The content of the answer is correct, showing at least three indicators of higher-order thinking (critical thinking, creative thinking, problem-solving, decision-making/conclusion).	4
The content of the answer is correct, showing at least two indicators of higher-order thinking (critical thinking, creative thinking, problem-	3

solving, decision-making/conclusion).	
The content of the answer is correct, showing at least one indicator of higher-order thinking (critical thinking, creative thinking, problem-solving, decision-making/conclusion).	2
The content of the answer is correct but does not show indicators of higher-order thinking (critical thinking, creative thinking, problem-solving, decision-making/conclusion).	1
Wrong answer / No answer	0

**Data Analysis Techniques**

The pre and post-test analysis aims to diagnose the teachers' experiences before and after using the training model in the learning process. Data analysis techniques were used based on information from questionnaires given to teachers before and after the training. Teachers were observed by filling out a form based on teachers' perspectives on the training model for developing higher order thinking problems. Statistical testing was conducted using the t-test method (Gall et al., 2016) to determine the effectiveness of the problem-solving-based training model in the classroom trial. The t-count value was compared with a one-way t-table, with a confidence level of 95% and  $df = n-1$ . The null hypothesis is accepted when the t-count is more significant than the t-table. If the opposite is trustworthy, then the null hypothesis is accepted.

**RESULTS AND DISCUSSION**

The results of this study produced a problem-solving-based training model to improve teachers' higher-order thinking skills. In developing problem-solving-based training for effective products, a pre-test and post-test were conducted on elementary school, junior high school, and senior high school teachers—the effectiveness trial of the developed product involved 30 teachers in Bekasi City. The trial process was conducted by providing training interventions for eight face-to-face meetings. This was done to identify shortcomings or weaknesses in the training process, the material, instructional objectives and the results of higher order thinking skills in developing questions.

In addition, the criteria for testing effectiveness before the intervention was carried out was a pre-test to see the teacher's initial understanding of the questions developed. At the end of the training process, a post-test was given to measure the level of higher order thinking skills in the questions designed. The results of the pre-test and post-test can be seen in Table 2.

Table 2. Effectiveness Test Post-test Results

	Pre-Test Results	Post-Test Results
N	30	30
Mean	35.8667	64.6000
Std Deviation	4.273	4.060
Sig. (2-tailed)	0.156	0.238

The Pre-Test results show the initial ability of the trainees can be described as follows. The average value is 35.9. At the same time, the Post-test results showed an Average value of 64.6. The average value of the learning outcomes of the trainees based on the Post Test results is in an excellent category. The training results show that the participants' scores increased by an average of 28.7 points after attending the training.

Based on the results of the normality test in table 2, the value of  $Sig. 0.156 > 0.05$ , it can be concluded that the data is normally distributed so that it can be continued with the Paired t-test, as the results of the Paired t-test can be seen in table 3.

Table 3. Paired t-test results.

Df 29	Pre and Post-Test Results
Mean	-9,5
Results oftstatistic	25.214
t Table	1.703
Sig. (2-tailed)	0.000

Table 2 shows that the t statistic = 25.214 when compared with the t table at DF 29 that t count = 25.214 > t table = 1.703, meaning that the pre-test score is different from the post-test. It can also be seen by looking at the Sig. (2-tailed): The probability value/value=0.000<0.05. This means there is a difference between before and after treatment. For the Mean value: -9.5 is negative, meaning there is an upward trend in post-test scores after treatment. The average increase is 9.5. It can be concluded that the problem-solving-based training model effectively improves teachers' higher-order thinking skills in developing questions.

The findings of this study are that by providing training treatment for four months through the training model, the teachers experienced changes in improving their thinking skills in developing high-level questions. The product resulting from this development is the development of questions to enhance higher order thinking skills. Based on the data from the trial analysis, the problem-solving-based training model effectively improves teachers' higher-order thinking skills in the Bekasi district.

The training process consists of a process of assessing learning outcomes in a contextualized manner aimed at equipping students with several competencies that are the demands of 21st-century skills: a) having a good character (religious, nationalist, independent, cooperation, and integrity)(Haryanto & Akhirin, 2018); b) having 4C abilities (critical thinking, creativity, collaboration, and communication)(Erdoğan, 2019; Permatasari et al., 2020; Slijepčević & Zuković, 2015); and, c) mastering literacy includes thinking skills using knowledge sources in print, visual, digital, and auditory forms(Muhali, 2019). The use of HOTS questions in learning and during the assessment process is an effort to familiarize students with the basic skills needed in this digital era(Rahman, 2019). By using HOTS questions, we will get an overview of the Test Participants' abilities in terms of; (a) critical thinking(Sobko et al., 2020), (b) creativity(Asset et al., 2015), and (c) learning self-reliance in making decisions(Baragash& Al-Samarraie, 2018; Wangkhahat & Mongkut, 2021). These skills can be mastered through practice in solving real problems in everyday life (problem-solving)(Omeng& Priscah, 2016; Ozdamar-Keskin et al., 2020; Segal et al., 2014; Zafar et al., 2008).

Higher order thinking skills include problem-solving, critical thinking, creative thinking, reasoning, and decision-making. Bloom's taxonomy requires the ability to analysed (C4), evaluate (C5), and create (C6). Meanwhile, The Australian Council for Educational Research(Acer, 2017) states that high-level thinking skills are analysing, reflecting, providing arguments (reasons), applying concepts to different situations, composing, and creating. Creativity in solving problems in HOTS consists of (a) the ability to solve unfamiliar problems; (b) the ability to evaluate strategies used to solve problems from different perspectives; and (c) finding new solution models that are different from previous methods. HOTS questions are developed creatively by teachers according to the current situation and conditions in the community. Teachers' creativity in choosing problem stimuli from real problems in the community where students live will produce problem stimuli easily understood and felt more closely by students. Students will be called upon to contribute to solving various problems that arise in society.

Contextual questions about societal problems will foster curiosity and encourage students to find solutions because they are related to their needs when they enter the community. If we relate it to HOTS questions, then the challenges that occur in the community can be used as contextual stimulus in the structure of HOTS questions that will be compiled so that the HOTS questions have their appeal for students, which in turn can increase learning motivation and bring the desire to think further to find solutions as an effort to solve problems in society.

Higher order thinking skills questions are contextual assessments, which are assessments based on real situations in everyday life. In this case, students are expected to apply learning concepts in class to solve problems. The scope of contextual issues the world community faces today is related to the environment, health, earth and space, and the use of science and technology in various aspects of life. It also includes the Test Participants' skills to relate, interpret, apply and integrate classroom learning to solve everyday problems. The following describes the five characteristics of contextual assessment, REACT(Sri Utami et al., 2016) : a. Relating, assessments are directly related to real-life experiences; b. They were experiencing reviews that emphasized exploration, discovery, and creation. c. Applying assessments that demand exploration, discovery, and innovation. Using assessments that require the Test Participants' ability to apply the knowledge gained in the classroom to solve real problems. d. Communicating an assessment that demands the ability to communicate model conclusions to the conclusion of the problem context. e. Transferring an evaluation that requires the ability to transform classroom knowledge concepts into new situations or contexts.

## CONCLUSION

Based on the discussion and data analysis of the training results, it can be concluded that with the proper training, the problems of teachers who are still constrained in developing High order thinking Skill (HOTS) questions can be reduced so that training in developing Hots questions for teachers can be used as a solution. The results of this training imply that the HOTS Problem Development Training through this P2M Program can be used as a model for solving teacher problems.

Suggestions Training programs for teachers through P2M should be continued and developed. The District Government, especially the Education Office, should map the problems of teachers and propose training needs to the University or college P2M Program theme that suits their needs. The weakness of the research is that the research time is minimal, so it is not optimal to provide training in higher-level thinking in developing questions. So, it needs to be done in the future for time planning that suits the needs.

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