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THE ABILITY OF PRIMARY TEACHERS TO CREATE HOTS-BASED MATHEMATICS QUESTIONS IN THE CERTAIN TEACHERS PPG PROGRAM AT UNIVERSITAS MUHAMMADIYAH CIREBON

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ABSTRACT

Nowadays, in the era of the Merdeka curriculum, there is a strong demand to foster high-order thinking skills (HOTS). However, many teachers struggle to create mathematics questions based on Higher-Order Thinking Skills, especially in mathematics study. When teachers are accustomed to creating contextual mathematical problems and high-level thinking, this can also influence the development of students' abilities in high-level mathematical thinking, especially in improving critical thinking skills. The PPG (Professional Teacher Education) Certain Teacher program at Universitas Muhammadiyah Cirebon (UMC) is one of the government programs designed to improve the quality of teachers who will receive educator certification. Certain teachers is a term for teachers who teach and are registered in Dapodik, qualifying them to obtain an educator certification. This research aims to investigate the ability of certain elementary school teachers in the PPG Certain Teacher Program to create HOTS-based mathematics questions and to identify the supporting and inhibiting factors in creating the questions. This research uses qualitative research methods with a case study approach, using observations, and interviews. Meanwhile, the research procedures include preparation, interviews, observations, documentaions and data processing. The subjects of the research are three teachers in the PPG certain teacher UMC. The result of this research can be summarized in four sections as follows: teachers' ability to design questions based on the cognitive domain of bloom's taxonomy, teachers' ability to create questions that promote critical thinking skills, teachers' ability to find information sources in creating non-routine questions, and the challenges they face in creating HOTS-based mathematics questions.
Keywords: HOTS, Merdeka Curriculum, Certain Teacher, Mathematics Elementary.

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PRELIMINARY

Assessment and evaluation are an essential part of learning as they serve to measure the achievement of learning objectives in each meeting. According to Supriyadi (2020), five indicators of assessment and evaluation competency are used to evaluate teacher performance: 1) Teachers' ability to develop assessment tools following learning objectives; 2) Teachers' ability to carry out assessments using various techniques and types of assessment; 3) Teachers' ability to analyze assessment results to identify difficult basic

compentencies; 4) Teachers' ability to receive and reflect on student feedback; 5) Teachers' ability to utilize the results of the assessment to informs futher planning.

In the current era of Merdeka curriculum, literacy and numeracy skills are the main competency goals for students to process. The teachers are required to enhance students' High-Order Thinking Skills (HOTS). One strategy involves incorporating Higher Order Thinking Skills (HOTS) into the curriculum, given its close relationships with mathematical literacy (Simamora & Tilaar, 2021). The term high-level thinking ability is currently often called HOTS (High Order Thinking Skill). Students' ability to answer HOTS questions is usually only possessed by students who have high cognitive abilities. In the evaluation of students' HOTS, the NSI category shows that 6% of students still require special intervention, while the Expert category indicates that approximately 5% of students have very good HOTS (Baharudin, 2025). However, findings indicated that the students' higher order thinking skills were enhanced in terms of their ability to (a) pose complex questions, (b) present solid opinions, (c) introduce consistent arguments, and (d) demonstrate critical thinking (Barak & Dori, 2009).

HOTS improvement includes providing learning assessments on HOTS-based types of questions and exercises, so that teachers need to pay attention to when creating questions for learning assessments. As a result, one of the skills and abilities the teachers must have is creating and developing evaluation tools to improve the quality of the students so they can think at a higher level (Nenny, 2021). However, in reality, many teachers still struggle to create HOTS-based questions. They produce questions that are less relevant to learning objectives, rely solely on textbooks, and fail to promote higher-level thinking (Zamsir, 2022). Furthermore, other research states that teachers cannot create HOTS questions. The difficulties faced by teachers include difficulties in understanding the concept of HOTS questions, formulating HOTS questions, developing HOTS questions, connecting HOTS questions and educational goals, knowing the assessment standards for HOTS questions, developing questions that involve critical thinking, carrying out HOTS-based learning, having minimal support from schools in the process of preparing HOTS questions, having minimal training and guidance for preparing HOTS questions, adapting to the curriculum and student abilities, as well as having lack of experience and qualifications (Hulaipah, 2023).

Many teachers mistakenly consider routine questions found in the textbooks to be sufficient for promoting higher-level thinking (Setiawati, 2018). Meanwhile, composing higher-order thinking questions requires special skills and intensive training (Widana,

2017). The proportion of higher-order thinking question in Chinese mathematics textbooks show that HOTS account for 48.18%, dominated by questions classified as analyzing (C1) totally around 40.08%, there are still a few questions classified as evaluating (C2) of around 6.48% or creating (C3) around 1.62%, which reflects China's emphasis on cultivating students' HOTS (Huang, et al 2025). The HOTS (*Higher Order Thinking Skill*) question is an instrument used to measure high-level thinking abilities beyond recalling, restating, or referencing without processing (Novita, 2021). Moreover, incorporating HOTS in evaluation not only supports curriculum goals in developing critical thinking students but also enhances teachers' competencies, which includes the ability and authority of teachers in carrying out their duties in the field of education responsibly and properly (Aini, 2023; Usman, 2016). Therefore, the use of HOTS in evaluation can help teachers hone their critical, creative, and skilled thinking skills in learning.

The actions taken by teachers are a form of facilitation in improving students' high-level thinking skills. The maximum role of teachers focusing on the HOTS-based learning process will support the implementation of learning that trains students to think at a high level (Ariandari, 2015). A teacher can implement and apply students' HOTS appropriately from planning, implementing, learning, and evaluating learning outcomes (Usep, 2022). The culture and green technology can help teacher to develop math higher-order thinking skills. it is anticipated that an inclusive, relevant, and sustainable learning environment will be fostered, aiding students in facing future challenges while comprehending the roles of culture and the environment in education (Ismail, et al 2025).

In the context of the Merdeka Curriculum, this ability is particularly crucial for *Certain Teacher*, a term for teachers who teach and are registered in Dapodik and will receive a professional educator certification. Universitas Muhammadiyah Cirebon has collaborated with GTK Kemendikbud for 2 years in assisting the PPG (Pendidikan Profesi Guru) program, therefore, researchers are keen to investigate the abilities of elementary school teachers in the UMC teacher professional program in creating HOTS-based mathematics questions. Previously conducted research, in several studies, has examined teachers' understanding and abilities in creating HOTS questions. The novelty in this study is that the samples taken came from teachers who had more than 2 years of teaching experience and had been entered into Dapodik data.

Based on the discussion above, this study aims to investigate the following research questions regarding the abilities of '*certain teacher*' elementary school teachers registered in Dapodik and eligible for professional educator certification in the PPG (Professional

Teacher Education) Program at Universitas Muhammadiyah Cirebon: (1) How is their ability to create HOTS-based mathematics questions (teachers' ability to design question based on cognitive domain of taxonomy's bloom, build critical thinking, and find information source in creating non-routine question); (2) What teachers' challanges or hinder their effort for developing HOTS-based mathematics questions. herefore, this research offers novelty through three main components: new topics in the Merdeka curriculum paradigm, participants of research, context and problem approaches.

METHODS

The research adopts a qualitative approach using the case study method. The researcher carried out an empirical approach by conducting direct observations and interviews to explore the supporting and inhibiting factors for teachers' abilities in creating HOTS-based mathematics questions (Sinta, 2022). The results of observations and interviews served as the primary source to address the research questions. Additionally, the teacher's self-reflection sheet in creating HOTS-based mathematics questions and the teacher's ability to answer HOTS-based mathematics questions became a reference in creating electronic assessments of elementary school mathematics questions and discussions. The sampling technique used in this study was based on the researcher's observations when assessing teachers; abilities in creating teaching modules. The researcher selected three teachers with the highest scores in designing teaching modules while participating in a certain teacher PPG progam. The technique used to determined participants was through direct observation of 35 participants of the 2024 Certain Teacher PPG through the results of the teaching modules and assessments created and assessed based on the assessment rubric provide by the ministry.

This study, conducted within the PPG (Professional Teacher Education) Program at Universitas Muhammadiyah Cirebon, followed a structured research process to examine teachers' abilities to create HOTS-based mathematics questions. Initially, the preparation stage involved a Focus Group Discussion (FGD) attended by the leader and members of the research where key issues in the research were discussed and outlined in an action plan. The FGD focused on designing interview questions based on indicators of higher-order thinking skills (HOTS). The researchers then implemented the interview questions into interview guidelines to explore teachers' abilities in creating HOTS-based math problems. They also directly observed documentation of the math problems created by the teachers as supporting data for analyzing their problem-making abilities. Then, they analyzed the data

by reducing the interview data using coding techniques supported by documentation of the math problems created by the teachers. The research instruments focusing on these factors resulted in four drafts of the research instrument, including observation sheets, teacher reflection sheets, and documentation studies, all validated by experts selected for their competencies and relevant backgrounds. Furthermore, the self-report inventory test was piloted on selected respondents by involving teachers. The data collection stage was marked by the holding of a self report inventory test through observation, interviews, teacher reflections, and documentation conducted on three elementary schools in Cirebon regency by involving teachers and producing research data, in the form of observation results, interview results, teacher reflection results, and documentation study results. Finally, the data processing and presentation stage was carried out by data reduction, data presentation, and conclusions to identify supporting factors and inhibiting factors for teachers in making HOTS-based mathematics questions in Cirebon Regency by using Quirkos to analyse the data.

RESULT AND DISCUSSION

Based on the results of the study of three elementary school teachers that have been conducted by researchers when analyzing teachers' abilities in creating HOTS-based mathematics problems through interview techniques and direct observation, the findings highlight several key aspects: teachers' understanding of HOTS questions, teachers' abilities in creating HOTS-based mathematics questions in learning, teachers' difficulties in compiling HOTS-based mathematics questions, and efforts to improve teachers' abilities in creating HOTS-based mathematics questions.

To assess the teachers' ability to create HOTS-based math questions, researchers obtained the data from the results of structured interviews using several questions on how the teachers were able to develop high-level thinking skills in students, which explored the cognitive domain, bloom at the level of analysis, evaluation, and creation, stimulus, critical, thinking skills, transferring one concept to another, processing and applying information, finding connections from various information, using information in solving problems, and ability to examine ideas and information critically. This was followed by the direct observation of math questions that were made by the teacher.

Using the interview results, the researcher conducted data reduction and coding through the Quirkos application. Interviews were conducted with three elementary school teachers, Mrs. A, Mrs. R, and Mr S, classified as "*certain teacher*" at the PPG program.

These indicators include the cognitive domain, bloom at the analysis level, and evaluation, then creation, stimulus, critical thinking skills, and transfer of concepts to other concept, then processing and appliying information, finding connections from various information, using information in solving problems, and being able to critically examine ideas and information. Based on Quirkos application shows that the answers are almost the same when asked about "tantangan guru (teacher challenges)", then understanding of the cognitive domain of Bloom's taxonomy, high order thinking, and critical thinking. The researcher aligned these findings with the mathematics questions created by the teachers. Based on the data, the researcher summarized the results from the interview and direct observations into four key areas: (1) the teacher's ability to design evaluation questions based on the cognitive domain of bloom's taxonomy, (2) the teacher's ability to create questions to build critical thinking skills, (3) the teacher's ability to find sources of information in making non-routine questions, and (4) the teacher's challenges in making HOTS-based math questions. The following is a clearer explanation:

1. **Teachers' Ability to Design Questions Based on The Cognitive Domain of Bloom's Taxonomy**

Based on the interviews that have been conducted, the respondents' answers revealed that their knowledge of making questions towards the cognitive level is limited to the level of understanding, and has not yet reached the level of analysis. One respondent, Mrs. A, believes that implementing HOTS-based questions to her students is impossible as she thinks that her students would find the questions increasingly difficult to comprehend. In contrast, another respondent, Mrs. R knows how to make HOTS questions based on problems in everyday life, and concrete media are needed in building students' understanding in analyzing math problems. Mrs. R notes that the level of level in making questions is still evenly distributed. Meanwhile, Mr. S emphasizes creating story-based questions for his students that contain elements of the surrounding culture, and use simple language so that they are easy for students to understand. Based on the results of the interviews, the three respondents have similarities in that when making questions, they focus on aligning to basic competencies based on national standard rules and learning objectives that have been established. Based on observations Mr S is better than the other when he created math problems with the contextual problem solving.

Based on direct observations and analysis of the questions created by the three respondents, the results indicate that the teachers are still unable to develop HOTS-based

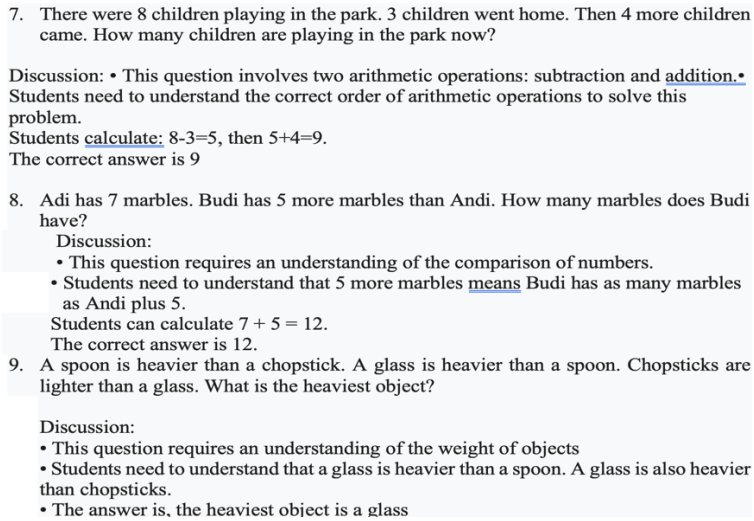
mathematics questions. Instead, their questions primarily focus on solving numerical mathematics problems, as detailed below:

Multiple Choice Questions
1. The decimal fraction of 4/5 is...
A. 0,5
B. 0,8
C. 1,4
D. 1,6
Solution:
4/5 = 4 : 5 = 0,8
Answer: B. 0,8
2. 0,4 is the same value as....
A. 2/5
B. 3/5
C. 6/5
D. 7/8
Solution:
A. 2/5 = 0,4
B. 3/5 = 0,6
C. 6/5 = 1,2
D. 4/8 = 0,5
Answer: A. 2/5
3. The result of adding the fractions ½ + 2/3 is....
A. 4/6
B. 5/6
C. 6/6
D. 7/6
Solution:
1/2 + 2/3 = 3/6 + 4/6 = 7/6
Answer: D. 7/6
4. The result of subtracting 7/6 – 4/9 is....
A. 8/9
B. 13/9

6. The result of 1,3 - 0,75 is....
A. 0,15
B. 0,35
C. 0,45
D. 0,55
Discusion:
1,3 - 0,75 = 0,55
Answer: D.0,55
7. The fraction form of 40% adalah....
A. 1/4
B. 3/4
C. 1/5
D. 2/5
Discussion:
40% = 40/100 = (40 : 20)/(100 : 20) = 2/5
Answer: D. 2/5
8. Mother buys 1 Watermelon and gave to Bimo as much as ¼ part and Gio as much as 1/5 part.
What percentage of the remaining watermelon is....
A. 15%
B. 20%
C. 40%
D. 55%
Discussion:
1 - 1/4 - 1/5 = (1 - 0,25 - 0,2) x 100 = 0,55 x 100 = 55 %
Answer: D. 55%

Figure 1. Examples of Numerical Mathematics Problems

Meanwhile, Mr. S created an application of story problems related to several mathematical concepts. Here are pictures of math problems that Mr. S has created:



7. There were 8 children playing in the park. 3 children went home. Then 4 more children came. How many children are playing in the park now?

Discussion: • This question involves two arithmetic operations: subtraction and addition.• Students need to understand the correct order of arithmetic operations to solve this problem.
Students calculate: 8-3=5, then 5+4=9.
The correct answer is 9

8. Adi has 7 marbles. Budi has 5 more marbles than Andi. How many marbles does Budi have?
   Discussion:
   • This question requires an understanding of the comparison of numbers.
   • Students need to understand that 5 more marbles means Budi has as many marbles as Andi plus 5.
   Students can calculate 7 + 5 = 12.
   The correct answer is 12.
9. A spoon is heavier than a chopstick. A glass is heavier than a spoon. Chopsticks are lighter than a glass. What is the heaviest object?

Discussion:
• This question requires an understanding of the weight of objects
• Students need to understand that a glass is heavier than a spoon. A glass is also heavier than chopsticks.
• The answer is, the heaviest object is a glass

Figure 2. Examples of Application of Math Problems

Based on the explanation of Figure 1 shows that math problems created by Mrs. R and Mrs. A and Figure 2 shows math problems created by Mr S, it shows that two of the three teachers create mathematical problems in the form of abstract mathematical numerical solutions, rather than the concrete understanding of students solving problems in their life context. However, the creation of questions for one teacher respondent has explained questions that can provide students with an understanding of the context of everyday life. Based on the results of observations, even though they have provided a contextual understanding in creating the questions, most of the questions are still only in the cognitive realm of knowledge, not at the level of analysis. So, it can be said that the three teachers in compiling and creating questions still focus on the basic competencies of each material and the learning objectives.

They still cannot create types of analysis-level questions that are under the Bloom's taxonomy theory. Bloom's taxonomy in the cognitive domain is developed into two categories, low-order thinking skills and high-order thinking skills. The stages of remembering, understanding, and applying are still at the low-order thinking skill stages, while analysis, synthesis, and evaluation are at the high-order thinking skill stages (National Library, 2021). Based on the results of observations from the making of evaluation questions by the teacher, the majority are still only at the low-order thinking skill stage. Students are only given questions that rely on memorizing, understanding, and applying. However, only a few questions asked by Mr. S have been able to enter the analysis stage.

2. Teachers' Ability to Create Questions to Build Critical Thinking Skills

Math problems that can encourage students to think critically are not limited to knowledge of memorizing, understanding, and applying; students must also be able to analyze. The questions made are open-ended, and there are several correct answers, requiring deep thinking, not just applying formulas to a problem. The character of questions that can build critical thinking skills can be seen in the questions that are already open, using the words: why, how, and explain. Teachers have an important role in developing students' critical thinking skills, as in previous research conducted by Risandy (2024) which stated that the use of lesson plans and evaluation instruments by teachers was considered effective in developing students' critical thinking skills.

The results of the interviews with the three teachers on building critical thinking in students have different answers. Mrs. A explained that she fosters critical thinking skills through a question-and-answer session starting with basic knowledge. However, she noted that her students struggle to achieve high-level thinking because even the low-level thinking, such as memorizing and understanding, is challenging.

Consequently, this prevents Mrs. A from creating questions that align with high-order thinking skills. However, Mr. S stated that the way he creates questions in distinguishing questions that only measure the level of understanding and critical thinking is when the learning process is given basic knowledge, while to build critical thinking skills, students are given independent tasks to work on. Mr. S also stated that he usually creates questions that vary in transferring between one concept to another. Based on the results of the observation, it can be seen that not all teachers have yet created math questions for learning evaluation using open sentences, so that students are only required to answer one question correctly.. Based on direct observations still Mr S is better than the other when he created math problems to build critical thinking skills. Meanwhile, Mrs R gave a statement that was almost the same as Mrs S. She could only create routine math questions and assessments to measure students' understandibf abilities in learning.

3. Teachers' Ability to Find Information Sources in Creating Non-Routine Questions

Teachers' efforts in creating non-routine questions can be done in various ways, such as identifying problems around them, paying attention to the news, and making observations in the environment. In addition, other efforts include using digital resources such as exploring educational websites, social media, and online platforms. These non-routine questions can support and encourage students' critical thinking skills (Fitri, 2023).

Previous research conducted by Sundawan (2019) stated that prospective professional teachers absolutely must have good abstract realtional skills, and this can be tested through their ability to answer non-routine questions. So, it is very important for teachers to be able to find sources of information in finding non-routine math questions.

Based on the interview, it was found that in making questions and searching for information sources, the teachers use digital resources. Because of Mrs. A and Mrs. R have not yet created many HOTS-based questions, the frequency of searching for information sources digitally is not as frequent as Mr. S. They only use general assessment question sources. Mr. S made questions based on information sources through searches on Google, which were then summarized and re-created by him and were then classified according to the character of each student's ability level. Non-routine questions that were ever made by Mr. S were about stacked flat shapes, so that students could think critically and analytically in answering the questions. The results of observations from the creation of questions carried out by teachers are still not in the non-routine category because they only rely on memorizing, understanding, and applying. Teachers still have limited creativity in making non-routine questions.

4. Teachers' Challenges in Creating HOTS-Based Mathematics Problems

Making HOTS-based math problems is certainly not easy. There are many challenges and obstacles that teachers have to face in the classroom. Some of the challenges faced by teachers in making HOTS questions are that teachers find it difficult to provide interesting and appropriate stimuli, analyze basic competencies with cognitive domains based on high-level thinking skills, teachers' habits of always making LOTS (Low Order Thinking Skills) problems, a very dense curriculum, and of course the lack of socialization and training for teachers in making HOTS problems. Teachers' difficulties in developing HOTS-based math questions are based on onternal and external factors. The internal factors include their own limited skills and knowledge in understanding HOTS problems. Furthermore, the external factors include the need for collaboration between teachers, schools, and students to develop HOTS problems (Miftahuddin, 2021).

This is in accordance with the results of the interview answers from the three teacher respondents, the three teacher respondents need training and socialization in making HOTS questions. Mrs. R stated that there was a lack of teacher assistance in making HOTS questions, while Mrs. A had difficulty in making HOTS questions, especially in visualizing mathematical problems into real and concrete forms, so she needed training in making HOTS-based questions. Meanwhile, Mr. S stated that another challenge in making HOTS-

based math questions was the constraints on his students' language skills. His students are accustomed to their regional language, so the language of HOTS-based questions is sometimes difficult for students to understand. Consequently, Mr. S believes that another thing that needs to be considered is the students' literacy skills so that they can understand the questions. This indicates that external factors, such as collaboration with schools and students, are the focus of the problem, causing teachers' difficulties in creating HOTS-based math questions. These challenges, experienced by teachers, have become a follow-up plan for the PPG progam, which plans to hold training for teachers on how to create HOTS-based math questions.

CONCLUSION

This study concludes that the teachers lack the ability to create HOTS-based mathematics questions effectively. The questions they developed at the elementary school level still employ LOTS (Low Order Thinking Skills) abilities, rarely include HOTS, and are non-routine. Teachers' question-design skills remain inadequate, largely due to insufficient socialization, training, and mentoring on HOTS questions development. These findings suggest the need for community service activities on socialization, training, technical guidance, or workshops to support elementary school teachers in creating HOTS-based mathematics questions. Additionally, another challenge is the students' limited literacy skills, which are crucial for understanding the high-level thinking questions. This issue suggests a further study on students' literacy skills in comprehending HOTS-based reading questions. So, the most influential supporting factor in teachers' ability to create HOTS-based questions is the external factor, namely cooperation between teachers, students, and schools.

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