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Challenges in Posing HOTS-Oriented Problems: A Study of Prospective Mathematics Teachers with Restricted Creativity

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Abstract:

The ability to pose problems that require Higher Order Thinking Skills (HOTS) is a crucial competency for prospective mathematics teachers. However, numerous prospective teachers still experience difficulties in constructing mathematics HOTS-oriented problems, especially those with restricted creativity. This qualitative research aims to explore the difficulties experienced by prospective teachers with low levels of creativity in posing HOTS-oriented mathematics problems. This research is an extension of prior investigation that categorized 85 prospective teachers into five levels of creativity, revealing that more than 40% fell into the less creative and non-creative categories. This research data was collected through documentation of problem-posing tasks from previous research and in-depth interviews. Data was analyzed using a thematic approach to identify emerging patterns of difficulty. The result revealed four main categories of difficulty: (1) difficulty posing problems with varying cognitive levels, (2) difficulty posing more than one HOTS problem, (3) inability to pose problems at the HOTS level, and (4) difficulty posing solvable problems. The most dominant difficulty was in the aspect of cognitive level variation. These findings indicate that creativity plays a significant role in the ability to pose HOTS-oriented problems. This research suggests the need to develop targeted pedagogical interventions to support creative thinking processes and question design skills in prospective teacher education).

Keywords: Creativity, HOTS, mathematics problem, problem posing, prospective teachers.

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Introduction

A teacher, as a professional educator, is required to master several competencies, one of which is pedagogical competence. This competency relates to the teacher's ability to design, manage, and evaluate meaningful learning processes (Faridah et al., 2020). When designing learning, teachers need to be able to modify and create new problems to help students achieve their learning goals (Mallart et al., 2018). In terms of evaluation, the ability to create varied questions allows teachers to conduct more integrated assessments within the teaching and learning process (Riyadi et al., 2023; Suryanti et al., 2022). The activity of modifying and arranging these questions can generally be seen as a problem-posing activity (Rafi & Sugiman, 2019).

Problem-posing ability is the ability to formulate problems by modifying existing ones or creating new ones. This definition supports the assertion that problem posing involves transforming existing questions to meet pedagogical needs (Papadopoulos et al., 2022; Puspitasari et al., 2019). Problem posing is considered a special type of problem-solving that plays an important role in the development of students' mathematical abilities. Furthermore, Siswono (in Samuji & Siswanto, 2020) states that problem formulation can occur before, during, or after the solution to the problem is found. The formulation of a problem from a given situation is called presolution posing, while the formulation of a problem by asking new questions or problems from the problem being solved is called within-solution posing. Meanwhile, post-solution posing is the formulation of a new problem after solving a given problem.

Beside teachers, prospective teachers also need to have problem-posing skills (Rahayu & Wulan, 2024). This is because this skill fosters strong conceptual knowledge and critical thinking, which are fundamental for creating innovative teaching methods (S. Prayitno et al., 2023). Furthermore, understanding the problem-posing process significantly contributes to prospective teachers' efficacy in mathematics instruction, facilitating a connection between problem posing and problem solving (Masriyah et al., 2023). With strong problem-posing and problem-solving skills, prospective teachers are expected to be able to teach these skills to their students in the future. By equipping prospective teachers with problem-posing skills, it is hoped that they will be able to foster higher-order thinking skills in the students they will teach (Rahayu & Wulan, 2024).

The need for prospective teachers to master problem-posing is becoming increasingly crucial due to curriculum demands and the 21st-century education paradigm, which encourages students to master higher-order thinking skills through learning (Masriyah et al., 2023; Sari et al., 2022). Higher-order thinking skills (HOTS) are abilities that go beyond simply recalling, restating, or referring without processing information. In the revised Bloom's Taxonomy concept, the cognitive domain is divided into 6 levels. The top three levels, namely analysing (C4), evaluating (C5), and creating (C6), are known as HOTS, while the bottom three levels, namely knowing (C1), understanding (C2), and applying (C3), are called Lower Order Thinking Skills (LOTS) (Anderson & Krathwohl, 2001). HOTS can be developed through mathematics learning because mathematics inherently involves critical, logical, analytical, and systematic reasoning (As'ari et al., 2019). In this context, problem-posing ability becomes highly strategic for prospective teachers, not only because problem-posing fosters deeper mathematical understanding but also promotes HOTS. Prospective teachers who can pose HOTS-oriented problems not only demonstrate mastery of content and pedagogy but also become agents for developing high-level thinking in their future students (Masriyah et al., 2023; S. Prayitno et al., 2023).

However, in practice, posing HOTS-oriented problems is not an easy skill to master. One of the challenges is that creating HOTS problems that require analysis and evaluation demands a deeper understanding of concepts compared to questions focused on basic knowledge levels (C1 to C3) (Jailani et al., 2023). Several teachers are still unable to identify the appropriate operational verbs for each level in Bloom's Taxonomy and still consider questions with long calculations and multi-steps solutions to be a sure measure of HOTS (Ghifari, 2021; Indrawati et al., 2022). This challenge is also experienced by prospective teachers, for example, misinterpreting terms like "analyze" and "evaluate," which leads to difficulty in formulating questions that meet the criteria for HOTS (Musdalifah et al., 2020; Santi et al., 2021). Meanwhile, the constraints in problem-posing activities to generate various types of varied questions are related to creativity (Iswanto, 2022). Creativity, especially in the novelty indicator, is crucial in determining the quality of the posed HOTS oriented problem. In other words, the obstacles in problem posing are not only rooted in the mastery of mathematical concepts, but also in creative thinking abilities (Wahyuni et al., 2022).

Regarding creativity, problem-posing can be used to measure and improve creativity (Muhtarom et al., 2020; Rahayu & Wulan, 2024). Creativity in problem-posing can be defined as a person's ability to generate a problem that is essentially new and previously unknown to the creator, and different from other problems created based on information (Wahyuni et al., 2022). According to Harpen & Sriraman (Rahayu & Wulan, 2024), problem-posing creativity can be seen from 3 aspects: fluency, flexibility, and originality. Fluency refers to the ability to pose a number of problems or questions, flexibility refers to the ability to pose a number of problems in different categories, and novelty refers to the ability to pose problems that are rarely asked. Thus, creativity is not only an important indicator of success in problem posing, but also a prerequisite that supports the flexibility and originality of the problems constructed.

The topic of problem posing in pre-service teachers has been extensively researched previously. However, most studies (Aşıkcan & Uygün, 2023; Fitriana et al., 2022; Masriyah et al., 2023; Peng et al., 2022; Prayitno et al., 2023) tend to focus on the subject's ability to pose the problem. Although there have been studies on prospective teachers' difficulties in posing problem (Mallart et al., 2018; Prayitno et al., 2018; Prayitno & Budiyo, 2018), there is still a few numbers of research (Jailani et al., 2023) specifically on HOTS-level problem. Meanwhile, research linking problem posing with HOTS is still limited to discussions of prospective teachers' ability (Prayitno et al., 2023) and creativity (Rahayu & Wulan, 2024) in constructing HOTS problems. To date, there has not been much research specifically examining prospective teachers' difficulties in problem posing when constructing HOTS problems, linking it to creativity aspects. In fact, studying the difficulties of prospective teachers in constructing HOTS problems while considering their creativity is very important to provide a more comprehensive picture of the factors that hinder and the opportunities to develop their competencies.

Responding to this gap, this study aims to deeply explore the difficulties and causal factors faced by prospective teachers categorized as having low creativity in constructing HOTS-based mathematics questions. This research is an extension of a previous study (Rahayu & Wulan, 2024) that classified 85 prospective mathematics teachers into five creativity categories based on their performance in constructing HOTS-oriented mathematics problems. This categorization was based on the fulfilment of three creativity indicators in problem-posing: fluency, flexibility, and novelty. From this classification, it was found that more than 40% of the subjects fell into the "less creative" or "not creative" category. Using a collective case study approach, this research focuses

on a group of prospective teachers with restricted creativity to understand the difficulties they face in posing HOTS problems and their causes.

Methods

This research is qualitative research with a collective-case study design. A collective case study involves the study of more than one case in order to investigate a phenomenon, population, or general condition (Creswell, 2012). This design was chosen to gain an in-depth understanding of the difficulties experienced by prospective teachers with restricted creativity in posing HOTS-oriented mathematics problems and their causes. HOTS problems in this study refer to problems that measure cognitive activity at the Analysing (C4), Evaluating (C5), and Creating (C6) levels based on the revised Bloom's Taxonomy (Anderson & Krathwohl, 2001). This research is an extension of a previous study involving 85 prospective mathematics teacher students at a state university in Indonesia. The previous study categorized subjects into five categories based on their level of creativity in posing HOTS-oriented mathematics problems. In the current study, "prospective teachers with restricted creativity" refers to subjects in the "not creative" (28 subjects) and "less creative" (10 subjects) category, which collectively represent more than 40% of the previous study population. From both categories, eight participants were purposively selected as subjects in the current study.

The data in this study were collected from documentation of HOTS-oriented problem-posing test results from previous research and from in-depth interviews with the subjects. The use of documentation techniques allowed the researchers to re-analyze the problems the subjects had posed to identify any errors or deficiencies. Meanwhile, in-depth interviews were used to further explore the subjects' experiences, difficulties encountered, and the reasons behind their difficulties in developing HOTS problems.

The data in this study consisted of descriptive qualitative data from HOTS problem documentation and interviews. The collected data were then transcribed and analysed thematically based on the findings. The steps taken included (1) reading and understanding the entire data to obtain an overview, (2) conducting initial coding of the data based on HOTS-based problem-posing difficulty indicators, (3) grouping the codes into main themes representing the types of difficulties, (4) reviewing the themes to ensure consistency and appropriateness with the data, and (5) compiling a narrative description that included the findings and the relationships between the themes. In this study, the primary focus was on the subjects' substantive difficulties in posing HOTS-oriented mathematics problems. Therefore, editorial and technical difficulties, such as difficulty constructing effective sentence structures, typos, or missing punctuation, were not included in further analysis. Data validity was maintained through triangulation of sources (comparing documentary and interview data) and member checking with subjects to confirm the researcher's interpretations.

Results and Discussion

Findings

After conducting documentation and thematic analysis on HOTS-oriented mathematics problem products posed by 38 prospective mathematics teachers with restricted creativity, several categories of difficulties were found as described below.

Table 1. Description of Difficulty Categories

Code	Category	Description
D1	difficulty to pose problems with varying cognitive levels	The subject successfully compiled more than 1 HOTS question but at the same cognitive level.
D2	difficulty to pose more than one HOTS problem	The subject only managed to compose 1 HOTS question
D3	inability to pose problems at the HOTS level	The subject failed to compose a single HOTS question.
D4	difficulty to pose solvable problems	The subject composes problems that cannot be solved

Based on the criteria for categorizing the difficulties experienced by the subjects in Table 1, the following data was obtained.

Table 2. Distribution of Difficulty

Code	Number of Appearances	Percentage
D1	18	43.90%
D2	10	24.39%
D3	9	21.95%
D4	4	9.76%
Total	44	100.00%

From Table 2 above, it can be seen that there were 44 difficulties occurrences experienced by 38 subjects. Furthermore, the following will present description of each difficulty of 8 participants in study based on Difficulty Category

1. Difficulty to Pose Problems with Varying Cognitive Levels

Based on Table 2, the majority (40.91%) of the difficulties experienced by pre-service teachers with restricted creativity fall into the first category, which is difficulty in constructing questions with varying cognitive levels. One of the subjects experiencing this type of difficulty is AR. AR successfully constructed 4 questions, but all at the same cognitive level, which is the Analysing level (C4). Here is one of the four questions successfully compiled by ARM.

Figure 1. One of the HOTS questions posed by AR

Seorang penjahit mempunyai 60 meter kain wol dan 40 meter kain sutra, dengan bahan yang tersedia penjahit setelan baju dan rok untuk beberapa orang. 1 stel baju memerlukan 3 meter kain wol dan 1 meter kain sutra. Kemudian 1 stel rok memerlukan 2 meter kain wol dan 2 meter kain sutra. Pendapatan setiap stel baju dan rok yaitu Rp. 120.000 dan Rp. 75.000. Berapakah maksimum laba yang didapatkan? Sertakan grafiknya!

Translation:

A tailor has 60 meters of wool and 40 meters of silk. With the available materials, the tailor sews shirts and skirts for several people. One set of shirts requires 3 meters of wool and 2 meters of silk. Then one set of skirts requires 2 meters of wool and 2 meters of silk. The profit for each set of shirt and skirt is Rp. 120,000 and Rp. 75,000. What is the maximum profit? Include a graph!

The question in Figure 1 is a C4 level question because to solve it, students must analyze the relationship between its variables. Based on the interview results, AR can only create questions at the C4 level because she believes this is the easiest level. The challenge of constructing HOTS questions at other levels from this perspective is due to the higher complexity of Evaluating (C5) and Creating (C6) level questions compared to C4, as stated below.

I think creating C5 and C6 questions is more difficult because with C6, we have to create questions with more than one correct answer. With C5, I'm still struggling with how to test it since there needs to be something to test. It's difficult to structure the part that needs to be tested.

Besides being easier to compile, AR can only compile questions at the C4 level because AR's experience is more exposed to C4-level questions than other HOTS levels. This is based on the following explanation from AR.

... As for C4, I've encountered and worked with it many times, so it's easier for me to create something similar.

Beside AR, Subject DN also faced the same challenges. DN successfully created only 2 questions at the C4 cognitive level. The reasons for this include DN's view that C5 and C6 level questions are difficult to solve, let alone create, as explained by DN as follows.

Difficult (red: to create C5 and C6 questions), I've tried to solve C5 and C6 questions... how many times, I wonder? It can be counted on one hand, and I think that's difficult. So, if I'm asked to create C5 and C6 questions, I'm confused about how to start.

Based on the two subjects mentioned above, it can be concluded that the difficulty in posing HOTS problems with varying cognitive levels lies in the difficulty of posing problem at the C5 and C6 levels. This is because the cognitive level characteristics at C5 and C6 are more complex, requiring more effort from the subjects, leading them to choose to construct C4 level questions and a lack of prior exposure to C5 and C6 level questions.

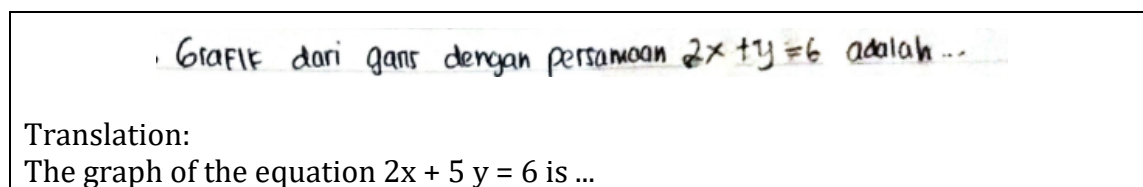
2. Difficulty Posing More Than One HOTS Problem

Out of all the research subjects, 10 subjects were found to have difficulty posing more than one HOTS problem. These difficulties were found in Subject BIN, among others. BIN created 2 questions, but one of them did not measure the HOTS level. This subject explained that what prevented them from successfully creating more HOTS questions in the problem-posing test was the amount of time needed to create HOTS questions and their uncertainty about the questions they had created, as shown in the following interview excerpt.

HOTS questions are not something you can answer right away, right? So I spent too much time thinking about just one question so I could answer it thru many steps... I even doubted whether it was a HOTS question or not. I didn't have time to think about the next question in more detail.

Beside the time issue, the cause of this difficulty was also revealed by Subject CD. In the problem-solving test, CD successfully constructed 2 questions, only one of which was a HOTS question, while the other was a question at the Lower Order Thinking Skills (LOTS) level, as shown in the following image.

Figure 2. LOTS Level Questions Posed by CD



In the interview, it was revealed that CD considered the question in Figure 2 to be a C6 question, as shown in the following quote.

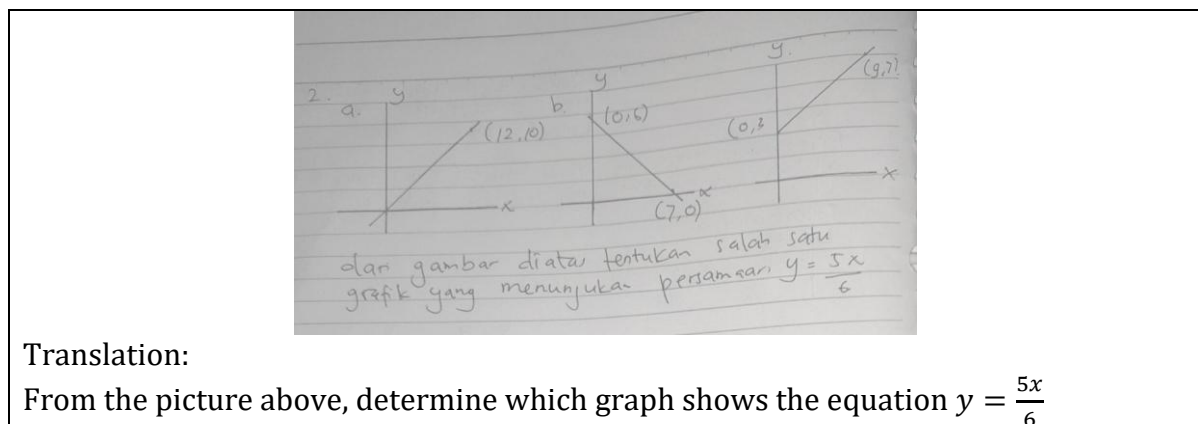
Yes, this question is for C6 because students are asked to create a graph.

In fact, if you look closely, the question in Figure 2 is a question that measures the cognitive level of Applying (C3) because even though students are asked to create a graph, the only ability required is the ability to apply procedures. This indicates that the subjects still have a vague understanding of cognitive activities across levels in Bloom's Taxonomy. They still consider these cognitive activities based solely on the literal operational verbs, without fully understanding the concept of Bloom's Cognitive Levels. Based on documentation and the results of the two subjects' tests, it can be seen that the difficulties in constructing more than one HOTS question are due to the longer duration of exploring HOTS questions and misconceptions about operational verbs at the HOTS Cognitive Level.

3. Inability To Pose Problems at the HOTS Level

From Table 2, it can be seen that there are still 9 subjects who failed to construct questions at the HOTS level. Each of these nine subjects was able to construct at least 1 solvable question, but none of them were HOTS questions. One of them is Subject FF. FF was able to construct 2 questions at the LOTS level, one of which is as follows.

Figure 3. LOTS question posed by FF



The interview results show that according to FF, the question in Figure 3 is a HOTS question because students are asked to compare more than 1 option, as explained below.

... because students don't just calculate directly, but have to look at three graphs and then choose the appropriate one. So there's a comparison activity involved.

... I think questions with more than one choice are automatically considered HOTS.

In fact, the question in Figure 3 only measures students' ability to apply (C3) the concept of linear equations to choose the correct graph without involving analytical, evaluative, or creative thinking processes. This shows that FF has limitations in understanding the difference between LOTS and HOTS.

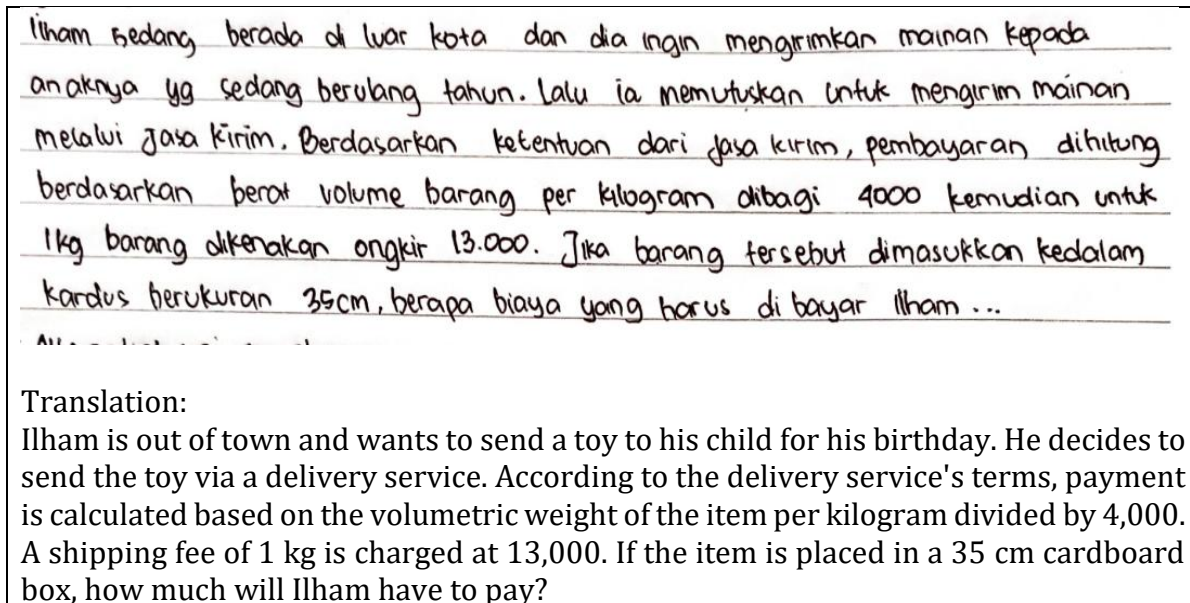
Another subject who failed to create HOTS questions is FGC. FGC was able to create 3 solvable questions, but none of them were at the HOTS level. Similar to FF, GVC has limitations in understanding the concept of HOTS. When the subject explained why they thought the questions they created were HOTS questions, the subject stated:

If there are many steps, it means it's already analysis. If it requires more than one calculation, in my opinion, it's already a HOTS question.

From the quote above, it can be seen that the subject mistakenly interpreted that multi-step calculations are the same as analytical activities, when in fact, multi-step calculations can simply be the application of routine procedures without requiring more complex abilities such as sorting, connecting, or finding patterns/structures in information. Therefore, such questions are still at the LOTS level. Thus, the subject's failure to construct HOTS questions is due to limited understanding of the concept of HOTS and the misconception that questions with multi-step solutions automatically measure HOTS.

4. Difficulty Posing Solvable Problems

From the documentation of the questions posed by the subjects, there were 4 subjects in this study who had difficulty formulating solvable problems. One of these four subjects was Subject IM. The following is an unsolvable problem posed by IM.

Figure 4. Unsolvable Problem Posed by IM


Ilham sedang berada di luar kota dan dia ingin mengirimkan mainan kepada anaknya yg sedang berulang tahun. Lalu ia memutuskan untuk mengirim mainan melalui jasa kirim. Berdasarkan ketentuan dari jasa kirim, pembayaran dihitung berdasarkan berat volume barang per kilogram dibagi 4000 kemudian untuk 1kg barang dikenakan ongkir 13.000. Jika barang tersebut dimasukkan kedalam kardus berukuran 35cm, berapa biaya yang harus di bayar ilham ...

Translation:
 Ilham is out of town and wants to send a toy to his child for his birthday. He decides to send the toy via a delivery service. According to the delivery service's terms, payment is calculated based on the volumetric weight of the item per kilogram divided by 4,000. A shipping fee of 1 kg is charged at 13,000. If the item is placed in a 35 cm cardboard box, how much will Ilham have to pay?

Regardless of the punctuation error in the question, the problem in Figure 4 above cannot be solved due to the lack of information about the dimensions of the solid and the unclear relationship between volume and mass for determining shipping costs. The interview results indicate that the subject IM's understanding of mathematical concepts and the connections between mathematics and real-world contexts are still weak, as shown by the following quote.

... I know there's a term called "volume weight" in shipping services, but I thot that if you divide the volume by 4000, you'd get the weight in kg directly. But it turns out that when you read it again, it's unclear and can't be done with the information available.

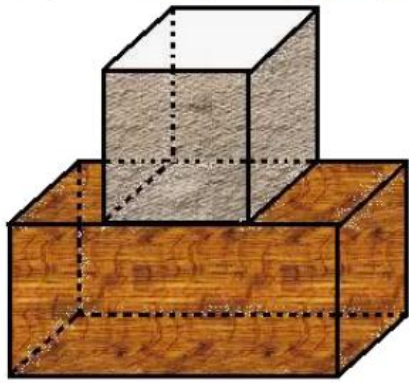
Beside a weak understanding of mathematical concepts and connections, the IM subject also admitted to forgetting to write down the shape of the solid intended, and when asked if the subject recheck the problem she had posed, she said

No, I didn't have time to double-check.

Beside IM, VP also did not recheck the questions she prepared, which resulted in unsolvable questions as shown in the following image.

Figure 5. Unsolvable Problem Posed by VP

Terdapat sebuah bangun ruang gabungan seperti gambar di bawah ini :



Jika bangun ruang balok memiliki panjang 10 cm, lebar 3 cm, dan tinggi 4 cm. Hitunglah volume gabungan dari bangun ruang balok dan kubus yang ada di atasnya ?

Translation:
 There is a combined geometric figure as shown in the image below:
 If the cuboid has a length of 10 cm, a width of 3 cm, and a height of 4 cm, calculate the combined volume of the cuboid and the cube above it.

VP forgot to mark the congruent sides of the cube and the height of the rectangular prism (see Figure 5), making the problem unsolvable due to the lack of information provided, as explained during the interview:

Oh yeah, I forgot to mark this as equal to this (pointing to the image of the cube's side and the cuboid's height).

Just like with the IM subject, VP also didn't double-check the results of her question compilation, so there were parts she forgot to include, as she admitted in the following statement.

... no, no, I didn't check it

Based on the research findings from both subjects, it was revealed that the subjects' difficulty in constructing solvable problems could be attributed not only to their weak mathematical understanding and connections but also to their failure to reexamine the problems they had successfully constructed.

In summary, the findings of this research can be presented in Table 3 below.

Table 3. Prospective Teachers' Difficulties in Posing HOTS-Oriented Mathematics Questions and Their Causes

No.	Difficulties Category	Causes of Difficulty
1.	Difficulty to pose problems with varying cognitive levels	• Tendency to choose levels considered easier (C4) • Limited exposure to C5 and C6 level problems

No.	Difficulties Category	Causes of Difficulty
2.	Difficulty to pose more than one HOTS problem	• Limited exploration time in preparing old questions • Misconceptions about operational verbs
3.	Inability to pose problems at the HOTS level	• Limited understanding of HOTS concepts • Misconception that multi-step questions automatically measure HOTS
4.	Difficulty to pose solvable problems	• Limited understanding of mathematical concepts and mathematical connections • Not checking again

Analysis

The findings of this study indicate that prospective mathematics teachers with restricted creativity face various challenges in constructing HOTS-oriented mathematics problems. Furthermore, these challenges include main difficulties that can be categorized as (1) difficulty posing problems with varying cognitive levels, (2) difficulty posing more than one HOTS problem, (3) inability to pose problems at the HOTS level, and (4) difficulty posing solvable problems. The greatest challenge lies in the aspect of varying cognitive levels (43.90%), while the least experienced challenge by the subjects is in the aspect of constructing solvable problems (9.76%).

Furthermore, difficulty posing problems with varying cognitive levels dominates the difficulties experienced by the subjects. Most subjects were only able to formulate questions at the analyzing level (C4) without being able to progress to the evaluating (C5) or creating (C6) levels. This is because there is a tendency for subjects to choose cognitive levels that are considered "easier" and more familiar, as stated by subjects AR and DN. The results of this study support the findings of research by Suwarno et al. (2022) Aşıkcan & Uygün (2023) that prospective teachers tend to be more capable of constructing questions at the C4 level compared to higher levels. This finding indicates that although prospective teachers with restricted creativity are able to construct HOTS-oriented questions, they do not yet possess the cognitive flexibility to develop variations in cognitive levels. This is because problem posing is considered a special type of problem-solving that requires creativity (Rahayu & Wulan, 2024). In addition, problem posing is correlated with creativity. Someone with a higher level of creativity tends to be better at solving and posing complex problems (Rustini & Siswono, 2020; Syahara & Astutik, 2021).

Beside creativity, the experience of prospective teachers in solving previous HOTS-level questions cannot be ignored in this case. This experience can help prospective teachers construct knowledge and skills to develop HOTS mathematical questions that are different from existing ones. This aligns with the opinion of Lil & (Peng et al., 2022), who state that the accumulation of a person's abilities, knowledge, and skills develops not only through formal and informal education but also through experience. Therefore, learning interventions are needed that explicitly introduce example questions at various cognitive levels and provide space for prospective teachers to practice designing question variations.

In addition to challenge in posing HOTS-level questions at various levels, some prospective teachers with restricted creativity also faced the challenge in posing more

than one HOTS question. The subject's efforts to construct additional HOTS-level questions resulted in the production of LOTS-level questions. Posing HOTS questions was considered to require higher cognitive effort and more time, as stated by subject BIN. This can happen because problem-posing activities demand a high cognitive load, requiring analysis and evaluation that necessitate a deeper understanding of concepts compared to questions focused on basic knowledge levels (C1 to C3) (Jailani et al., 2023)). This is further exacerbated by misconceptions about certain operational verbs, such as "create" in the question posed by CD, which is equated with the creating level (C6). In fact, activities using this kind of word might only require the ability to apply routine procedures and not necessitate a deep level of creativity if the context or instructions are not well-designed. These findings support previous research (Musdalifah et al., 2020) indicating errors in interpreting operational verbs when constructing HOTS questions.

Furthermore, some subjects in this study also faced difficulties in being unable to generate even a single HOTS question. The main cause of this inability was a misconception of the revised Bloom's taxonomy. Some subjects believed that questions involving multiple steps of automatic calculation were considered analyzing-level questions (C4), or that questions with more than one answer choice were already considered HOTS-level questions. This indicates a fundamental misconception regarding the difference between LOTS and HOTS. In fact, analysis is not determined by the number of calculation steps, but rather by the involvement of the processes of differentiating, connecting, and organizing information (Anderson & Krathwohl, 2001). This is in line with the opinion of Widiatsih et al. (2020) that there is a misconception that HOTS questions must be complex and require lengthy steps due to a lack of understanding of the characteristics of HOTS-level questions and how to construct them. Thus, the results of this study emphasize the importance of strengthening conceptual understanding regarding cognitive levels, so that prospective teachers are not merely fixated on operational verbs or the number of steps to solve a problem.

Other findings indicate that a small percentage of subjects experienced challenges in formulating solvable problems because the information in the problems was incomplete or inconsistent with the context. For example, questions about shipping costs cannot be answered because the relationship between volume and weight is unclear. This phenomenon indicates a weak understanding of the subject in connecting mathematical concepts with real-world contexts (mathematical connection). Additionally, some subjects admitted to not rechecking the questions they had answered, indicating a lack of self-monitoring skills. This finding aligns the recent research emphasizing the importance of connection and reflection in problem posing (Ran et al., 2025). In line with this, the difficulty in creating unsolvable questions can be attributed to insufficient exploration of the problem situation and minimal reflection on the suitability of the questions (Zhang et al., 2024). Thus, strengthening the ability to connect and reflect needs to be a focus in training for developing HOTS questions, so that prospective teachers are more meticulous and aware of the importance of internal validation of the questions they create.

The four categories of difficulty discussed above are rooted in the subjects' low level of creativity. Creativity, demonstrated thru the aspects of fluency, flexibility, and novelty, is a key asset in problem posing. Subjects with limited creativity are less likely to have the flexibility to create variations in difficulty, generate a large number of questions, be trapped by misconceptions about cognitive levels, and fail to integrate realistic contexts into the questions. This aligns with the research by Rahayu & Wulan (2024), which confirms that problem posing is not only a means of measuring creativity but also a vehicle for fostering creativity in prospective teachers. Therefore, the teacher candidate

education program needs to provide a wider space for creative exploration, for example, thru project-based assignments or collaboration in designing HOTS questions.

The results of this study have several important implications. First, the curriculum for future teachers needs to explicitly emphasize training in constructing HOTS questions by providing examples, step-by-step practice, and constructive feedback. Second, learning strategies are needed that integrate problem posing with reflective activities so that future teachers become accustomed to reviewing the questions they create. Thirdly, strengthening conceptual understanding of the revised Bloom's taxonomy is crucial to prevent prospective teachers from falling into misconceptions. Fourth, the aspect of creativity needs serious attention, for example, thru open-ended problem-posing activities that encourage novelty and flexibility.

Conclusion

This study aims to explore the difficulties faced by pre-service mathematics teachers with low creativity in constructing HOTS-oriented problems and the factors causing these difficulties. The research findings revealed four categories of difficulties, namely: (1) constructing questions with varying cognitive levels, (2) constructing more than one HOTS question, (3) inability to construct HOTS questions, and (4) constructing questions that can be solved. The most dominant difficulty lies in the aspect of varying cognitive levels, where most subjects only produced questions at the analysing level (C4) and were not yet able to reach evaluating (C5) or creating (C6). The factors causing these difficulties include: 1) A tendency to choose levels considered easier, 2) Limited exposure to C5 and C6 level questions, 3) Long exploration time in question construction, 4) Misconceptions about HOTS questions, 5) Limited understanding of mathematical concepts and connections, and 6) Lack of metacognitive skills in reviewing questions.

Theoretically, this research confirms the important role of creativity in developing HOTS questions. Practically, these results imply the need for explicit training for prospective teachers in creating varied, contextual, and cognitively appropriate HOTS questions. Teacher education needs to strengthen conceptual understanding of LOTS and HOTS and provide space for creative exploration thru reflective and collaborative activities. For future research, it is recommended to involve prospective teachers with different levels of creativity to obtain a more comprehensive picture, and to examine the effectiveness of specific pedagogical interventions in improving HOTS-oriented problem-posing skills.

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