Exploring Creativity in Prospective Mathematics Teachers through Context-Based Posing Numeration Task Design: A Case Study in Mathematics Learning

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ABSTRACT

Background and Objectives: Creativity is an essential competency for prospective mathematics teachers if they are to effectively meet the demands of modern education. In mathematics learning, creativity includes the ability to connect concepts, develop new learning methods, and create relevant and interesting materials. One's attitude can be trained through context-based numeration task activities. The activity requires students to design numeration problems that are based on real situations. This process helps students develop creative thinking skills, such as generating new ideas (fluency), thinking flexibly, and creating original solutions, while also improving their understanding. This study aimed to provide an in-depth description of how prospective mathematics teachers design context-based posing numera tasks design in personal, socio-cultural, and scientific contexts, and to identify the types of creativity that emerge during the process of creating contextual story problems.

Methodology: This study employed a qualitative case study approach to explore how prospective mathematics teachers develop creativity by designing context-based numeracy tasks in mathematics learning. This study included the participation of 32 prospective mathematics student-teachers from the Mathematics Education study program in one of the universities in East Java, Indonesia. Data were collected by having all prospective mathematics teachers collaboratively complete a task in which they designed numeracy problems.

Main Results: The results of this study showed that the average achievement for the creativity indicators was 33.36% for both fluency and flexibility, and 33.33% for originality, based on the mathematical problems submitted by the participants. The analysis shows that 38.1% of the numeracy task designs are based on the context of understanding and application, while 23.8% are oriented toward the reasoning level. Overall, these findings indicate the need to strengthen the creativity and pedagogical competencies of prospective mathematics teachers, especially in terms of generating fluent, varied, and original problem ideas, and in developing problem designs that encourage students' mathematical reasoning.

Discussions: The limited number of numeracy tasks designed at the reasoning level may be due to most prospective mathematics teachers preferring to create problems that are more structured and procedural, rather than those that encourage creative thinking and the development of diverse solution strategies. When the majority of tasks

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performed by students were still focused on comprehension and application, this showed that the ability to create analytical and reflective tasks was not well developed. In the long run, this attitude could cause students to fail in handling real-world situations that require numeracy-based problem-solving, data analysis, and logical argumentation.

Conclusions: The study found that the limited number of numeracy tasks designed at the reasoning level may be due to most prospective mathematics teachers preferring to create structured, procedure-based problems rather than tasks that encourage creative thinking and the development of diverse solution strategies. Therefore, educators needed to provide strategies in mathematics learning to train student-teachers in designing tasks that could explore the creativity of students by including context-based numeracy. These strategies should be the main focus in the education curriculum of prospective mathematics teachers

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Introduction

Creativity in mathematics education is a competency that plays an important role in building critical as well as innovative thinking skills, for both students and teachers. In mathematics learning, creativity helps students understand concepts deeply and also urges students to find various alternative solutions in solving problems (Ayvaz & Durmuş, 2021; Elgrably & Leikin, 2021). For prospective mathematics teachers, this competency is the main asset in designing innovative, relevant, and contextualized learning that increases student interest and participation (Emre-Akdoğan, 2023; Reyes & Andrade, 2024; Wijayanti et al., 2022). Creativity also allows prospective mathematics teachers to connect mathematical concepts with real situations and create more meaningful learning. Developing this competency in mathematics education is essential for preparing educators to meet the challenges of 21st-century learning (Chang, 2023; Díez-Palomar et al., 2023).

Mathematics learning that emphasizes creativity can develop the ability to connect concepts, new learning methods, or create relevant and interesting materials (Momdjian et al., 2024; Saefudin et al., 2023). Student creativity can be measured using indicators such as fluency the ability to quickly generate multiple ideas or solutions and flexibility, which refers to the capacity to view and solve problems from different perspectives. In addition to these indicators is originality, which is the ability to generate ideas or solutions unique and different from others. Creativity can be developed by engaging students in activities where they design numeracy problems, which serves as an effective way to explore creative thinking in mathematics (Elgrably & Leikin, 2021; Rawlings & Cutting, 2024).

The numeration tasks activity includes creating challenging, relevant, and contextualized numeracy problems, enabling prospective mathematics teachers to think divergently, originally, as well as flexibly (Papadopoulos et al., 2022). Posing numeration tasks specifically indicates the development of problems related to numeracy. Following the discussion, there are three kinds of contexts in numeracy, namely personal, socio-cultural, and scientific contexts. Personal context focuses on the ability of an individual to use numbers in managing their personal life. Additionally, the socio-cultural context refers to the use of mathematics in social and cultural contexts, which includes the interpretation of demographic data, election statistics, and the division of resources in society. The scientific context relates to the application of mathematics in scientific and technical contexts, such as data analysis in experiments or the use of mathematical models in science and technology (Chang, 2023). Designing context-based numeracy tasks can provide prospective mathematics teachers with an idea of how to adapt problems to the needs and backgrounds of students, which requires flexibility as well as originality in packaging the material. Through this activity, the creativity of prospective mathematics teachers in generating fun and meaningful learning can continue to develop, providing a strong foundation for educating students more interestingly and effectively (Ku et al., 2024; Li et al., 2022; Siller et al., 2024).

Previous studies showed that some students expressed limitations in critical and creative thinking skills, especially in solving mathematical problems requiring deep and innovative thinking. This issue may result from insufficient practice or limited variety in learning methods, which can hinder students' ability to develop alternative solutions in mathematics (Kim et al., 2019; Zappatore, 2023). Until now, there are still few studies discussing the creativity of prospective mathematics teachers through posing context-based numeration tasks. Most of the existing findings focus more on the aspects of preparing numeration problems (Herlinawati et al., 2024; Rawlings & Cutting, 2024; Singh et al., 2021), project-based assignment design (Thornhill-Miller et al., 2023; Vong & Kaewurai, 2017), and HOTS-oriented questions (Giblin et al., 2022; Pramuditya et al., 2022). Moreover, the main difference between the previous studies is the expression of the exploration of creativity of prospective mathematics teachers through posing context-based numeration tasks. The prospective mathematics teachers were invited to design numeration problems in three contexts, namely personal, socio-cultural, and scientific.

This study offers a new and more in-depth approach to developing the creativity of prospective mathematics teachers by engaging them in context-based numeracy tasks that are applicable and relevant to everyday life. Therefore, the authors aim to conduct the study herein titled "Exploration Creativity of Prospective Mathematics Teachers through Context-based Posing Numeration Task Design: A Case Study in Mathematics Learning". This study is expected to provide a new and deeper contribution to the understanding of this topic by improving the quality of mathematics learning in the future. Additionally, this study is expected to inform mathematics curriculum development by highlighting the importance of creativity in designing contextual problems and tasks, which can help prospective mathematics teachers create innovative and relevant classroom learning experiences.

Method

The study used a qualitative method involving a case study procedure. This is because the analysis aimed to explore the creativity of prospective mathematics teachers through posing context-based numeration tasks in mathematics learning. This study focused on how prospective student-teachers design context-based numeration tasks. The qualitative method was used to understand phenomena deeply and thoroughly in the real context. This analysis focused on understanding, describing, and interpreting phenomena from a natural perspective without manipulation or control of the variables under study (Creswell, 2016). The main focus was on the task products designed by student-teachers, namely context-based numeracy problems that had been formed. This study explored deeper into the creative ideas that developed from student-teachers through posing numeration tasks.

Respondents

This research was conducted in the context of lectures in the Mathematics Education Study Program which focuses on developing pedagogical and professional competencies of prospective mathematics teachers, especially in designing mathematics tasks based on real-life contexts. Research activities were integrated in courses that support problem design skills, thus providing authentic space for students to apply the conceptual and pedagogical knowledge they have acquired. The research participants consisted of 32 fourth-semester prospective mathematics student-teachers from the Mathematics Education study program in one of the universities in East Java, Indonesia and who had academic experience in understanding mathematical concepts as well as initial experience in designing learning activities. This experience allowed them to show creativity in posing numeration tasks that relate mathematical concepts to personal, socio-cultural, and scientific contexts, in accordance with the focus and objectives of the study.

Data Collection

Data were collected by having all prospective mathematics teachers work together to design and submit numeracy problems. The collaborative method was selected to create an environment that represented the dynamics of learning in the classroom and allowed interaction between participants in the process of designing numeracy problems. Relating to the process, the student-teachers were cooperatively asked to design numeracy problems based on real-life contexts or everyday situations that were relevant to the mathematical concepts being taught. The tasks produced by the students were analyzed by tracking creativity indicators, including fluency, flexibility, and originality that refer to the creativity indicators by Kim et al. (2019). Fluency is the ability to generate many mathematical ideas or problems from one context in a fluent and varied manner. Flexibility is the ability to propose problems with various forms, approaches, or different points of view. Originality is the ability to generate ideas or problems that are unique, uncommon, and show novelty compared to typical problem patterns.

The study aimed to explore important aspects of the problem design process, including how students used creativity in creating problems that were mathematically challenging and relevant to the real world by focusing on this product.

The collected data was then analyzed by organizing and categorizing the data based on the context relevant to the study focus. This helped in identifying the views, experiences, and factors that influenced the ability of participants to design numeracy problems based on the selected context.

Data Analysis Technique

The data analysis method used was qualitative data analysis with a content analysis procedure. This method enabled the researchers to explore, organize, and interpret data from various sourcesn such as students' numeracy task designs and reflective documents in order to understand how students develop creativity when designing context-based numeracy tasks. A more detailed explanation of the data analysis methods used is presented in the following sections.

Data Processing

Data were collected by having participants work together to create numeracy problems. This collective method aimed to reflect the dynamics of group work and create a more authentic representation of the assessment design process in a real environment. After the data was collected, the next step was coding, where the coordinator marked important parts of the data, such as ideas related to creativity, the use of context, as well as relationship between mathematics and real life. Coding was performed by labeling or assigning a specific code to each relevant piece of data. This coding demonstrates how prospective mathematics teachers achieved creativity indicators while designing numeracy tasks. The coding includes F representing the achievement of the Fluency indicator, FL representing the achievement of the Flexibility indicator, and O representing the achievement of the Originality indicator. This coding helped the coordinator organize the data based on themes or categories that were easier to analyze.

Data Classification and Identification

After the data was coded, the study classified the codes based on the dimensions of creativity and context. For example, codes related to creativity in designing problems such as fluency, flexibility, and originality were classified accordingly. Similarly, codes related to context such as personal, socio-cultural, or scientific context were also classified. This classification aimed to identify patterns that appeared in the data and facilitated coordinators in analyzing the data. The data from the prospective student-teachers' numeration task designs were analyzed according to the creativity indicators outlined in Table 1.

Table 1. Analysis Creativity Numeration Task based Context

Creativity indicator	Sub Indicators	Score 4 (Very Good)	Score 3 (Good)	Score 2 (Fair)	Score 1 (Less)
Fluency (F)	Appropriateness of questions to the context and topic of the material (F1)	Questions were very relevant to the context and topic of the material	Questions were relevant to the context and topic of the material	Questions were not appropriate to the context and topic of the material	The question did not match the context or topic of the material
	Ability to develop initial ideas into more complex and varied problem situations (F2)	Able to develop ideas with a variety of complex problems	Develop ideas with several variations of the problem	There was little variation in the questions	No variety of questions was not complex
	Number of context-based numeracy problems in a given time (F3)	Produced a large number of context-based numeracy problems in the allotted time	Produced some context-based numeracy problems	Produced a few context-based numeracy problems	Produced one problem or did not finish in the specified time
Flexibility (FL)	Presenting problems in different ways, such as stories, charts, tables, or numbers. (FL1)	Used a variety of question formats with consistent variation	Used several question formats that were quite diverse	Used a limited question format	Only used one question format without variation
	Adapting questions to fit each student's level of thinking (FL2)	Developed questions at various cognitive levels (understanding, application, analysis)	Composed questions at two different cognitive levels	Questions only covered one cognitive level	There was no adjustment of questions to the cognitive level of students
	Making questions at different levels of difficulty (comprehension, analysis, application) (FL3)	Problems were organized in stages from easy to difficult with a variety of problem-solving types.	Problems had different levels of difficulty although not consistent	Problems at one level of difficulty with no variation	Monotonous questions with the same difficulty level
Originality (O)	The level of uniqueness or novelty of the question compared to standard or common questions (O1)	Problems were very unique, innovative, and different from common problems	The questions were unique but there were still similarities with common questions	Slightly general problem with some novelty	The questions were very general and there was no uniqueness
	Context use of numeracy problems (O2)	Using new contexts relevant to daily life	Used general context but remained relevant	Used common and frequently used contexts	No context or irrelevant to learning
	Using innovative tools, technologies, or media to present numeracy problems. (O3)	Used innovative tools or technologies that support the question	Using common tools or technology but still supporting the question	Using traditional tools or no technology	There was no use of tools or media in the question

The sub-indicators and rubric in Table 1 were developed based on the theoretical framework of mathematical creativity that refers to the main indicators: fluency, flexibility, and originality (Kim et al., 2019). Fluency sub-indicators include aspects of the relevance of the problem to the context, the ability to develop a variety of ideas, and the number of problems produced in a given time. The Flexibility sub-indicator assesses the diversity of question formats or methods, the ability to adapt questions to students' cognitive levels, and variations in difficulty levels. The Originality sub-indicator focuses on the novelty of the idea, the context used, and the uniqueness of the proposed problem compared to common problems. Each sub-indicator has a scoring rubric with a scale of 1-4 (Less - Fair - Good - Very Good) that describes the level of occurrence of the indicator qualitatively and quantitatively.

Data Interpretation

After classification and identification, the study analyzed and interpreted the findings. At this stage, the coordinator related the findings to relevant theories and literature on creativity and context-based numeration task design. This study provided a deeper understanding of how prospective mathematics teachers developed creativity through posing context-based numeration tasks. The data interpretation was performed by using theories and concepts that were relevant to the study topic. The researcher applied source and method triangulation to the data interpretation process. Source triangulation is done by collecting data from various sources, such as the results of problem submission tasks. Triangulation of methods was applied to analyze task documents with the achievement of creativity indicators that have been determined by researchers.

Inference

Conclusions were drawn throughout the data analysis process, based on a review of the results and their interpretation, as well as responses to the study's research questions. Moreover, the content analysis method was selected because it could explore the views as well as experiences of participants in-depth and holistically.

Findings and Discussion

The creativity demonstrated by prospective mathematics teachers in designing numeration tasks is also evaluated according to the context levels of understanding (P1), application (P2), and reasoning (P3). The following explains in detail the results of the tasks of prospective mathematics teacher students in designing numeracy tasks. At the understanding level (P1), students design questions that focus on the learners' ability to recognize, understand, and use basic numeracy concepts in the context of everyday life. Problems at this level are usually routine, direct, and emphasize the application of concepts that have been learned. The application level (P2), the problems designed require students to apply numeracy concepts in more complex or indirect situations. Problems at this level usually involve applying concepts in new contexts, solving practical problems, or solving situations that require several steps. Meanwhile, the reasoning level (P3) reflects higher creativity because students design problems that encourage students to use mathematical reasoning, think critically, and connect several concepts in depth.

Creativity of student-teachers in designing assignments

This study was based on data from a corporative analysis of assignments of students using content analysis. The achievement of creativity among prospective mathematics teachers in designing numeration tasks was assessed by analyzing the content of the problems they produced. After the data in the form of numeration task design products are collected, it was identified and coded, as Fluency (F), Flexibility (FL), and Originality (O). This coding shows the achievement of indicators of creativity for prospective mathematics teachers in designing numeration tasks. There were eight groups of students who designed numeration tasks. The following was shown in Table 2 concerning the average score of creativity achievement through posing numeration tasks based on context in eight groups of prospective mathematics teachers.

Table 2. Average Score for Achievement of Creativity Indicators

Indicator	Sub Indicators	Group 1 Score	Group 2 Score	Group 3 Score	Group 4 Score	Group 5 Score	Group 6 Score	Group 7 Score	Group 8 Score	Average
F	F1	4	4	2	2	2	4	4	4	3.25
	F2	2	3	2	3	2	3	4	3	2.75
	F3	2	4	3	4	4	4	4	4	3.625
FL	FL1	3	3	2	3	2	2	4	2	2.625
	FL2	2	4	3	4	4	4	4	4	3.625
	FL3	2	3	3	2	3	3	4	2	2.75
O	O1	3	2	1	3	3	2	4	2	2.5
	O2	3	2	2	3	2	2	4	2	2.5
	O3	4	4	4	4	4	4	4	4	4

Table 2 indicates that, among the fluency indicators, student-teachers achieved the highest average score on the sub-indicator measuring the number of context-based numeracy problems they could design within a given time (F3), with most groups producing more than two such problems. Meanwhile, the lowest average score for the fluency indicator was on the sub-indicator assessing the ability to expand an initial idea into more complex variations (F2); most student-teachers produced only one variation, and their problems lacked complexity. In the flexibility indicator, the highest average achievement score was in the sub-indicator of adjusting questions to the needs or abilities of students at different cognitive levels (FL2), namely designing numeracy problems with at least two cognitive levels. On the other hand, the lowest achievement score was in the sub-indicator of using various methods or formats in problems (stories, graphs, tables, or numbers) (FL1), namely using a limited problem format. In the originality indicator, the highest average achievement score was in the sub-indicator of using unusual tools, technology, or media in supporting numeracy problems (O3). The student-assignments designed had been incorporated with technology using a variety of applications. Overall, Figure 1 presents the percentage of achievement for each creativity indicator in designing context-based numeracy tasks.

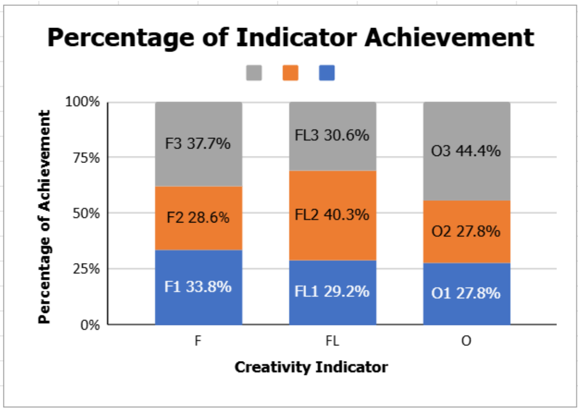


Figure 1 Percentage of Achievement for Creativity Indicators in Context-Based Numeracy Task Design

Figure 1 shows the average percentage of achievement of the fluency indicator of 33.36% with details on the F1 sub-indicator of 33.8%, F2 of 28.6%, and F3 of 37.7%. This shows that students' ability to generate problem ideas fluently (F1) is quite good, but there is still room for improvement in expanding the variety of ideas (F2). Meanwhile, the overall achievement for the Flexibility (FL) indicator was 33.36%, with the FL1 sub-indicator at 29.2%, FL2 at 40.3%, and FL3 at 30.6%. The highest score was achieved for FL2, indicating that students were relatively proficient at adjusting questions to suit different cognitive levels. However, flexibility in the format and variety of question forms (FL1 and FL3) is still at a moderate level. Meanwhile, the overall achievement for the Originality (O) indicator was 33.33%, with sub-indicator scores of 27.8% for O1, 27.8% for O2, and 44.4% for O3. The highest achievement in O3 shows that students are quite capable of linking problems with real-life contexts, although the ability to create truly unique ideas (O1 and O2) is still relatively low.

Context level of the Task

The level of numeracy context in the design of student tasks was classified into three main aspects, namely understanding, application, and reasoning. At the comprehension level (P1), students were able to recognize, interpret, and explain the basic numeracy concepts used in the task. The students developed problems that required an understanding of number concepts, counting operations, or relationships between numbers in a particular context. Furthermore, students began to design tasks that required the use of numeracy concepts in real situations at the application level (P2). In this case, students presented theory-based problems and developed scenarios that required numeracy skills, such as calculating budgets, determining the efficiency of raw materials, or estimating travel time. Meanwhile, students were prompted to develop tasks that required analysis, evaluation, and decision-making based on numeracy concepts at the reasoning level (P3). At this stage, the tasks used calculation of results, consideration of numerous variables, and the development of logical arguments in solving problems, such as designing investment strategies based on economic trends or developing optimal solutions for logistics planning. By understanding and applying these three levels of numeracy context in task design, prospective mathematics teachers were able to develop the critical and creative thinking skills needed to guide students in understanding as well as applying mathematical concepts more meaningfully in everyday life. Based on the results of the content analysis of the tasks designed by prospective mathematics teachers, the results are presented in Figure 2.

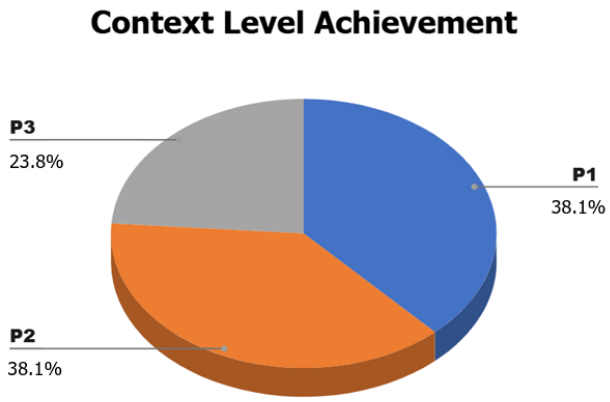
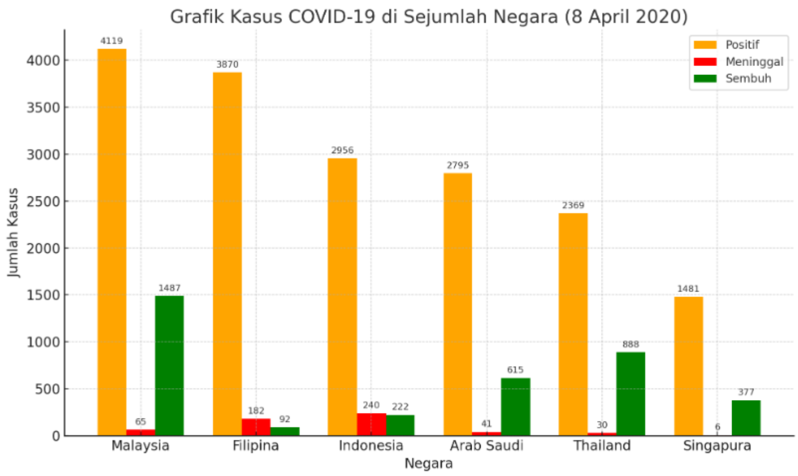


Figure 2 Context Level Achievement

Figure 2 shows a diagram signifying of context-level accomplishment, where P1 and P2 had a greater proportion compared to P3. When P1, P2, and P3 refer to the levels of understanding, application, and reasoning in numeracy, it can be concluded that achievement in the aspects of understanding and application are higher compared to reasoning. Achievement of indicators at P1 and P2 levels, each at 38.1%. This shows that most students can design problems that relate mathematical concepts to contexts at the basic understanding level (P1), such as identifying information in a particular context, as well as at the application level (P2), namely applying mathematical concepts to common contextual situations. Meanwhile, the achievement at level P3 (reasoning) was only 23.8%, which is the lowest achievement among the three levels. This indicates that only a small number of students can design problems that demand higher mathematical reasoning, such as analyzing complex situations, making generalizations, or solving non-routine problems. This outcome indicated that students tended to easily achieve understanding and application in tasks, while the reasoning aspect still needed to be improved.

Design of Mathematics Teachers Candidate Student-Tasks based on Creativity and Context Levels

The findings of this study provide an overview of how prospective mathematics teachers design innovative and relevant tasks in mathematics learning, based on their creativity and the context level of the assignments. The following was presented on posing numeration tasks based on the context level, which included understanding (P1), application (P2), and reasoning (P3).

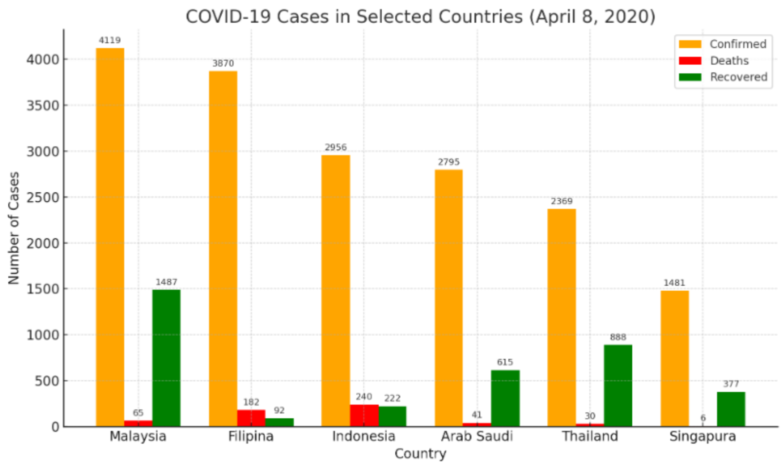


Sejumlah negara tetangga Indonesia juga sedang berjuang melawan Corona. Jumlah kasus negara yang ditampilkan tidak jauh berbeda dengan Indonesia. Data yang ditampilkan adalah data pada tanggal 8 April 2020. Namun, angka per 9 April 2020 tidak menunjukkan perubahan signifikan dibandingkan data sebelumnya. Berdasarkan gambar grafik di atas, tentukan kebenaran dari pernyataan-pernyataan berikut:

1. Malaysia memiliki jumlah kasus positif tertinggi dibandingkan negara lainnya.
2. Jumlah kasus sembuh di Indonesia berada di antara Arab Saudi dan Singapura.
3. Selisih antara jumlah kasus positif Corona di Indonesia dan Arab Saudi adalah 161 kasus.
4. Selisih jumlah kasus orang meninggal dan sembuh di Thailand menempati peringkat ke-2.

Figure 3 Understanding Level Task Design

Translate

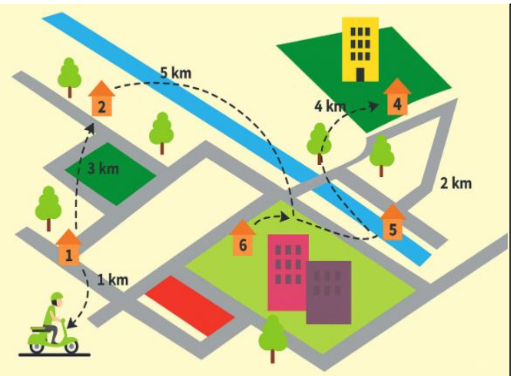


A number of neighboring countries of Indonesia were also struggling against Corona. The number of countries showed was not much different from Indonesia. Following the discusion, the data indicated was dated to April 8, 2020. However, the figures as of April 9, 2020 had not moved significantly from the previous data.

Based on the graph in Figure 1, the truth of the following statements was determined.

1. Malaysia had the highest number of positive cases of any country.
2. Cured cases in Indonesia were between Saudi Arabia and Singapore.
3. The difference between positive Corona cases in Indonesia and Saudi Arabia was 161 cases.
4. The difference in the number of cases of people dying and recovering in Thailand was ranked 2nd.

Figure 3 shows the design of a question in a true-false answer format, as an image of the cognitive level of understanding at the Understanding Aspect level (Bloom's Taxonomy), specifically the aspects of intelligence, analyzing, and evaluating. The question required students to read the graph carefully, understand the relationship between one data point and another, as well as determine the truth of the statement given based on the presented data. Since the answer category was true or false, this task did not require students to further explain the reason for the answers. The task was more focused on identifying true or false information from the data.

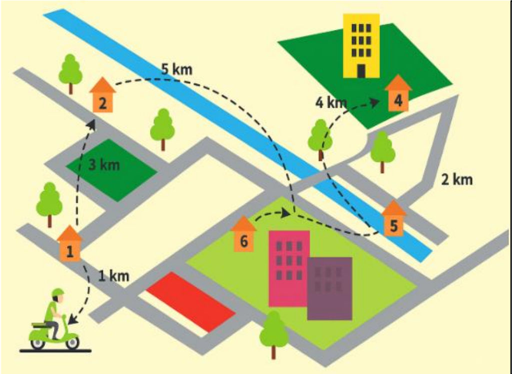


Pak Oni adalah seorang kurir barang yang bertugas mengantarkan barang-barang kepada pemesannya. Hari ini Pak Oni harus mengantarkan 6 paket ke alamat yang berbeda-beda. Untuk mengantarkan paketnya, Pak Oni menggunakan sepeda motor agar dapat menghemat biaya dan waktu tempuh. Rute yang harus ditempuh oleh Pak Oni dapat dilihat pada peta di samping.

Jika total waktu tempuh sepeda motor Pak Oni dalam menyelesaikan semua pengantaran adalah 1 jam, maka kecepatan rata-rata motor Pak Oni adalah ...

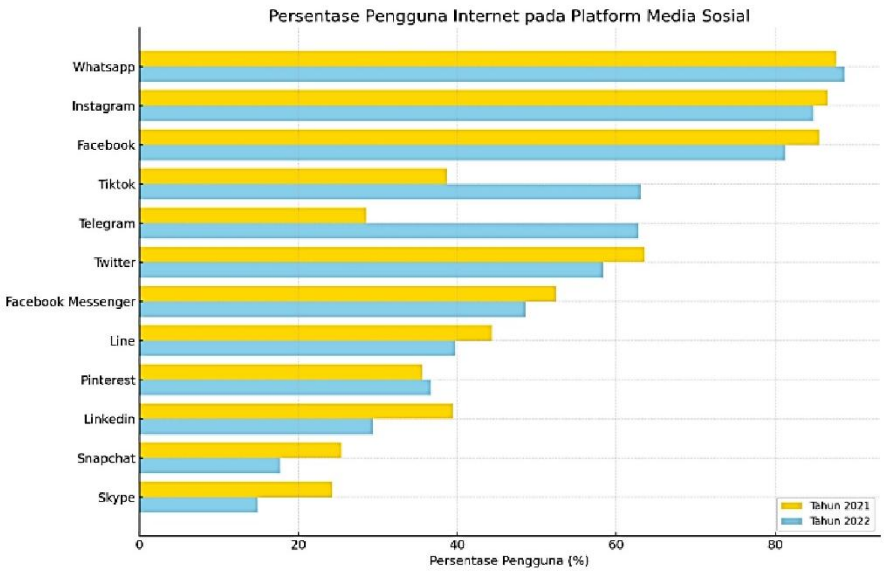
Figure 4 Application-Level Task Design

Translate



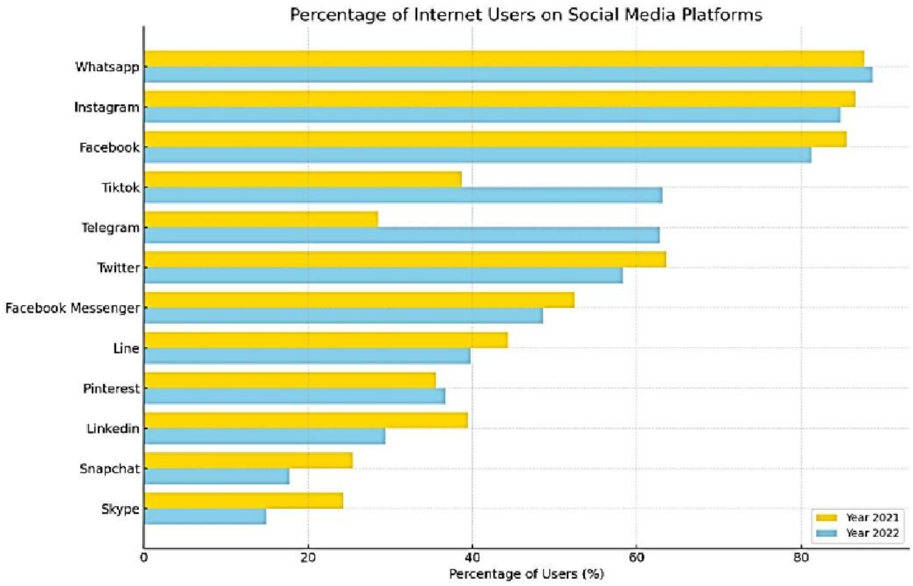
Mr. Oni is a courier whose job is to deliver goods to their customers. Today Mr. Oni has to deliver 6 packages to different addresses. To deliver the packages, Mr. Oni uses a motorcycle to save costs and travel time. The route that Mr. Oni must take can be seen on the map on the side. When the total travel time of Mr. Oni's motorcycle in completing all deliveries is 1 hour, then the average speed of the motorcycle is ...

Figure 4 shows the problem design in applying the concepts of speed and distance. Students were required to understand basic concepts, including basic remote sensing notions, problems, as well as practices, and to have the ability to apply basic concepts for solving problems based on instructions in text and maps. Through the context of real-world problems such as package delivery and route travel, these problems allowed students to connect theory with real descriptions as well as strengthen the understanding of mathematical comprehension from concept knowledge and its application in daily life.



Perhatikan gambar di atas!
Pada tahun 2021 dan 2022, Hootsuite mengeluarkan data tren tentang pengguna internet pada platform media sosial. Hootsuite menyajikan data tren seperti WhatsApp, Instagram, Facebook, Tiktok, Telegram, Twitter, Facebook Messenger, Line, Pinterest, Linkedin, Snapchat, dan skype.
Pilih setuju atau tidak setuju dan tulis penjelasanmu!
Seorang siswa ingin menggabungkan data pengguna media sosial bulan Januari 2021 dan Februari 2022 menjadi sebuah diagram batang. Ibu guru tidak menyarankan hal tersebut. Setujukah kamu dengan saran ibu guru? Jelaskan!

Translate



Take a look at the picture above!
In 2021 and 2022, Hootsuite released trend data about internet users on social media platforms. HootSuite presents trend data for various social media platforms, including WhatsApp, Instagram, Facebook, TikTok, Telegram, Twitter, Facebook Messenger, LINE, Pinterest, LinkedIn, Snapchat, and Skype.
Vote agree or disagree, and write your explanation!
A student wants to combine January 2021 and February 2022 social media user data into a bar chart. The teacher does not recommend it. Do you agree with the teacher's suggestion? Explain!

Figure 5 showed the design of the question with the aim of students being able to think critically and analyze social media trends. After being connected to Bloom's Taxonomy, this task was at the reasoning and evaluating level. Students were also asked to assess the actions taken by the teacher in terms of combining social media user data from two different times in addition to being asked to understand the data in the graph. When answering, students had to keep in mind aspects of data validity, whether there was a possibility of changing trends and the attractiveness of using bar charts to represent the data. This task developed analytical thinking skills in evaluating arguments based on the data that had been given and developed argumentation skills in explaining the reasons for agreeing or disagreeing with the statement.

Linkage of creativity in understanding (P1), application (P2), and reasoning (P3).

The results showed that designing numeracy tasks was closely related to the creativity produced by students. By designing tasks that varied according to context level, students developed creativity skills such as fluency, flexibility, and originality in their responses. Figure 6 shows the connection between creativity and context level during the analysis.

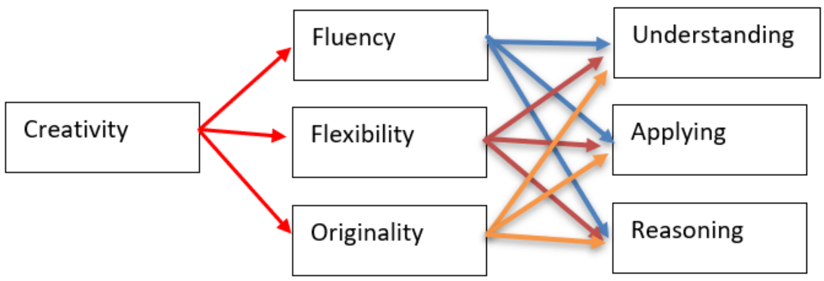


Figure 6 Connection chart between Creativity and context level

Figure 6 showed the relationship between creativity and indicators of fluency, flexibility, and originality in numeracy task design based on the context levels of understanding (P1), applying (P2), as well as reasoning (P3). In fluency indicator under the aspect of understanding (P1), students could think quickly and select patterns as well as basic concepts of statistical data. At the application level (P2), students used various alternative solutions to solve problems in real life. In addition, the action was easy to streamline thinking to accompany the exploration process using various principles in solving more complicated problems. Following the discussion, the analysis explained flexibility and its relationship with understanding (P1), application ability (P2), and reasoning ability (P3). Flexibility in understanding (P1) helped students connect various numeracy concepts. Additionally, the components in application (P2) allowed the use of different models to solve numeracy problems in real-world contexts. In reasoning (P3), flexibility was needed to test hypotheses, consider concepts as well as rules for various possible answers, and find alternative solutions to complex numeracy problems. The analysis also explained originality and its relationship with understanding (P1), application ability (P2), and reasoning ability (P3). Originality in understanding (P1) enabled students to find new ways of understanding mathematical concepts. In application (P2), students who had originality were certainly more capable of using creative methods to solve numeracy problems in a variety of ways. In reasoning (P3), originality allowed students to create strong arguments, develop broader thinking patterns, and generate solutions that had not been previously considered.

The results of this study show that the numeracy task designs produced by prospective mathematics teachers were still mostly at the levels of understanding and application context only. The percentage of numeracy task designs at the reasoning context level was only 23.8%, signifying that most of the tasks designed by prospective mathematics teachers still focused on understanding and application. Moreover, the percentage of tasks that required students to analyze, evaluate, and make decisions based on reasoning was lower. These results indicate that when mathematics learning only focused on understanding and application, then students learning mathematics were limited to procedural knowledge and were not inspired to think critically or solve more complex problems. This finding aligns with Leikin (2023), who emphasized that the creative process involves a combination of multiple skills or cognitive components including reasoning by fulfilling the indicators of fluency, flexibility, and originality. Giving assignments that showed student creativity developed thinking, reflection, and reasoning skills (OECD, 2022; Vale & Barbosa, 2024).

The limited number of numeracy tasks designed at the reasoning level may be due to most prospective mathematics teachers preferring to create problems that are more structured and procedural, rather than those that encourage creative thinking and the development of diverse solution strategies. The opinion was reinforced by Hovik & Nolan (2024), who stated that students should solve problems provided by teachers and develop creativity through problem-solving activities conducive to conceptual understanding in designing mathematics tasks. Following the discussion, creativity in numeracy tasks was essential in inspiring students to find different methods to solve problems, consider different points of view, as well as evaluate solutions based on logic and real context (Sari et al., 2024).

Creative math tasks included the ability to create problems that inspired critical thinking, exploration, and innovative problem-solving in addition to the usual procedural tasks. When the majority of tasks performed by students still focused on comprehension and application, this showed that the ability to create analytical and reflective tasks was not well developed (Wijayanti et al., 2022). Ordinary problems that required calculations or the application of formulas without a deep understanding of the concepts became a habit for students. In the long run, this attitude could cause students to fail in handling real-world situations that require numeracy-based problem-solving, data analysis, and logical argumentation (Emre-Akdoğan, 2023).

The limited number of tasks at the reasoning level showed that prospective mathematics teachers needed to improve the ability of students to construct more cognitively challenging problems. Strategies such as problem-based learning and contextual exploration in mathematics learning should be a major focus in the pre-service education curriculum for teachers (Widodo et al., 2023). Therefore, future educators are expected to design tasks that assess students' basic thinking abilities and encourage them to make more complex decisions in everyday life.

Conclusion

In conclusion, giving assignments to prospective mathematics teachers in designing context-based numeracy tasks is essential, based on the study results including the levels of understanding (P1) and application (P2). Based on the study data regarding the percentage of achievement for creativity indicators in posing numeration tasks, the average achievement for both fluency and flexibility indicators was 33.36%, while the originality indicator averaged 33.33%. The percentage of numeracy task designs based on the context levels of understanding and application amounted to 38.1%, while the reasoning level was 23.8%. These values showed the lack of numeracy task designs at the reasoning level could be caused by the tendency of the majority of prospective mathematics teachers to make problems that were more structural and procedure-based, compared to tasks challenging students to think creatively in developing diverse solution strategies. Therefore, educators need to provide strategies in mathematics learning to train student-teachers in designing tasks that explore the creativity of students by including context-based numeracy. These strategies should be the main focus in the education curriculum of prospective mathematics teachers. Through such strategies, prospective educators are expected to complete tasks that test the basic abilities of students to think and make more complex decisions in everyday life.

Future research should explore the development of learning models or strategies that enhance creativity in posing numeration tasks, as well as evaluate the implementation of context-based numeracy tasks in school settings. This recommendation is expected to further contribute to improving the quality of prospective mathematics teachers by helping them prepare numeracy tasks that demonstrate understanding and application, as well as inspire deeper reasoning and creativity in their students.

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