Prospective Mathematics Teachers' Creativity in Developing Mathematics Problems Based on Ethnomathematics Context and AKM Framework

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Abstract

Developing instrument tests is an important skill for prospective teachers. The implementation of the *Merdeka* Curriculum is a means to meet 21st-century skills, one of which is numeracy literacy. This study aims to describe the creativity of prospective teachers and the cognitive level of the developed mathematics problem oriented with Minimum Competency Assessment (AKM) using ethnomathematics context. This qualitative research employed a phenomenological approach, with subjects 7th-semester prospective teachers at an Islamic higher education. Stratified random sampling and maximum variation sampling techniques were used to select 12 students from 96 based on prerequisite course grades. Student creativity in constructing problems was assessed using rubrics based on creativity indicators: *fluency*, *flexibility*, and *elaboration*. The Gwet AC1 Coefficient was used to ensure agreement on the scoring results. Based on the *fluency* indicator, the results showed that the algebra content was the most difficult to develop, while the measurement and geometry content was the easiest. Based on the *flexibility* indicator, the majority of the problems were at the application level, and the fewest were at the reasoning level. Considering the level of problems, content on measurement & geometry, data & uncertainty, and algebra were least frequently developed into reasoning-level problems. Based on the problem type in the *elaboration* indicator, the majority of students developed problems that did not contain new additional information. The least frequently developed problem type was one that included additional information but was not necessary to solve the problem. The findings of this study imply the necessity of measuring teachers' numeracy literacy skills before students' numeracy literacy is developed and measured, as well as the importance of problem development training.

Keywords: Creativity, Minimum Competency Assessment, Problem Development

Introduction

The government suggests that university education should provide a pleasant learning environment through activities that foster creativity (Menteri Pendidikan Kebudayaan Riset dan Teknologi, 2023). The importance of creative thinking and creativity is a central focus in the curriculum development of Islamic Higher Education Institutions (PTKI), which adheres to the National Standards for Higher Education (SN-Dikti), requiring student-centered learning (Direktur Jenderal Pendidikan Islam, 2018). To achieve the graduate profile of mathematics educators, undergraduate students are expected to master and apply theoretical concepts and be able to design mathematics learning necessary for planning, implementing, and evaluating innovative instruction

(Indonesian Mathematics Education Society, 2024). Creativity from both in-service and prospective teachers is essential to support the attainment of these learning outcomes.

In the context of mathematics, Sriraman defines creativity at the professional level as the ability to produce original work that significantly expands knowledge and opens new ways of inquiry for other mathematicians. At the school level, mathematical creativity is defined as the process that yields unusual (novel) solutions to a given problem, as well as the process of formulating new questions and/or possibilities that allow old problems to be viewed from a new perspective (Nadjafikhah, Yaftian, & Bakhshalizadeh, 2012). Based on these definitions, mathematical creativity is closely related to *problem solving* and *problem posing*.

To achieve the expected learning outcomes for graduates of mathematics education programs, courses such as learning strategies, instructional media, learning assessment, school mathematics, and other relevant subjects are required. These courses are designed to equip prospective teachers with the ability to plan, implement, and evaluate both the processes and outcomes of mathematics instruction (Indonesian Mathematics Education Society, 2024). This body of knowledge provides prospective teachers with the foundation needed to fulfill pedagogical and professional competencies, particularly those related to mastery of subject matter and the management of learning processes (Presiden Republik Indonesia, 2005). Learning management includes the skills necessary to conduct assessments. Assessment is defined as a series of processes involving the collection and processing of information to determine students' developmental progress or learning outcomes (Menteri Pendidikan Kebudayaan Riset dan Teknologi, 2022).

In 2021, the national examination was replaced by the National Assessment (AN) (Menteri Pendidikan dan Kebudayaan Republik Indonesia, 2019). The National Assessment is a form of educational system evaluation carried out by the government to measure cognitive learning outcomes, including reading and numeracy literacy (assessed through the Minimum Competency Assessment or AKM); non-cognitive learning outcomes, namely attitudes/character in the Pancasila Student Profile (measured through a character survey); and the quality of the learning environment (measured through a learning environment survey) (Menteri Pendidikan Kebudayaan Riset dan Teknologi, 2021).

One of the key abilities focused on in the AKM is numeracy literacy. This ability measures students' proficiency in using mathematical concepts (facts, concepts, principles, and procedures) for solving practical problems within various relevant contexts. The contexts used include personal, socio-cultural, and scientific contexts. The mathematical content areas are numbers, algebra, geometry and measurement, and data and uncertainty. This content and context are structured into various problem formats (e.g., multiple-choice, essay, complex multiple-choice) to measure the cognitive levels of understanding (*knowing*), application (*applying*), and reasoning (*reasoning*). The cognitive level of understanding encompasses the abilities to recall, identify, classify, compute, retrieve, and measure. The cognitive level of application includes the abilities to select strategies, represent or construct models, apply or implement procedures, and interpret results. Meanwhile, the cognitive level of reasoning comprises the abilities to analyze, synthesize, evaluate, draw conclusions, and justify (Kepala Badan Standar, Kurikulum dan Asesmen Pendidikan, 2023).

Based on the preceding explanation, it is evident that the ability to develop assessment tasks oriented toward contemporary issues is an essential competency for prospective mathematics educators. Research related to the skills and challenges faced by preservice teachers in constructing mathematics problems can be grouped into three major themes: the types of problems posed, the ability to generate problems, and the difficulties encountered in problem posing (Rafi & Sugiman, 2019). Within the theme of problem types, various studies indicate that preservice teachers are able to employ diverse contexts—such as everyday, scientific, and social contexts—to construct problems aimed at assessing higher-order thinking skills. However, none of the preservice teachers incorporated cultural contexts in the problems they created (Ismail, 2024), despite cultural contexts being a crucial component in the development of AKM-style assessment tasks designed to measure numeracy literacy.

In the process of problem posing, preservice mathematics teachers were found to most frequently modify the conditions of a problem—by adding or removing information—while making contextual modifications least often. Contextual modification involves altering the context of a problem to make it more relatable to students. In contrast, question modification pertains to altering what students are required to answer, making the tasks more open-ended, or increasing their complexity by requiring deeper investigation (Lee, Lee, & Park, 2016). Difficulties in contextual modification arise from less ability to connect social situations to the design of mathematics instruction and to pose meaningful problems that assess reasoning-level cognitive skills (Kohar, Rahaju, & Rohim, 2022; Sari, et al., 2024; Sari, Saadah, & Hanifah, 2024; Yilmaz, 2020). These studies indicate that preservice mathematics teachers still require further development of skills to equip students with higher-order thinking abilities as well as the competence to integrate more diverse contexts into assessment tasks.

In the second theme, which focuses on preservice teachers' abilities in problem posing, studies show that their problem-posing performance depends on their mathematical knowledge, imagination or creativity, prior experiences in problem solving, and instructional activities designed to support problem-posing tasks (Chapman, 2012). This finding is reinforced by research indicating that preservice mathematics teachers' numeracy skills are influenced by their mathematical abilities; high numeracy skills contribute positively to problem-solving processes, yet the majority of preservice mathematics teachers still demonstrate suboptimal numeracy proficiency (Nahdi et al., 2020; Nugraheni et al., 2023; Yustitia, & Siswono, 2021). Furthermore, within the third theme difficulties encountered by teachers and preservice teachers in the problem-posing process, studies reveal that preservice teachers struggle to align operational verbs, formulate indicators, and construct test items that correspond to the cognitive processes required for designing higher-order thinking tasks, particularly in the form of multiple-choice items (Jailani et al., 2023; Şengül & Katrancı, 2014). Previous studies indicate that preservice teachers' creativity in mathematical problem posing, numeracy literacy, mathematical connection skills, and the ability to construct mathematics assessment tasks are essential competencies that must accompany their mathematical proficiency. In the process of developing assessment items based on AKM, preservice mathematics teachers may incorporate socio-cultural elements as contextual foundations, which are then articulated in the problem stimulus and further developed into mathematical tasks. This is in accordance with the important components in the AKM framework including context (personal, socio-cultural and scientific), content (number, geometric and measurement, algebra, data and uncertainty), and cognitive level (knowing, applying and reasoning) (Kepala Badan Standar, Kurikulum dan Asesmen Pendidikan, 2023)

The relationship between mathematical content and socio-cultural context is known as ethnomathematics (D'Ambrosio, 1990; Marsigit, 2016; Rosa & Orey, 2011). The integration of ethnomathematical contexts into mathematics instruction has been shown to positively influence students' perceptions of mathematics and culture, enhance mathematical literacy, promote the application of mathematics in real-life situations, and improve problem-solving skills (Barton, 1996; Laurens, 2016; Susilo & Widodo, 2018; Torres & Lobo, 2004; Wahyuni, Tias & Sani, 2013).

Innovations in mathematics assessment can be achieved not only through the selection of relevant contexts but also through the adoption of assessment formats aligned with current issues in educational evaluation. A number of studies on AKM have been conducted to examine students' and teachers' readiness for the assessment, as well as students' ability to solve AKM-type problems. These include analyses of teacher and student readiness for the National Assessment (Rokhim et al., 2021), examinations of middle school teachers' understanding of AKM and the need for AKM-related professional development (Fauziah, Sobari & Robandi, 2021), and descriptions of students' numeracy skills in solving AKM items (Cahyanovianty & Wahidin, 2021; Sari, Lukman & Muharram, 2021). Collectively, these studies highlight the need for continuous exposure to numeracy-oriented assessment tasks to strengthen students' numeracy literacy. One practical effort to support such exposure is equipping teachers and preservice teachers with the skills required to construct appropriate stimuli and AKM-type tasks. With these skills, educators can integrate AKM-style stimuli and questions into classroom assessments, thereby familiarizing students with numeracy-based problem formats.

Drawing upon the discussion above, the present study examines the creativity of preservice mathematics teachers in designing problem stimuli grounded in ethnomathematics and aligned with AKM characteristics, as well as the cognitive levels reflected in the problems they pose. The creativity of preservice mathematics teachers is measured based on indicators of fluency—the ability to generate a large number of questions; flexibility—the ability to produce diverse types of items from each stimulus; and elaboration—the ability to articulate detailed aspects of objects, ideas, and situations (Abdussalam, 2006; Olson, 1996; Setiawati, 2014).

Method

This is a descriptive study aimed at illustrating the characteristics of abilities and behaviors of individuals or groups (Fraenkel, Wallen, & Hyun, 2023). Based on the research approach, the research questions align with the characteristics of qualitative research, which seeks to understand a situation from the participants' perspectives and uses open-ended questions to collect diverse responses (Creswell, 2015; Johnson & Christensen, 2020). The population consisted of 7th-semester students at an Islamic State Higher

Education Institution during the 2023/2024 academic year who had completed the prerequisite courses Mathematics Learning Assessment and Capstone Selecta of Junior High School Mathematics. The maximum variation sampling technique was applied based on the students' prerequisite course grades, selecting 12 subjects from the high ability categories and based on previous research indicating that preservice mathematics teachers' ability in posing problems are influenced by their mathematical abilities (Nahdi et al., 2020; Nugraheni et al., 2023; Yustitia, & Siswono, 2021).

The process of developing mathematics assessment with ethnomathematical contexts aligned with the Minimum Competency Assessment (AKM) begins with the construction of the problem stimulus. The stimuli were derived from an analysis of mathematical elements embedded in cultural forms reported across 294 ethnographic research articles related to ethnomathematics, published in Sinta-accredited journals (levels 1–4) between 2018 and 2023. All collected articles were subsequently analyzed in terms of the complexity of their research findings and their alignment with the content domains of the AKM framework, which include numbers, measurement and geometry, data and uncertainty, and algebra. From this process, twelve studies representing each content domain were selected to serve as the basis for constructing the problem stimuli.

Before constructing the stimuli into assessment items, a five-week orientation on AKM-oriented item construction was provided to the research participants. This orientation covered several key components, including an overview of the AKM framework, the importance of AKM implementation, the types of instruments used, the content areas, domains, and contexts within AKM items, distinctions between AKM items and other types of assessment items, technical guidelines for AKM item development, and hands-on practice in constructing AKM items. Following this activity, participants practiced developing AKM items based on the provided stimuli. Each participant received four stimuli corresponding to the content domains of numbers, measurement and geometry, data and uncertainty, and algebra. The items produced were subsequently reviewed, revised, and analyzed and described based on creativity indicators.

Creativity analysis was conducted using an assessment rubric developed according to the indicators of fluency, flexibility, and elaboration. The fluency indicator (DeVink et al., 2022; Dunn, 1975; Haylock, 1987; Kontorovich et al., 2011; Leikin, 2009; Tabach & Friedlander, 2013) refers to preservice teachers' ability to generate a large number of distinct and correct items that align with the targeted aspects of measurement. Evaluation of fluency considers the appropriateness of each item in terms of content, domain, stimulus relevance, correctness of the answer, and clarity of the explanation.

The second creativity indicator, flexibility, pertains to preservice teachers' ability to construct items in various formats and across multiple cognitive levels for each stimulus. This indicator refers to the changes in approach used when posing problems (Siswono, 2008). categorized into four types as presented in Table 1.

Table 1. Scoring rubric for creativity based on flexibility indicator

Type	Description
3	Subjects were able to develop problems with different formats and cognitive levels in each stimulus content
2	Subjects were able to develop problems with different formats or cognitive levels in each stimulus content
1	Subjects were able to develop problems with the same format and cognitive level in each stimulus content
0	Subject cannot develop problems with diverse formats or cognitive levels in at least 1 stimulus content

Creativity based on the flexibility indicator is categorized based on the content presented, the types of items constructed, and their corresponding cognitive levels. The elaboration indicator refers to students' ability to add relevant information to the items in accordance with the context of the stimulus, which is classified into four types as shown in Table 2 below. Elaboration indicator is related to the ability of preservice mathematics teachers to add details of objects, ideas and situation enhancing its depth when posing a problems (Abdussalam, 2006; Olson, 1996; Setiawati, 2014).

Table 2. Scoring rubric for creativity based on elaboration indicator

Type	Description
1	The developed problem does not contain any new additional information from the stimulus
2	The developed problem contains new information but it is not relevant to the context (important information in the available stimulus is not needed to solve the problem)
3	The developed problem contains new additional information similar to the information in the stimulus (quantification is added to the important information in the available stimulus)
4	The developed problem contains new additional information that differs from the stimulus but is still relevant to the stimulus context (important information in the available stimulus is still needed to solve the problem)

In the subsequent stage, the creativity scores of the preservice mathematics teachers for each indicator were categorized. The creativity ratings for each respondent were then analyzed to determine the level of agreement among multiple raters. Each rater provided evaluations using two possible scores: 1, indicating agreement, and 0, indicating disagreement. The inter-rater agreement was then analyzed using Gwet's AC1 Coefficient (Gwet, 2014).

Results and Discussion

Preservice Mathematics Teachers' Creativity in Designing AKM-oriented Problem with Ethnomathematics Context

The first objective of this study was to describe the creativity of preservice mathematics teachers in designing problem stimuli grounded in ethnomathematics and aligned with AKM characteristics. Creativity was analyzed based on three indicators: fluency, flexibility, and elaboration. First, the AKM-oriented mathematics problems with an ethnomathematics context posed by the subjects were analyzed based on the **fluency** indicator. Fluency indicator is considered based on the suitability of the problems compiled with content such as numbers, geometry and measurement, data and uncertainty, and algebra. The following is an example of problems that are not suitable for the content:

The Lopo roof uses circular bamboo, if the diameter at L1 = 4.90, L2 = 3.37, L3 = 1.77, L4 = 1.05 and L5 = 0.20. What is the difference between the area of the smallest circle and the area of the largest circle?

Figure 1. Example of Inappropriate Questions Content

The problem in Figure 1 was designed by MBP based on stimuli related to algebra content, but the questions measured the area of a circle, which is related to measurement and geometry content. This shows that the problems created by MBP was not appropriate for the content. Based on the analysis of the problems submitted, the following results were obtained:

Table 3. Cognitive level of problems developed by subjects based on content

Content	Cognitive Level			
	Understanding	**Application**	**Reasoning**	**Total**
Numbers	1	7	4	12
Geometry and Measurement	2	7	1	10
Data dand Uncertainty	3	4	2	9
Algebra	3	7	1	11
Total	9	25	8	42

Table 3 shows that problem with **algebra** content were the least developed by the subjects in this study compared to the other three content areas. On the other hand, problems with **geometry and measurement** content were mostly composed by the subjects. After analyzing the suitability of the questions and their number based on the fluency indicator, the questions were then analyzed based on the flexibility indicator, which refers to the students' ability to develop questions with various question types and various cognitive levels for each stimulus.

Table 4. Subjects' creativity in flexibility indicators

Content	Type 0	Type 1	Type 2	Type 3
Numbers	6	2	3	1
Geometry and Measurement	4	7	1	0
Data and Uncertainty	6	4	0	2
Algebra	5	5	0	2

Based on Table 4, it can be seen that only five students, namely ANF, LF, LW, KNN, and HF, obtained a score of 3 on the flexibility indicator. As explained in Table 1, a score of 3 on the flexibility indicator means that students can compose questions with different forms and cognitive levels. This was achieved by students ANF and LF in the algebra content, LW and KNN in the data & uncertainty content, and HF in the numbers content.

On the elaboration creativity indicator, which refers to the ability to add additional information to construct problems according to the context of the stimulus, the results show that 35.71% of questions were elaborated using Type 1, 4.76% type 2, 30.95% Type 3, and 28.57% Type 4. These results indicate that the majority of prospective teachers constructed problems by adding information in accordance with Type 1, while very few added information to questions in Type 2. The problem in Figure 2 below is an example of a Type 1 Problem that does not add any information to the question stimulus to construct an AKM question.

Stimulus Questions
Jambi Province has several traditional houses spread across several regions. One of the traditional houses in Jambi Province is called the Rumah Tuo, located in Baruh Village, Tabir District, Merangin Regency. There are various tools in the Rumah Tuo, one of which is the Gantang Biheh. The Gantang Biheh is a tool used by local farmers to determine how much rice is obtained during the harvest and determine how much rice is allocated for zakat. A total of 10 gantang biheh of harvested rice indicates 1 gantang biheh of rice for zakat.

Figure 1. Gantang Biheh at Rumah Tuo

The questions created by Subject
If a citizen's harvest is 40 gantangs and 1 gantang contains 1.5 kg of rice, then how many kg does that person harvest?

Figure 2. Example of Type 1 Questions on the Elaboration Indicator

Meanwhile, in problem Type 2, an example of problem containing new information that is not necessary to solve the problem is as follows:

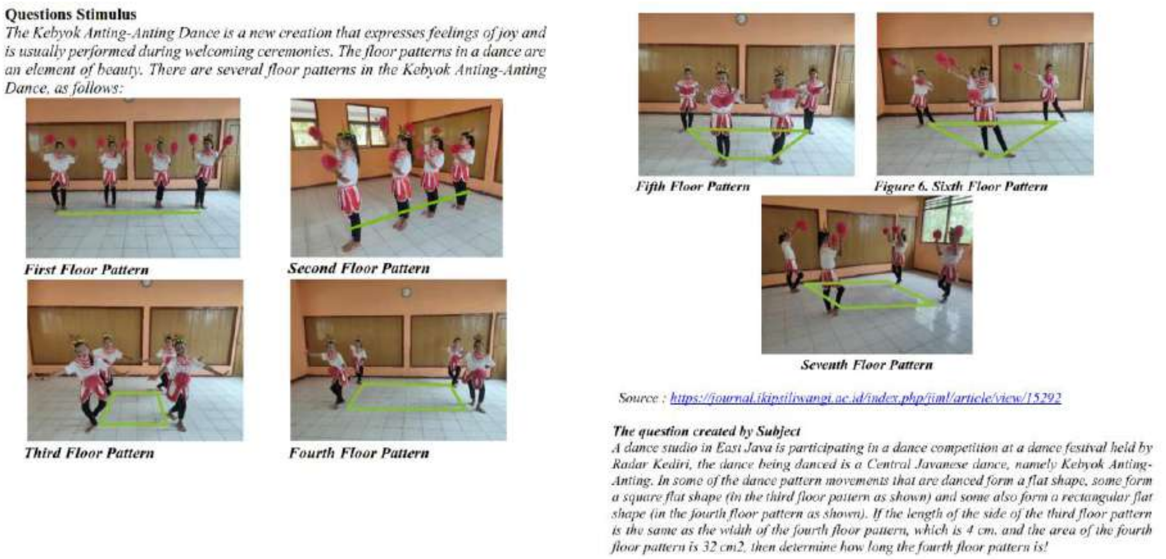


Figure 3. Example of Type 2 Questions on the Elaboration Indicator

The information about "the dance festival held by Radar Kediri and Central Java" in Figure 3 above does not provide additional information that is useful in solving the problem. Therefore, it is classified as a Type 2 problem based on the elaboration indicator.

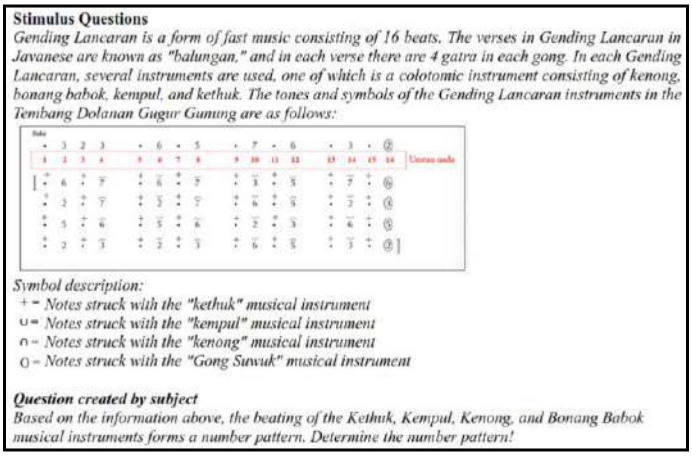
Based on the analytic perspective, the fluency indicator shows that algebra content is the most difficult to develop into many mathematics problems by prospective mathematics teachers, whereas geometry and measurement content is the easiest. The lack of creativity of prospective mathematics teachers in constructing problems based on the fluency indicator will affect their ability to develop AKM problems or mathematics problems in general. This is because the fluency indicator is an important component in the preparation of mathematics problems, as the larger the number of questions in an assessment, the higher its reliability. A longer assessment will provide a more adequate research sample regarding the behavior being measured, and the scores tend not to be distorted by unintended factors such as familiarity with the task given (Miller, Linn, Gronlund, 2009). This is in line with the opinion of Waugh and Gronlund (2013), who state that the factor that reduces test reliability is too few questions, so that to increase reliability, a large number of questions is required.

The activity of creating questions, or problem posing, is essentially a specific type of problem-solving activity (Silver & Cai, 2005). Meanwhile, problem solving requires good conceptual understanding (Nurhandayani, 2022), so that one of the results of this study can indicate that the subjects' conceptual understanding of algebra content is still not optimal. This finding is supported by the results of previous studies (Erdriani & Devita, 2019; Imelda, 2018; Mufidah et al., 2019), which also found that prospective teachers still experience many difficulties in various topics in the field of algebra. This may be due, among other things, to the abstract nature of algebra material, which requires reasoning and is therefore relatively difficult to master (Shonia et al., 2021).

In the elaboration indicator in constructing stimulus problems and mathematics problems with ethnomathematics content oriented towards AKM problems, the results show that the majority (more than 50%) of subjects were able to add additional information that was either similar or different from the stimulus but in line with the available stimulus context. Of all the additional information, information similar to that in the stimulus was added by many subjects to create problem. The addition of similar information referred to the addition of quantitative information to the information already available in the stimulus. This activity can be understood by the term editing quantitative information in problem-posing tasks (Işik et al., 2011; Yulistianti & Megawati, 2019) Furthermore, editing quantitative information is mostly associated with tasks that require students to pose problems without any restrictions from the information, stories, or clues provided. The results of the study by Christou et al. (2005) show that editing quantitative information is easiest for students to do in problem-posing tasks

The Cognitive Levels of Problem Posed by Preservice Mathematics Teachers

The second objective of this study was to examine the cognitive levels of AKM-oriented problem with ethnomathematics context posed by the preservice mathematics teachers. The cognitive levels of AKM-oriented problem in this study are understanding (*knowing*), application (*applying*), and reasoning (*reasoning*) level. From the data in Table 3, it can be seen that the mathematics problems created by the subjects are evenly distributed across each AKM content area. The smallest proportion is in the Data and Uncertainty content area (21.43%), followed by Geometry and Measurement (23.81%), and Algebra (26.19%). The Numbers content (28.57%) is the most common content included in the AKM problems compiled. In addition, it was also found that of all the questions compiled, more than half (59.52%) were at the application level and the least (19.05%) were at the reasoning level. The remaining 21.43% were identified as questions to measure the level of understanding. At the level of understanding, Data and Uncertainty (33.33%) and Algebra (33.33%) content were included in the majority of questions created by the subjects, one of which is as follows.



Stimulus Questions
Gending Lancaran is a form of fast music consisting of 16 beats. The verses in Gending Lancaran in Javanese are known as "balungan," and in each verse there are 4 gatra in each gong. In each Gending Lancaran, several instruments are used, one of which is a colotomic instrument consisting of kenong, bonang babok, kempul, and kethuk. The tones and symbols of the Gending Lancaran instruments in the Tembang Dolanan Gugur Gunung are as follows:

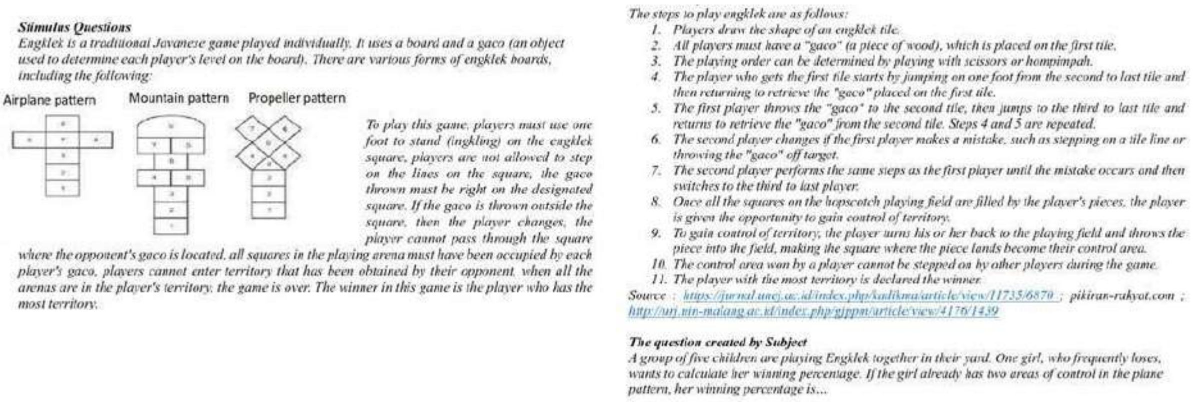
Symbol description:
+ = *Notes struck with the "kethuk" musical instrument*
∪ = *Notes struck with the "kempul" musical instrument*
∩ = *Notes struck with the "kenong" musical instrument*
○ = *Notes struck with the "Gong Suwuk" musical instrument*

Question created by subject
Based on the information above, the beating of the Kethuk, Kempul, Kenong, and Bonang Babok musical instruments forms a number pattern. Determine the number pattern!

Figure 4. Example of Questions on Understanding Level

Although the question in Figure 4 above seems to ask students to find a pattern, the question created by ANF only measures the level of understanding of algebra content. This is because in solving it, students only need to take information directly from the question stimulus in the form of a collection of integers and signs/symbols to summarize the number pattern related to the playing of the *Gending Lancaran* instrument.

At the application level, seven problems were generated for each of the following content areas: Numbers, Algebra, and Geometry and Measurement. Only four problems were generated for the content area of data and uncertainty, one of which was the problem created by AZZ below:



Stimulus Questions
Engklek is a traditional Javanese game played individually. It uses a board and a gaco (an object used to determine each player's level on the board). There are various forms of engklek boards, including the following:

To play this game, players must use one foot to stand (ingkling) on the engklek square, players are not allowed to step on the lines on the square, the gaco thrown must be right on the designated square. If the gaco is thrown outside the square, then the player changes, the player cannot pass through the square where the opponent's gaco is located, all squares in the playing arena must have been occupied by each player's gaco, players cannot enter territory that has been obtained by their opponent, when all the arenas are in the player's territory, the game is over. The winner in this game is the player who has the most territory.

The steps to play engklek are as follows:
1. *Players draw the shape of an engklek tile.*
2. *All players must have a "gaco" (a piece of wood), which is placed on the first tile.*
3. *The playing order can be determined by playing with scissors or hompimpah.*
4. *The player who gets the first tile starts by jumping on one foot from the second to last tile and then returning to retrieve the "gaco" placed on the first tile.*
5. *The first player throws the "gaco" to the second tile, then jumps to the third to last tile and returns to retrieve the "gaco" from the second tile. Steps 4 and 5 are repeated.*
6. *The second player changes if the first player makes a mistake, such as stepping on a tile line or throwing the "gaco" off target.*
7. *The second player performs the same steps as the first player until the mistake occurs and then switches to the third to last player.*
8. *Once all the squares on the hopscotch playing field are filled by the player's pieces, the player is given the opportunity to gain control of territory.*
9. *To gain control of territory, the player turns his or her back to the playing field and throws the piece into the field, making the square where the piece lands become their control area.*
10. *The control area won by a player cannot be stepped on by other players during the game.*
11. *The player with the most territory is declared the winner.*

Source : https://jurnal.unej.ac.id/index.php/kadikma/article/view/11735/6870 ; pikiran-rakyat.com ; http://urj.uin-malang.ac.id/index.php/gjppm/article/view/4176/1439

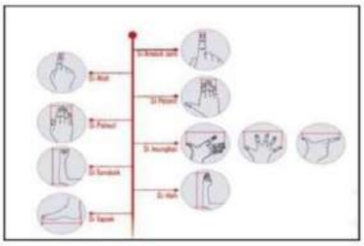
The question created by Subject
A group of five children are playing Engklek together in their yard. One girl, who frequently loses, wants to calculate her winning percentage. If the girl already has two areas of control in the plane pattern, her winning percentage is...

Figure 5. Example of Questions on Application Level

The problem in Figure 5 is an Application level that measures the competency of executing commonly used procedures to solve probability problems. Executing procedures in this case means applying operations to integers based on the probability of an event in the context of the game of *Engklek,* Meanwhile, numbers content (50%) dominated the content of problems at the reasoning level. Conversely, geometry and algebra content were the least covered in the problems by the research subjects. Of all the problems at the reasoning level, only one was produced for each of these contents. One of them is the following problem.

Stimulus Questions

In the past, when measuring the construction of Rumoh Aceh (traditional houses of the Acehnese people), the Acehnese people used the size of body parts as a benchmark, known as Seunipat.



Size name	***Dimensions***
Si aneuk jaroe (one finger across the middle joint)	*± 1.6 cm*
Two athletes jaroe (two sections finger)	*± 5 cm*
The patent (same length width with four finger hand No including Mother finger)	*± 12 cm*
The paleuet (one palm / measured at the point of the middle joint of the thumb)	*± 10 cm*
The jeungkai teuhunyok (size long from Mother finger until to end finger index finger if second finger hand it is stretched as far as Possible)	*± 20 cm*
The jeungkai (One span measured from Mother finger to end finger outstretched little finger free)	*± 21 cm*
The jeungkai geutiek (size long from end Mother finger to the end finger middle . with position fingers hands outstretched the farthest possible)	*± 22 cm*
The tumbok (One pound / from elbow to end hand clenched)	*± 40 cm*
Si hah (one cubit/ measured from elbows up to to end finger middle)	*± 45 cm*
The footprint (One soles of the feet/ measured from heel to longest toe)	*± 25 cm*

Source : https://ojs.fkip.ummetro.ac.id/index.php/matematika/article/view/4751/pdf

The questions created by Subject

One of the residents wanted to repair his house. He came to the Jaya Abadi building store to order 4 pipes with a size of 5 times the size of each pipe. It turned out that the only pipe in the store was one pipe with a length of 8 meters. Can the 8 meters be divided into 4 with the size according to the resident's order? Explain!

Figure 6. Example of Questions on Reasoning Level

The problem in Figure 6 is a reasoning problem on geometry and measurement content that was successfully created by KNN. This problem measures competence in checking non-standard units in the cultural context of the Acehnese community. To solve this problem, students need to evaluate and justify the adequacy of the pipe for their needs.

The findings of this study indicate that preservice mathematics teachers mostly developed application-level questions, while reasoning-level questions were limited. This demonstrates a tendency for preservice mathematics teachers to design questions that measure the ability to implement procedures rather than those that measure the ability to analyze, synthesize, evaluate, draw conclusions, and justify. Lower-level questions are easier to develop because problem-posing skills are positively correlated with problem-solving skills (Yuntawati, 2019). Solving more complex problems requires higher-order thinking skills, as does posing more complex problems. This finding is also supported by previous research on mathematical task construction (Suwarno et al., 2022; Aşıkcan & Uygun, 2023; and Rahayu & Wulan, 2024), which consistently showed that reasoning or higher-order thinking questions were more difficult to construct than those at lower levels.

Further analysis across various mathematics content areas also revealed that problems with algebraic content at the reasoning level were the least common, compared to those related to geometry, measurement, or data representation. These findings can be attributed to the abstract and symbolic nature of algebra. Algebra emphasizes the relationship between contextual problems and mathematical symbols, which requires a complex process of decontextualization, abstracting the situation and representing it symbolically (Susac et al., 2014; NCTM, 2010). This potentially poses challenges for preservative mathematics teachers when attempting to integrate algebra into meaningful contextual or ethnomathematical situations. In contrast, geometry and measurement are more easily visualized and contextualized through concrete cultural artifacts such as heritage architectural facades, traditional ornaments, and visual practices that have been part of human life for centuries (Maschietto & Swidan, 2019).

Creativity is an important skill in the 21st century for everyone, including prospective teachers (Kupers et al., 2019). Several research themes related to 21st-century skills for teachers are research on teachers' experiences in teaching 21st-century skills, assessment of 21st-century skills, and improvement of 21st-century skills for teachers (Almazroa & Alotaibi, 2023). Teachers' creativity in constructing questions is part of a research theme related to 21st-century skills, particularly on the topics of assessing 21st-century skills and improving 21st-century skills for prospective teachers. In the previous section, it was found that students' creativity in constructing questions with an ethnomathematics context oriented towards AKM questions was measured based on creativity indicators, namely fluency, flexibility, and elaboration. The creativity of prospective mathematics teachers in constructing questions is closely related to mathematical creativity, which is defined as the ability to formulate new questions or solutions or new possibilities by providing a different perspective on the previous problems (Sriraman, Yaftian & Lee, 2011).

Creativity for prospective teachers is also an important skill to develop during pre-service training if education is required to meet government standards (Bolden, Herries, & Newton, 2010), one of which is competence in developing assessments (Widana, Suarta, & Citrawan, 2019). Creativity for prospective teachers in creating mathematics problems with ethnomathematics content oriented towards AKM problems is one of the efforts to identify and facilitate teachers' creativity before teachers have the desire to facilitate the fulfillment of their students' 21st-century competencies. This is in line with the opinion of Beswick and Fraser (2019), who stated that before teachers facilitate their students' 21st-century competencies, teachers must first ensure that they themselves have 21st-century skills. Students who already possess 21st-century skills, one of which is creativity, will have other important skills related to their academic success. Akpur states that creativity, critical thinking, and reflection can positively predict academic achievement (Akpur, 2020). This means that the more creative, critical, and reflective students are, the better their academic achievement will be.

In addition to impacting creativity and other abilities, prospective teachers' creativity is related to good practices in classroom management. Cremin and Cappell argue that there are several characteristics of creative pedagogical practices, namely generating and exploring ideas, problem-solving skills, activities that build collaboration, and teacher creativity (Cremin & Chappell, 2021; Leikin, & Aizik, 2019). The importance of prospective teachers' creativity is also closely related to student learning outcomes (Meier & Grabner, 2022; Utami, Suhendri, & Dian, 2019). This is because creative teachers make efforts to increase student motivation to learn, encourage students to gain understanding and knowledge, and encourage students to be creative (Lev & Leikin, 2011). This means that as a teacher or prospective teacher, one needs to have creativity that will impact one's ability to manage the classroom and impact student learning outcomes and achievements.

In the process of good classroom management, prospective teachers or teachers can use challenging mathematics tasks that are oriented towards problem-solving skills and tasks that can provide broad and diverse insights. Problem solving, problem posing, and redefining new strategies support the emergence of creativity in mathematics (Gontijo, 2018). In addition, based on Leikin's (2016) opinion, learning that leads to creativity requires expertise and creativity from the mathematics teacher themselves. This means that the teacher's expertise in providing challenging questions, training problem-solving skills, and broad insight are important abilities that support good creative mathematics learning practices. The broad insight of prospective teachers or mathematics teachers is related to the objectives of numeracy skills as stated by Steen, which include the fulfillment of knowledge/skills to solve problems in daily life, at work, and appreciation of the mathematical aspects of human culture. This means that in order to manage a class well, prospective mathematics teachers or mathematics teachers need to have broad knowledge, including knowledge of the mathematical aspects contained in human culture (Gal et al., 2020). The development of mathematics problems with ethnomathematics content oriented towards AKM problems is one of the efforts for prospective teachers to develop a broad understanding of the mathematical aspects contained in human culture, and in an effort to develop creativity as a fulfillment of 21st-century competencies.

Conclusion and Suggestion

Based on the results of the research and discussion in the previous section, it can be concluded that the creativity of prospective mathematics teachers in creating ethnomathematics-based mathematics problems oriented towards AKM on the fluency indicator shows that algebra content is the most difficult content for prospective mathematics teachers to develop into many mathematics problems. On the other hand, measurement and geometry content is the easiest. Based on the fluency indicator, the majority of problems constructed by students were at the application level and the fewest were at the reasoning level. In measurement and geometry, data and uncertainty, and algebra content, the fewest questions were developed at the reasoning level. Based on the question type in the elaboration indicator, the majority of students were able to develop questions that did not contain new information from the stimulus provided. The least common were questions that contained additional information that was not needed to solve the problem. The results of this study imply that it is necessary to measure teachers' numeracy literacy skills before students' numeracy literacy skills are developed and measured. In addition, there is a need for training in problem development, especially problems with an ethnomathematics context oriented towards AKM, so that prospective teachers or teachers have a collection of exercise problems that contain numeracy literacy skills. In addition, prospective teachers and teachers should also have good ability to construct mathematics problems. Further research recommendation on this study is a research on the quality of ethnomathematics-based mathematics problems oriented towards AKM problems so that the problems can be used and implemented in the wider community

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