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# Aligning numeracy task design with SDG goals: Nutrition facts as a context for prospective mathematics teachers' problem posing

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## Abstract

Nutrition facts are the details on food packaging that describe its nutritional value, including serving size, calories, macronutrients like carbohydrates, protein, and fat, and micronutrients such as vitamins and minerals. These facts have mathematical concepts that can be utilized as a context for prospective teachers to create mathematical problems. By leveraging this real-world data, educators can contribute to multiple Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), by promoting nutritional awareness, and SDG 4 (Quality Education) by enhancing student engagement and understanding through relatable examples. This study examines the profile of mathematical tasks created by prospective mathematics teachers using nutrition facts as a context that meets numeracy task criteria. Data were collected from 62 mathematical tasks created by 31 prospective teachers attending a realistic mathematics education course on numeracy based on a problem-posing task at a public university in Surabaya, Indonesia. The posed tasks were categorized into solvable or unsolvable tasks and the domains of the level of context use and the level of cognitive processes. Results revealed that the level of context use in the posed tasks varied from zero to second order. Surprisingly, most of the tasks were in the first-order level context. Most posed tasks reached the application level, with only a few identified as reasoning tasks. Interestingly, some tasks coded as second-order context were classified as reasoning tasks. The study provides implications for designing numeracy tasks using nutrition facts and interventions in teacher education related to numeracy task design.

**Keywords**: Numeracy Tasks, Nutrition Facts, Problem Posing, Prospective Teacher, Quality Education

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Nutrition is an essential aspect of our lives and is crucial in maintaining our health and well-being (Ma & Zhuang, 2021). Understanding nutrition facts is essential for making informed decisions about what we eat and ensuring a balanced and healthy diet (Gao et al., 2021). Most of the nutrition-related details are summarized in the nutrition facts label that can be found on the product. This label usually contains the following elements: (1) information about the serving size, (2) data on the number of calories, (3) the percentage of the daily value (based on a 2000-calorie diet), (4) information about nutrients, and (5) a note containing the recommended daily values for 2000- and 2500-calorie diets (Rothman et al., 2006). Many people, however, require assistance in assessing and employing nutrition knowledge, mainly concerning mathematics and numeracy.

In recent years, there has been growing interest in using real-world contexts, such as nutrition, to support the development of students' numeracy skills (Blitstein et al., 2020). According to Wagner, those who practice mathematics in a specific cultural or disciplinary environment and try to respect its values gain a deeper grasp of mathematics and the context in which it is used (Michelsen et al., 2022). This emphasis has drawn many researchers and policymakers, notably in Indonesia, to create curricula and additional resources that promote the existence and durability of this kind of activity within educational classrooms (Zulkardi & Kohar, 2018). This approach involves designing mathematical tasks grounded in practical, everyday contexts, providing students with opportunities to develop their mathematical understanding and knowledge of the world around them (Wijaya et al., 2015; 2018).

One area where this approach has been auspicious is training prospective mathematics teachers. These individuals play a crucial role in fostering mathematical growth using context-based problems. According to several studies, several barriers can lead to a context-based problem. For instance, Paolucci and Wessels (2017) noted that although the item designers in their research were somewhat successful in building suitable and stimulating contexts, they needed to be more successful in converting these contexts into relevant problems. Additionally, Zulkardi and Kohar's (2018) research indicated that the prospective teacher needed help to ensure that language structure and context usage were realistic. It can be clearly seen that they must have a solid grasp of creating and implementing practical numeracy exercises.

The difficulties in creating numeracy tasks, mainly when using the context of nutrition facts, lie in how to translate the context into a collection of real-world tasks that adhere to the numeracy idea (Paolucci & Wessels, 2017). It can be viewed as a method to assess the authenticity of a problem situation (Sevinc & Lesh, 2017), where the level of authenticity of a given challenge in mathematics learning is comparable to the actual task in the simulated community (Palm, 2006). These specifications show how much context is used in mathematical tasks and how much problem-solving involves using context in cognitive processes when formulating a problem into mathematical form, solving it mathematically, interpreting the mathematical results, and validating the interpretation in the context of the original problem (Salgado, 2016).

The importance of conducting this study lies in recognizing that designing mathematics tasks is essential for teachers. It enables them to effectively design mathematical tasks based on a comprehensive understanding of the content, as well as contextual factors that include classroom and environmental conditions (context). It also considers students' unique circumstances (including considerations regarding cognitive abilities, developmental stages, and diverse backgrounds) (Taufiq et al., 2023). This study highlights the importance of providing prospective mathematics teachers with opportunities to work with real-world contexts, such as nutrition facts, when developing their problem-posing skills. The utilization of nutrition facts is mainly related to health/nutrition literacy (Gibbs et al., 2020). However, it is essential to recognize that to support the achievement of SDG 3, which targets good health and well-being (United Nations, 2015), there are potential avenues for integration in education. This integration can be realized by promoting mathematical literacy, aligning with SDG 4, which advocates for quality education (United Nations, 2015). By incorporating nutrition facts into mathematics education, students not only enhance their mathematical skills but also develop a critical understanding of health-related information (Gibbs et al., 2020; Malloy-Weir & Cooper, 2017), thus contributing to the broader agenda of supporting SDG 3.

The study's results revealed that the prospective teachers had varying levels of success when designing practical numeracy tasks based on nutrition facts. While some could create tasks well-aligned with mathematical concepts and focused on essential aspects of nutrition, others needed help to create meaningful or relevant tasks for students (Salgado, 2017; Sevinc & Lesh, 2022). By doing so, we can ensure that these future educators are well-equipped to design and implement practical numeracy tasks that engage students and support their mathematical development.

## METHODS

This paper employs a design research methodology to investigate the use of nutrition facts as a context for designing numeracy tasks and analyze the problem-posing abilities of prospective mathematics teachers. The study consists of a validation study in the initial stages, focusing on the design of numeracy tasks. The task development process involves task conceptualization, expert input, and task finalization. We implemented validity and reliability measures through content validity checks, expert review, pilot testing, and reliability assessment. The tasks are documented with clear instructions and sample questions. This validation study ensures the quality, relevance, and suitability of the numeracy tasks used to assess prospective mathematics teachers' problem-posing abilities in the context of nutrition facts.

### Participants

The participants in this study were 31 prospective mathematics teachers enrolled in the mathematics education program at The State University of Surabaya. The participants were selected because they were taking realistic mathematics education courses. In addition, the participants had also taken an assessment course, so they had experience in creating mathematical problems.

### Instruments

The instrument was in the format of a problem-solving task where participants had to pose two mathematics problems related to a nutrition facts context. The participants had approximately 30 minutes to complete the task. The task was evaluated by an expert in assessment from the same university as the first author by asking him to qualitatively review the initial draft of the instrument in terms of content, construct, and language.

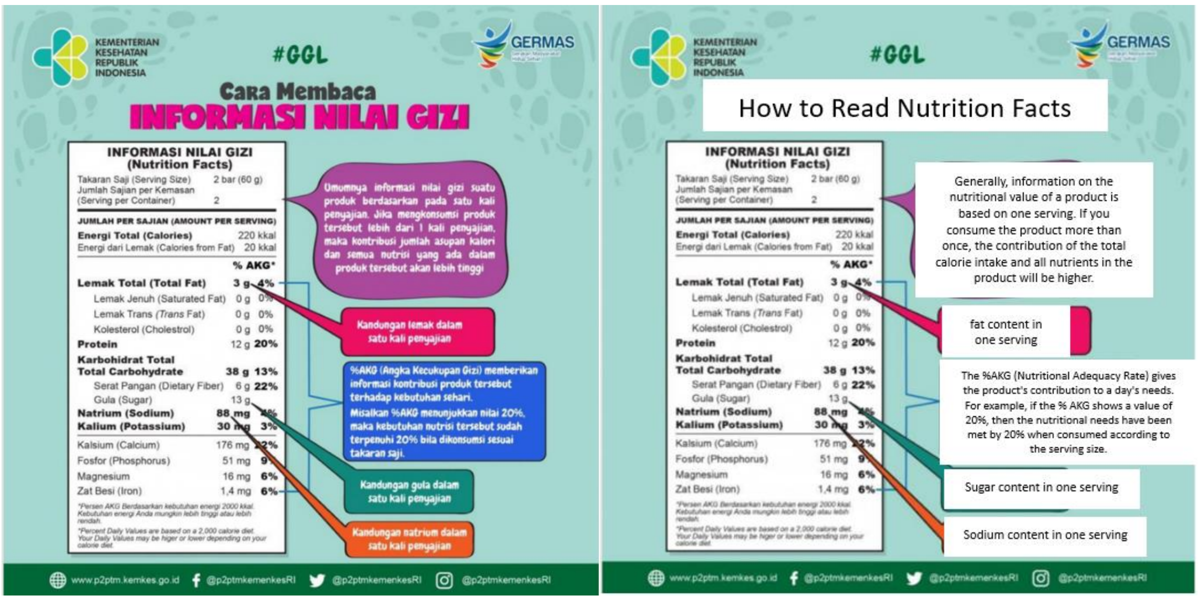



**Figure 1**. Illustration of how to read nutritional value information

Based on the review results, revisions were made, including adding two images reflecting the notion of nutrition facts to make the assignment more illustrative. The improved version of the problem-posing task is depicted in Figure 1 and Figure 2.


| NUTRITION FACTS | | |
|---|---|---|
| Serving Size | : 250 ml | |
| Serving per Container | : 1 | |
| **AMOUNT PER SERVING** | | |
| Calories | 180 kkal | |
| Calories from Fat | 20 kkal | |
| | | %AKG |
| **Total Fat** | **2 g** | **3%** |
| **Protein** | **6 g** | **9%** |
| **Total Carbohydrate** | **36 g** | **11%** |
| Dietary Fiber | 5 g | 17% |
| Sugar | 26 g | |
| **Sodium** | **90 mg** | **6%** |
| Potassium | 270 mg | 6% |
| Calcium | | 20% |
| Phosporus | | 25% |

*Percent Daily Values are based on a 2150 calorie diet. Your Daily Values may be higher or lower depending on your calorie diet.

**Figure 2**. Nutrition facts of a beverage product

A validity and reliability analysis was carried out to develop a problem-posing instrument with a high-quality nutrition facts context. The process of analyzing this instrument is not only carried out qualitatively but also quantitatively, especially in the aspects of validity and reliability. The instrument was assessed using the Aiken validity method to ensure content quality, in which three experts provided ratings. Two of them are lecturers specializing in mathematics education assessment, while the other is an expert in mathematics learning. As a result, the Aiken validity index reached 0.85, indicating that the instrument has good validity (Aiken, 1985).

Furthermore, in assessing its reliability, we applied the interrater reliability technique, which involves assessment from various experts. This technique resulted in a validity index of 0.91, confirming that the instrument is not only valid but also reliable (Gisev et al., 2013). Both indices revealed that this context-based problem-posing instrument, "nutrition facts," has met the quality standards and is ready for research.

## Data Collection

Participants were asked to design mathematical tasks based on nutrition facts. To do so, they were given sample nutrition facts labels and asked to create a mathematical task relevant to students and the answers. The task needed to incorporate at least one mathematical concept and be aligned with one or more learning goals in the Merdeka Curriculum. After designing their tasks, participants were asked to reflect on their process in a written statement. The reflection prompts asked them to describe their thought process, explain why they chose the task and context, and identify the level context of the task design.

## Data Analysis

The frequency of tasks developed by prospective teachers was categorized according to two domains: the level of context used in each discipline and the level of cognitive processes in each domain. Each task was first classified as solvable or unsolvable before being labeled in one of those two domains. Unsolvable problems (tasks) have clearer language, unstated crucial premises, or excessively complicated algebraic formulas (Kwek, 2015). The authors also considered a task item unsolvable if it contained inaccurate contextual, numerical, figural, tabular, or graphical information about nutrition facts, making it challenging to perform. In addition, the unsolvable task can also be caused by the lack of connection between the answer and the problem that has been created. Following this, the tasks classified as solvable tasks were split into two domains, each with an analytical description in Table 1.

**Table 1**. Dimensions of the analytical tool

| **Level of context use** (Salgado, 2016) | **Level of cognitive demand in numeracy exercises** |
|---|---|
| Zero-order<br>The ability to directly respond to or deduce directly from a mathematical problem's instructions is made possible by context. Therefore, assessing mathematical conclusions or arguments considering a problem's context is unnecessary. | Understanding<br>The task that evaluates students' comprehension of factual knowledge, operational techniques, and mathematical resources. |
| First-order<br>Context refers to the use of information, variables, or relationships that are relevant or selected for the mathematical formulation of a problem. It is also used to assess the suitability of the mathematical results. | Applying<br>The task that evaluates students' proficiency in utilizing mathematical principles in real-world situations or routine problem |
| Second-order<br>Context serves as the origin for defining or retrieving variables, assumptions, or relationships that are relevant for the mathematical formulation of a problem. Additionally, context is used to evaluate the appropriateness of the mathematical results or arguments with respect to the initial problem. | Reasoning<br>The task evaluates students' ability to use critical thinking to solve unfamiliar problems. |

Several procedures were taken to ensure the data's reliability. First, member checking ensured the data and interpretations were correct. Participants were given a summary of their responses and asked to confirm the accuracy of their responses. Second, a peer debriefing was employed to provide another point of view on the research method and findings. Third, an audit trail was kept documenting the research process and decisions.

## RESULTS AND DISCUSSION

### Distribution of Posed Problem Tasks

Out of the 62 task items, 50 (80.64%) were found to have a solution, while the remaining 12 (19.36%) were unsolvable. As we were focused only on the solvable tasks, we disregarded the unsolvable ones in our subsequent analysis.

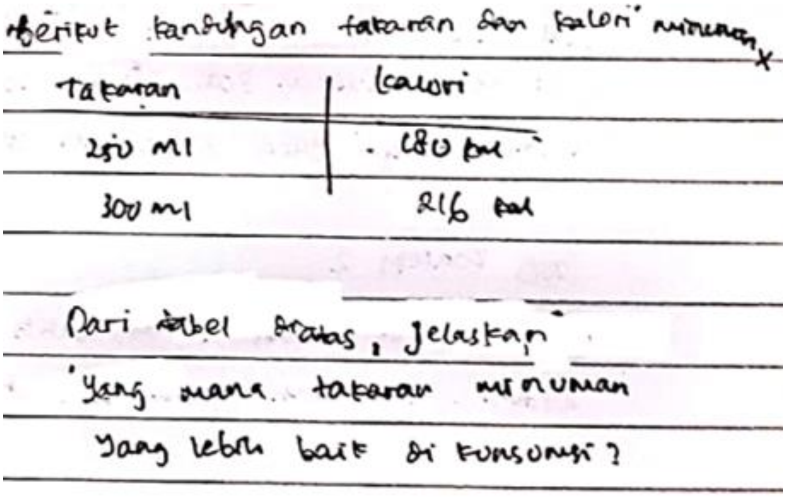
Table 2 presents information on how solvable tasks are distributed based on the level of context usage and cognitive processes involved. It reveals that most task items (58%) involve a first-order use of context, and a significant proportion of tasks (46%) require the problem-solving skill of 'applying.'

**Table 2.** Distribution of posed problem tasks

| | Understanding | Applying | Reasoning | The level of task contexts |
|---|---|---|---|---|
| Zero-order | 3 (6%) | 4 (8%) | 0 (0%) | 7 (14%) |
| First-order | 10 (20%) | 16 (32%) | 3 (6%) | 29 (58%) |
| Second-order | 0 (0%) | 3 (6%) | 11 (22%) | 14 (28%) |
| The level of cognitive process | 13 (26%) | 23 (46%) | 14 (28%) | 50 (100%) |

## The Posed Tasks Unsolvability

Although the percentage of unsolvable tasks is relatively low (19.36%), paying attention to the characteristics of tasks developed by prospective teachers is essential. Figure 3 and Figure 4 highlight some of the factors that contribute to task unsolvability.


Berikut kandungan takaran dan kalori minuman X

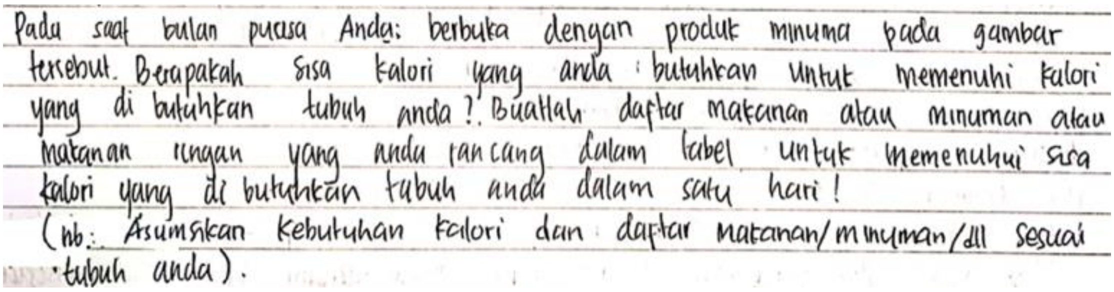
| Takaran | Kalori |
|---|---|
| 250 ml | 180 kal |
| 300 ml | 216 kal |

Dari tabel diatas, jelaskan yang mana takaran minuman yang lebih baik di konsumsi?

*Translation: The following are the dosage and calorie content of a drink X, from the table above, explain which dosage is better for consumption.*

**Figure 3**. The examples of an unsolvable problem 1

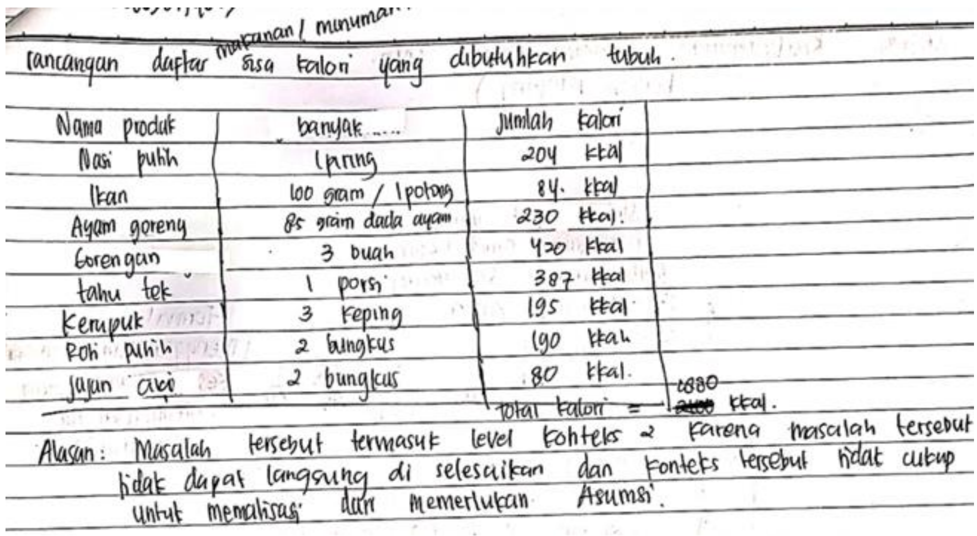
In this task, participants were instructed to create a second-order level task. However, Figure 3 was classified as unsolvable due to the absence of essential assumptions, such as the type of drink with the optimal consumption dosage. This lack of information made the task impossible to solve. Additionally, unclear wording was identified in the task question, "Which dosage is better for consumption," which could be interpreted differently, such as selecting the drink with the highest calorie content or finding the optimal ratio between dosage and calorie. Consequently, participants had difficulty distinguishing between assumptions necessary to complete the task and general assumptions for second-order tasks.


Pada saat bulan puasa Anda: berbuka dengan produk minuma pada gambar tersebut. Berapakah sisa kalori yang anda butuhkan untuk memenuhi kalori yang di butuhkan tubuh anda?. Buatlah daftar makanan atau minuman atau makanan ringan yang anda rancang dalam tabel untuk memenuhi sisa kalori yang di butuhkan tubuh anda dalam satu hari!
(nb: Asumsikan kebutuhan kalori dan daftar makanan/minuman/dll sesuai tubuh anda).

*Translation: During the fasting month, you break your fast with the beverage product in the picture. How many calories do you need to fulfill the calories your body needs? Make a list of foods, drinks, and snacks you design on a table to meet the remaining calories your body needs in one day! (Assume your calorie needs and food/drink/etc. The list is appropriate for your body).*

**Figure 4**. The examples of an unsolvable problem 2

The issue of unstated assumptions is also observed in another unsolvable second-order task (Figure 4), similar to the first problem. Some crucial information must be included to solve the problem, such as the number of calories in each food. Moreover, a few tasks need more information, which leads to their unsolvability.


rancangan daftar makanan/minuman sisa kalori yang dibutuhkan tubuh.

| Nama produk | banyak .... | jumlah kalori |
|---|---|---|
| Nasi putih | 1 piring | 204 kkal |
| Ikan | 100 gram / 1 potong | 84. kkal |
| Ayam goreng | 85 gram dada ayam | 230 kkal |
| Gorengan | 3 buah | 420 kkal |
| tahu tek | 1 porsi | 387 kkal |
| Kerupuk | 3 keping | 195 kkal |
| Roti putih | 2 bungkus | 190 kkal |
| Jajan aci | 2 bungkus | 80 kkal |
| | | Total kalori = 1880 kkal. |

Alasan: Masalah tersebut termasuk level konteks 2 karena masalah tersebut tidak dapat langsung di selesaikan dan konteks tersebut tidak cukup untuk memalisasi dan memerlukan asumsi.

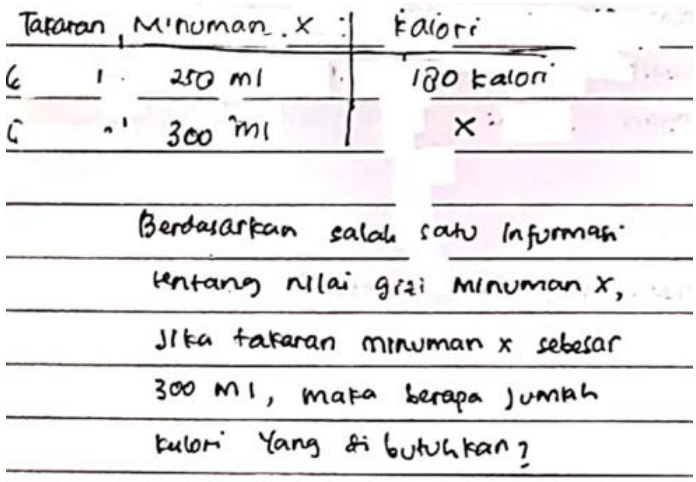
*Translation: Draft a list of foods/drinks remaining calories the body needs*.

**Figure 5**. The examples of alternative answers to unsolvable task 2

Surprisingly, Figure 5 shows that participants were able to create alternative answers to the unsolvable task. Because participants believe that the context was not mathematized enough and requires assumptions, it is a second-order category problem. It is implied by the participant's answer, which states to assume the calories according to the body's needs and assume the list of foods along with the calories contained. The latter is information that must be given to students because of facts or information that supports students' answers.

## The Level of Context Utilization in Numeracy Tasks

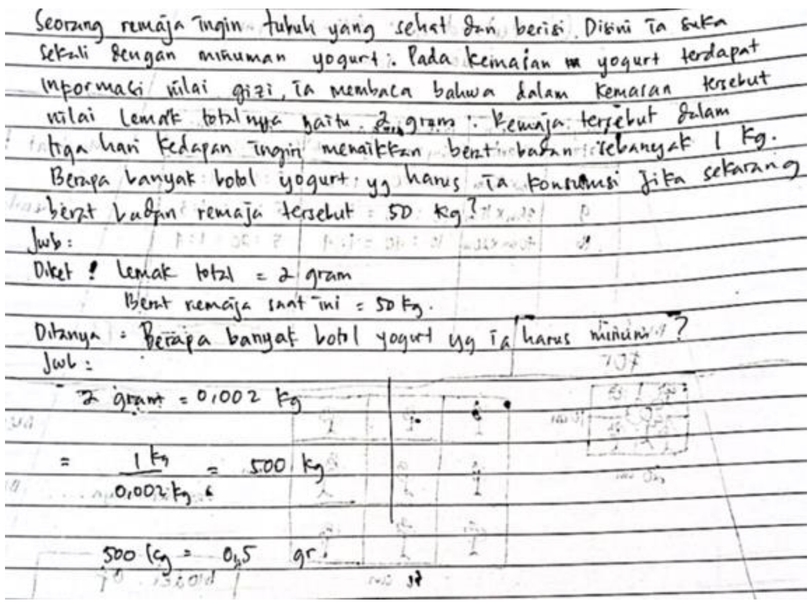
Several instances of tasks produced by participants concerning their level of context usage are respectively presented in Figure 6, Figure 7, Figure 8, and Figure 9.




*Translation: Based on one piece of information about the nutrition fact of drink x, how many calories are needed if the dose of drink x is 300 ml?*

**Figure 6**. The examples of zero-order task 1

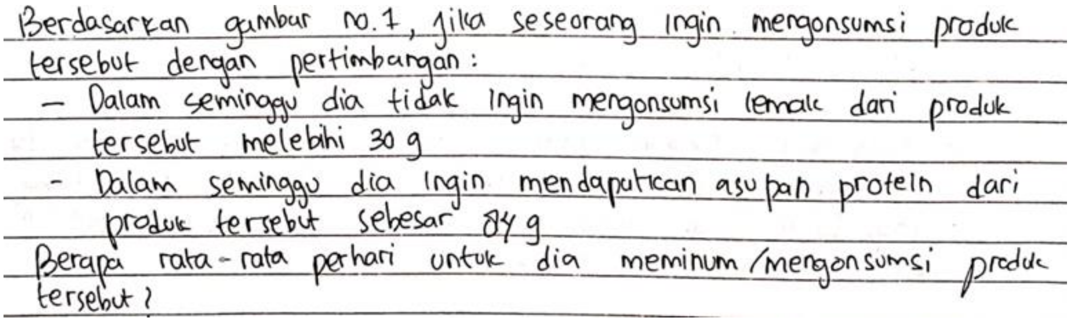
The utilization of nutrition facts to determine the calorie dosage in drink X needs to be more evident. In other words, whether the nutrition facts are applied or not, it does not affect the approach used by solvers to find the requested calorie dosage. Students could directly rely on the concept of value comparison. A similar observation is also illustrated in Figure 7.




*Translation: A teenager wants a healthy body. Here, he likes yogurt drinks. On the yogurt package, there is nutritional value information; he reads that the package has a total fat value of 2 grams. The teenager wants to gain 1 kg of weight in the next three days. How many yogurt bottles should he consume if he currently weighs 50 kg?*

**Figure 7**. The examples of zero-order task 2 and the alternative answer provided

Although the task presented in Figure 7 can be solved using mathematical methods, it does not necessitate the utilization of the nutrition facts context found in food labels. The problem formulation stage and the interpretation of the mathematical results to real-world scenarios do not require incorporating the nutrition facts context mentioned in the problem. Another type of task that exemplifies zero-order contexts is those that demand high cognitive effort but lack mathematization, such as finding a diet based on nutrition facts. Despite the presence of the nutrition facts context in the task, solvers can derive a solution without relying on that information. It can also be seen from the alternative answer proposed by the participant that does not use the context of nutrition facts. Participants directly perform mathematical procedures in general without the mathematization process.

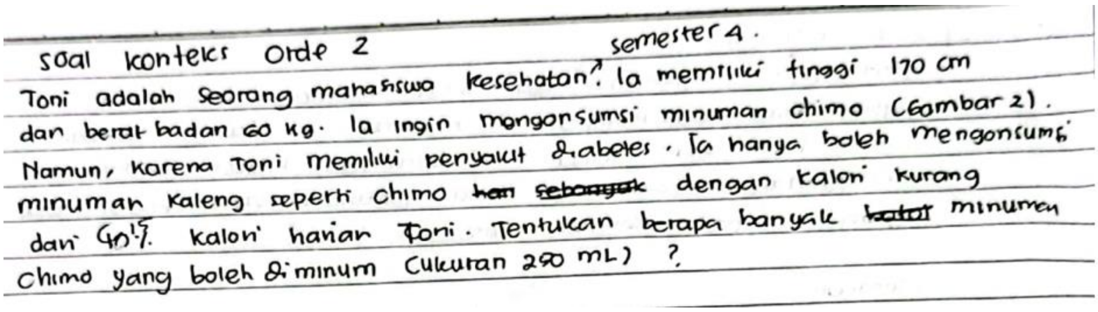

Berdasarkan gambar no.1, jika seseorang ingin mengonsumsi produk tersebut dengan pertimbangan:
- Dalam seminggu dia tidak ingin mengonsumsi lemak dari produk tersebut melebihi 30 g
- Dalam seminggu dia ingin mendapatkan asupan protein dari produk tersebut sebesar 84 g

Berapa rata-rata perhari untuk dia meminum/mengonsumsi produk tersebut ?

*Translation: Based on the nutrition facts picture provided, if someone wants to consume the product with consideration, In a week, he does not want to consume fat from the product exceeding 30 grams and wants to get a protein intake from the product of 84 grams. What is the average daily for him to drink/consume the product?*

**Figure 8**. The examples of first-order task

Figure 8 shows that the problems created use the context of nutrition facts. It causes the solver to use information about protein and sugar in food labels for the mathematical formulation of a problem. Context is also used to assess the appropriateness of the mathematical results done by students. Therefore, the Figure 8 problem is categorized as a first-order task.


soal konteks Orde 2 semester 4.

Toni adalah seorang mahasiswa kesehatan? Ia memiliki tinggi 170 cm dan berat badan 60 kg. Ia ingin mengonsumsi minuman chimo (Gambar 2). Namun, karena Toni memiliki penyakit diabetes. Ia hanya boleh mengonsumsi minuman kaleng seperti chimo ~~kan sebanyak~~ dengan kalori kurang dari 15% kalori harian Toni. Tentukan berapa banyak ~~kotak~~ minuman chimo yang boleh diminum (ukuran 250 mL) ?

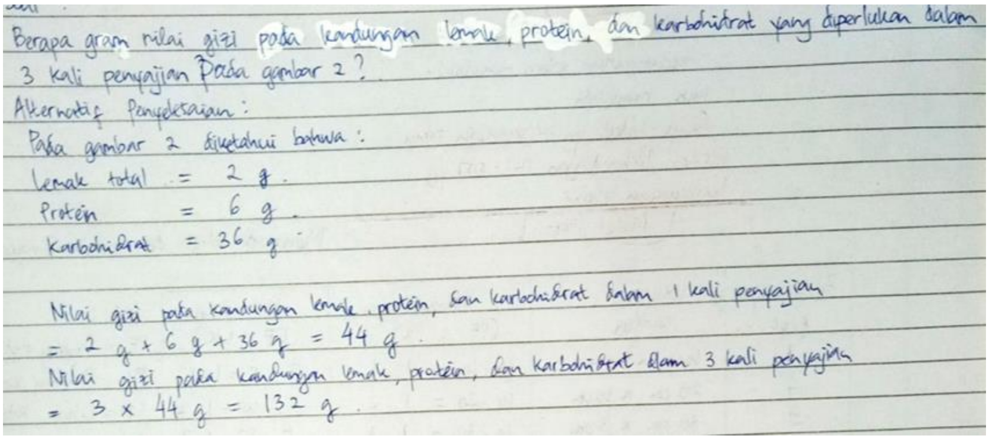
*Translation: Toni is a 4-semester student in the health department. He is 170 cm tall and weighs 60 kg. In addition, Toni wants to consume a yogurt drink with the nutritional content shown in the picture. However, because Toni has diabetes, he can only consume yogurt drinks with calories less than 15% of Toni's daily calories. Determine how much yogurt he can drink (250 ml size).*

**Figure 9**. The examples of second-order task

The activity, daily calories, and medical history are necessary to find the maximum number of drinks consumed according to the relevant nutrition facts in the task's context in Figure 9. However, the information must arrive at a specific strategy that leads the problem solver to find the solution. To find the maximum number of drinks consumed, the solver needs to identify possible daily activities and calories that cover all activities the college student performs outside the information. Therefore, the solver must extract additional information regarding daily activity and calories. Therefore, this task is coded as a task with second-order context.

## The Level of Cognitive Processes in Numeracy Tasks

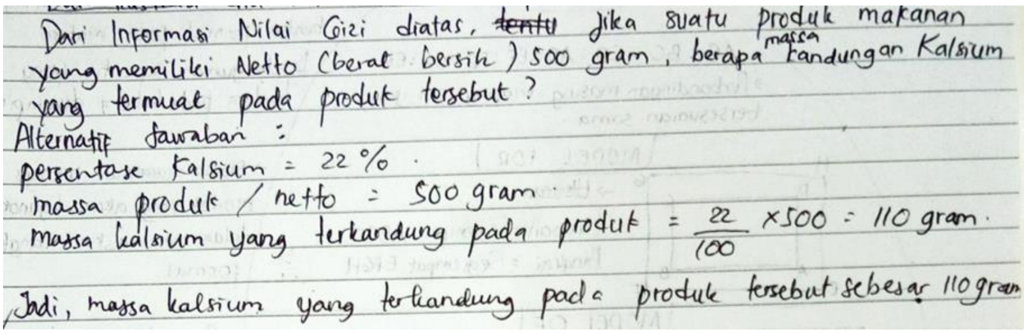
Figure 10 to Figure 12 present several task examples created by prospective teachers, showcasing different levels of cognitive processes. For instance, the task depicted in Figure 10 evaluates students' comprehension of procedural skills, specifically counting basic integer operations to determine the total consumption of fat, protein, and carbohydrates.


Berapa gram nilai gizi pada kandungan lemak, protein, dan karbohidrat yang diperlukan dalam 3 kali penyajian pada gambar 2?
Alternatif Penyelesaian:
Pada gambar 2 diketahui bahwa:
Lemak total = 2 g.
Protein = 6 g.
Karbohidrat = 36 g.
Nilai gizi pada kandungan lemak, protein, dan karbohidrat dalam 1 kali penyajian
= 2 g + 6 g + 36 g = 44 g.
Nilai gizi pada kandungan lemak, protein, dan karbohidrat dalam 3 kali penyajian
= 3 x 44 g = 132 g.

*Translation: How many grams of nutritional value in fat, protein, and carbohydrate are needed in 3 servings in the picture?*

**Figure 10**. Understanding task 1

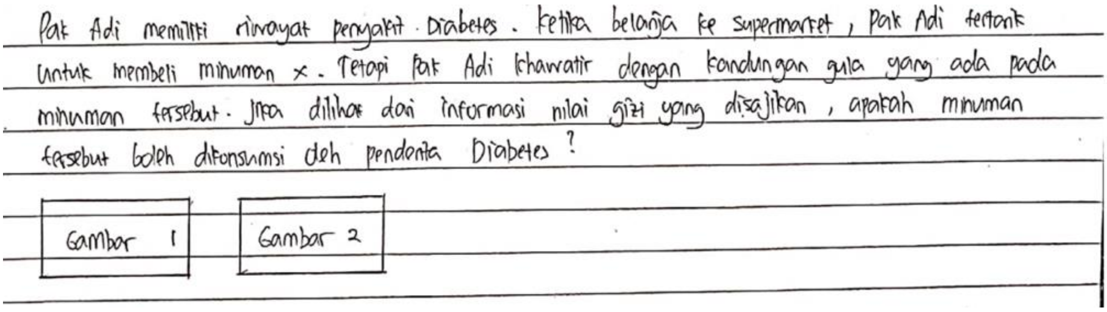
It is clear that no matter the BMR or daily calories needed by each person, each drink has its own fat, protein, and carbohydrate content according to the nutrition facts label. So, if a person drinks three drinks, the calorie content is simply multiplied by the number of drinks drunk. Thus, this task is labeled as an 'understanding' task.


Dari Informasi Nilai Gizi diatas, ~~tentu~~ jika suatu produk makanan yang memiliki Netto (berat bersih) 500 gram, berapa massa kandungan Kalsium yang termuat pada produk tersebut?
Alternatif Jawaban:
persentase Kalsium = 22 %.
massa produk / netto = 500 gram
massa kalsium yang terkandung pada produk = $\frac{22}{100} \times 500$ = 110 gram.
Jadi, massa kalsium yang terkandung pada produk tersebut sebesar 110 gram

*Translation: From the nutrition facts in the picture above, if the food product has a net weight of 500 grams. What is the mass of calcium content contained in the product?*

**Figure 11**. Understanding task 2

Figure 11 illustrates another task that falls under 'understanding.' The question is derived from examining the provided image of the nutrition facts label. In this case, a solver can quickly determine the product's calcium by looking at the image. In addition, the problem depicted in Figure 8 presents a straightforward scenario that challenges the solver to utilize the value comparison rule to determine the calorie composition of drink X compared to similar products with varying volume packaging. Therefore, the solver must ascertain the calorie composition by comparing the volume of drink X's packaging with the preexisting calorie information provided on the label.


Pak Adi memiliki riwayat penyakit Diabetes. Ketika belanja ke supermarket, Pak Adi tertarik untuk membeli minuman x. Tetapi Pak Adi khawatir dengan kandungan gula yang ada pada minuman tersebut. Jika dilihat dari informasi nilai gizi yang disajikan, apakah minuman tersebut boleh dikonsumsi oleh penderita Diabetes?

Gambar 1 Gambar 2

*Translation: Mr. Adi has a history of diabetes. While shopping at the supermarket, he was interested in buying drink X, but he was worried about the sugar content in the drink. Based on the nutritional value information presented, can the drink be consumed by people with diabetes? (Figure 1 refers to an Illustration of how to read nutritional value information, and Figure 2 refers to nutrition facts on the drink X label).*

**Figure 12**. Reasoning task

Figure 12 depicts that the condition of people with diabetes can consume the drink, which refers to a reasoning task level because it requires the individual to analyze and draw conclusions based on the information. It involves using logical reasoning skills to assess the sugar content of the drink and determine its suitability for individuals with diabetes. The solver should compare it to the dietary recommendations or restrictions for individuals with diabetes. This reasoning task requires the solver to interpret the information, consider the potential impact of sugar on blood glucose levels, and decide whether the drink is suitable for the given condition. By evaluating the sugar content and applying reasoning skills, the solver can determine if the drink meets the requirements for individuals with diabetes. This reasoning task goes beyond simple recall or identification of facts and involves analyzing, evaluating, and making judgments based on the information provided.

## Discussion

Based on the study's findings, creating numeracy tasks with nutrition facts as the context is challenging. The results show that only a few tasks reach the highest level of context use and cognitive processes, which require mathematization and promote reasoning skills among students. This discovery raises concerns about the use and impact of context, which will be further discussed.

During the assignment of this context to students, limited research is available regarding the review of nutrition facts. Even considering the context's authenticity in the task design, understanding these nutrition facts seems to be complicated. Several research studies have indicated that consumers encounter challenges when utilizing the information displayed on nutrition labels (Huizinga et al., 2009; Mansfield et al., 2020). The primary factors contributing to the limited use of nutrition labels include time constraints, small print size, difficulties in understanding the terminology used, and concerns regarding the accuracy of the information presented (Cowburn & Stockley, 2005; Grunert et al., 2010). However, nutrition facts provide valuable information regarding our food's nutritional content, including details such as calories, fat, protein, and carbohydrates. By understanding these facts in a numeracy task, participants can make informed choices regarding their diet and adopt a healthy lifestyle (Rothman et al., 2006). Hence, when designing numeracy tasks using nutrition facts as the context, it is important for prospective teachers to also consider the decision-making aspects associated with the context. Moreover, it involves selecting food compositions that align with the calculation aspects derived from the context, as exemplified in the tasks proposed within this study.

The study's results revealed that all the first-order context tasks were application tasks created by prospective teachers, which is almost 32%. This finding indicates that the prospective teachers in the study were able to effectively incorporate real-world applications of numeracy skills using the context of nutrition facts. This argument is supported by the theoretical statement that designing context tasks requires students to apply their mathematical knowledge and skills in the context (Nijlen & Janssen, 2015) and to enhance students' understanding and ability to use numeracy skills in real-life scenarios (Wang & Li, 2014). It aligns to promote mathematical literacy and numeracy skills transferable to everyday life.

Some of the problems posed by prospective mathematics teachers showed a positive correlation between the context of nutrition facts and the Sustainable Development Goals (SDGs), especially regarding health and well-being (SDG 3) (Follong et al., 2020b). The pre-service mathematics teachers who developed problems based on the "nutrition facts" context improved their mathematical understanding and promoted awareness about healthy dietary patterns, calorie needs, and healthy sugar consumption limits. With this, mathematics education serves as a tool to improve numerical literacy and as a platform to educate and equip individuals with skills and knowledge that support healthy lifestyles (Follong et al., 2020b; Stage et al., 2018). It aligns with the SDG target to ensure healthy lives and promote well-being for all ages (Follong et al., 2020a). As such, this approach expands the scope and impact of mathematics education in a broader and socially relevant context.

The data reveals that while the proportion of second-order tasks remains relatively high, there are noteworthy observations regarding incomplete tasks (19.36%) and the relatively frequent use of zero-order context tasks (14%). In a 2010 report, the Organization for Economic Cooperation and Development (OECD) emphasized avoiding zero-order context tasks in numeracy task design (OECD, 2010). These tasks do not stimulate higher-level mathematical thinking but focus on basic concept comprehension (Salgado, 2017). Utilizing such tasks may impede the development of critical thinking and mathematical problem-solving skills in students (Guo et al., 2020). Although second-order tasks still dominate, incomplete tasks suggest a need to revise the task design provided to students. It could be linked to an inadequate understanding of concepts or challenges in applying relevant mathematical formulas (Guo et al., 2020). When designing numeracy tasks, it is crucial to foster second-order tasks that involve problem-solving, critical thinking, and the application of mathematical concepts within more complex contexts.

Therefore, the findings of this study serve as an important warning for teacher education programs to focus on improving the skills of prospective teachers in formulating numeracy tasks that meet the criteria of effective numeracy tasks. Since problem-posing is recognized as a multifaceted and complex task, addressing issues related to this phenomenon requires interventions that enhance prospective teachers' ability to use authentic contexts for mathematization, reduce reliance on excessive task information, unfamiliar terminology, vague contextual units, and inappropriate use of mathematical symbols (Crespo & Harper, 2020; Kohar et al., 2022). Additionally, engaging prospective teachers in collaborative problem-posing activities can be beneficial. Furthermore, to enhance the level of contextual use, it is recommended that designers of mathematical literacy (numeracy) tasks simplify complex real-world contexts and associated stimuli while incorporating mathematical information to ensure accessibility for students while still maintaining authenticity.

While this study provides additional insights into the degree to which numeracy tasks designed by prospective teachers meet the criteria of practical numeracy tasks, there is a need for improvement in the methodology and data sampling. Therefore, further research is required, such as employing more advanced statistical procedures to examine the correlation between the level of contextual use and the cognitive processes involved in tasks created by prospective teachers and involving a larger sample size to enhance the external validity of the findings.

## CONCLUSION

Overall, the findings from this study reveal that most of the tasks submitted by prospective mathematics teachers are solvable but often need more incorporation of additional information essential for a robust mathematical process. It underscores the importance of further training and guidance for prospective mathematics teachers to improve the validity and depth of their numerical tasks. Moreover, the prevalence of tasks that fall into the first-order context use category confirms the relevance of context in problem-solving, even when not explicitly stated.

Relating it to the context of nutrition information, this finding is relevant to the Sustainable Development Goals (SDGs), specifically SDG 2 (No Hunger) and SDG 3 (Good Health and Well-Being). Nutrition information plays an essential role in encouraging healthy eating habits and ensuring access to nutritious foods, in line with the goal of SDG 2. Furthermore, the ability to create robust mathematical tasks related to nutrition information can contribute to a better understanding of nutritional choices and their impact on overall health, thus supporting the goal of SDG 3. Therefore, improving the quality of numerical tasks, mainly when applied to contexts such as nutrition information, can advance progress towards achieving these SDGs.

For future research, it is recommended to provide more intensive training to prospective mathematics teachers in developing quality numerical tasks with attention to essential elements such as using appropriate mathematical language and adding relevant information. In addition, there is a need to explore more effective ways to integrate real-world contexts, such as nutrition information, into mathematical tasks so that students or prospective mathematics teachers can better relate them to everyday life. Further analysis of the cognitive level of the proposed tasks is also needed to understand how much they encourage critical thinking and problem-solving. It will help improve the quality of mathematics education and learning for future mathematics teachers.

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## Declarations

| | | |
|---|---|---|
| Author Contribution | : | YMS: Conceptualization, Writing - Original Draft, Editing and Visualization.<br>AWK: Conceptualization, Writing the Instruments.<br>YIE: Writing - Review & Editing.<br>SF: Formal analysis, and Methodology.<br>DSR: Validation and Supervision |
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