Implementing Snack Food Composition Label Analysis for Numeracy Learning in Elementary School: A Study in Teacher Professional Education

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Abstract
The use of authentic contexts in numeracy learning is important to help prospective elementary school teachers design meaningful and contextual mathematics instruction. However, a gap remains in the literature regarding how prospective teachers perceive the feasibility and potential of authentic context-based numeracy activities. This study aimed to explore how elementary student teachers in a Teacher Professional Education (TPE) program perceive the feasibility and potential of implementing the activity "Analysis of Composition Labels of Snack Foods" as a vehicle for promoting numeracy learning. A descriptive qualitative method was employed, involving 57 TPE students who completed a perception questionnaire following the learning activity. Data triangulation was conducted through semi-structured interviews and classroom observations. Quantitative data were analyzed using descriptive statistics, while open-ended responses were analyzed through content analysis using NVivo 12. Findings revealed that 92.98% of participants regarded the activity as feasible and relevant for initial numeracy assessment, recognizing its contextual nature, engaging quality, and ease of implementation. The activity was found to support the development of cognitive and practical skills, including proportional reasoning, unit conversion, critical thinking, and data interpretation. Furthermore, the activity demonstrated applicability across multiple elementary school subjects, reflecting its potential as a cross-curricular instructional approach. These findings suggest that snack food composition label analysis is a feasible and beneficial learning activity that can be meaningfully integrated into core elementary mathematics topics, including fractions, measurement, and data presentation.

1. Introduction

Mastery of numeracy literacy is a key competency in 21st-century education. This competence contains not only numerical ability, but also the capability to interpret and evaluate data for application in daily life (Iswara et al., 2022; Rahmadeni et al., 2023; Rakhmawati & Mustadi, 2022). In this study, numeracy is the ability to understand, utilize, and reason about numerical information in everyday situations including the ability to interpret data, reason proportionally, and make quantitative comparisons (Goos et al. 2020; OECD, 2021). Despite its importance, research indicates that student teachers struggle to connect mathematics and real-world situations (Anggraini et al., 2025; Borji et al., 2025; Sen Zeytun et al., 2024; Winarni et al., 2025). When numeracy is taught without authentic context, students tend to graduate with limited applied mathematics literacy. Grounding numeracy instruction in real-life experiences, by contrast, fosters deeper conceptual understanding and greater cognitive engagement among prospective teachers.

One promising avenue for contextualizing numeracy instruction is the use of real-world objects such as food composition labels. These materials contain rich quantitative information including quantitative information including nutritional composition, ingredient ratios, and measurement units that can effectively engage learners in authentic mathematical reasoning. Research has shown that authentic, real-life learning materials offer prospective teachers stronger conceptual understanding and deeper cognitive involvement, equipping them to design more meaningful and contextual instruction (Putra et al., 2025). Interdisciplinary educational interventions using food labels have been found to be motivating and enriching, actively involving learners and improving content integration across subject areas (Castagnoli et al., 2023). However, the potential of such materials as pedagogical tools within teacher professional education programs remains considerably underexplored, particularly regarding how pre-service teachers engage with and respond to authentic, context-based numeracy activities as part of their professional preparation.

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Many recent studies emphasize the use of real-world context in the learning of numeracy. According to González-Polo et al. (2025), students are able to improve their proportional reasoning and data interpretation skills by using the nutrition label in their context. However, there are still many students who struggle to even use any sort of numerical understanding in order to make a rational decision. Sari et al. (2024) also stated that the numeracy tasks made by pre-service teachers using nutrition facts are very basic in terms of real-world application and are very low in terms of the consideration of the higher order thinking. The challenges faced by students in real life application of evaluating and interpreting a ratio and percentages, specifically about portion size and percentage daily value has also been documented (Miller, 2014; Miller et al., 2017). The studies inspire the need to focus on the learning of numerical information and using it in context. To map the research landscape on this topic, a bibliometric analysis was conducted using VOSviewer based on 1,000 articles retrieved from Google Scholar using the keywords numeracy and elementary school, published between 2021 and 2026 (Figure 1).

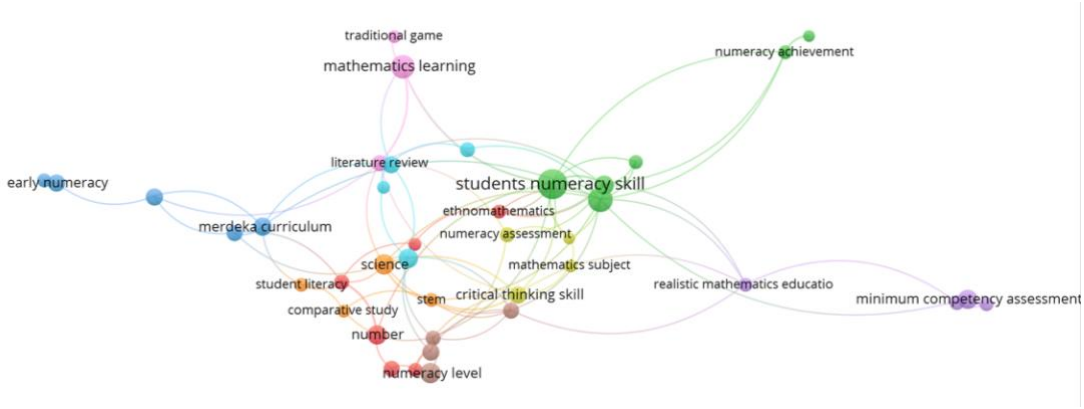

Figure 1. VOSviewer Bibliometric Map of Research on Numeracy in Elementary School

As illustrated in Figure 1, the visualization revealed that the most prominent research cluster centers on students' numeracy skills, connected to themes such as mathematics learning, critical thinking skills, numeracy assessment, ethnomathematics, and realistic mathematics education. Additional clusters highlight topics including *Merdeka Curriculum*, student literacy, STEM, and minimum competency assessment. Notably, while existing research demonstrates a rich body of literature on numeracy skill measurement and curriculum-based approaches, studies focusing on the use of real-world contextual materials such as snack composition label analysis as a learning medium remain scarce. Furthermore, research addressing the implementation of contextual numeracy activities in teacher professional education programs is considerably underrepresented in the existing literature. These gaps are particularly evident in the Indonesian context, where the development of contextual learning approaches in elementary mathematics education has gained increasing attention. Preliminary studies suggest that such approaches can increase the motivation of learners and their numeracy skills (Jazuli et al., 2017; Nurlita & Jailani, 2023; Sari et al., 2024). Nevertheless, little of this research addresses the needs of teacher education, especially given the importance of such experiences for designing and implementing contextual approaches to numeracy education.

Despite the growing literature on numeracy learning, a critical gap persists in teacher professional education research. Existing studies predominantly focus on measuring students' numeracy outcomes or designing school-based numeracy tasks (González-Polo et al., 2025; Sari et al., 2024), with few examining how pre-service teachers themselves engage with authentic, context-based numeracy activities during their professional preparation. Moreover, while food composition labels are recognized as valuable sources of quantitative information, their role as pedagogical tools in teacher education programs has yet to be systematically investigated. The bibliometric findings in this study confirm that research at the intersection of contextual numeracy materials and teacher professional education is markedly underrepresented. This gap is significant: pre-service teachers' acceptance of and engagement with contextual activities directly shapes how such approaches are implemented in actual classroom practice.

Addressing this gap, the present study examines the use of snack food composition label analysis as a contextual numeracy activity within a Teacher Professional Education program. Therefore, this study aims to examine: (1) the feasibility of snack food composition label analysis as an initial numeracy assessment, (2) the cognitive and practical skills developed through the activity, and (3) its potential application across elementary school subjects, as experienced by pre-service teachers in a Teacher Professional Education program. Unlike previous studies that focus on student outcomes or task design, this study offers new insights into prospective teachers' responses to a pre-defined contextual activity. This factor is relevant as whether a teacher accepts an activity or not should contribute considerably in determining the extent to which such approaches will be implemented in the real enactment of classroom activities.

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2. Method

2.1. Research Design

This study uses a descriptive qualitative method to examine the implementation of snack food composition label analysis as a contextual numeracy learning activity among pre-service teachers in the Teacher Professional Education (TPE) Program. A qualitative approach was selected because the study seeks to explore participants' experiences, responses, and perspectives toward a pre-defined learning activity, which requires an in-depth and contextual understanding of phenomena that cannot be adequately captured through quantitative measures alone. This method gives a systematic and factual account of the phenomena derived from participants' reflections and assessments of the learning activity (Sugiyono, 2021).

2.2. Participants

The participants of this study were 57 active pre-service teachers (49 female, 8 male) enrolled in the Teacher Professional Education (TPE) Program in Elementary School Teacher Education at a private university in Bandung, Indonesia, all of whom were taking the Principles of Teaching and Assessment course at the time of the study. Participants ranged in age from 23 to 25 years and came from diverse undergraduate educational backgrounds, with the majority holding degrees in Elementary School Teacher Education, and the remainder from Physics Education, Chemistry Education, Biology Education, English Language Education, and other related fields. A purposive sampling technique was employed given that all participants had already undergone a numeracy screening as part of the TPE selection process, indicating that they were anticipated to possess a foundational level of competence in numeracy and data-related reasoning skills applicable to this study.

2.3. Research Procedure

This research was conducted in three stages, that is, Planning, Implementation, and Evaluation. During the Planning phase, learning activities were organised that involved composition label analysis of snack foods and integration of numeracy concepts like arithmetic operations, unit conversions and data analysis. During the Implementation phase, collaborative classroom activities were used to engage participants in the analysis of the snack food label composition and the relevant discussions of numeracy in the elementary school curriculum. In the Evaluation phase, participants received a reflective questionnaire assessing the benefits and realistic outlook of the activity.

2.4. Data Collection and Instrument

Data were collected using a questionnaire administered via Google Form served as the main instrument, consisting of both closed and open-ended questions across three categories: (1) the appropriateness of the activity as a first numeracy assessment, (2) the numeracy skills that may be fostered, and (3) the connection of the activity to the elementary school math content. Likert-type items (closed-ended) were used to select a response from the offered alternatives (e.g. agree/disagree, or degree of agreement) while sub-items (open-ended) offered respondents the opportunity to elucidate their rationale and perspective in greater detail.

2.5. Validity and Reliability

Content validity of the questionnaire was established through expert judgment involving two university lecturers specializing in mathematics education and one expert in educational assessment, who reviewed the items for relevance, clarity, and alignment with the research objectives. For qualitative data, trustworthiness was ensured through data triangulation across three sources, namely questionnaire responses, semi-structured interviews with selected participants and classroom observations (Nowell et al., 2017).

2.6. Data Analysis

Data analysis was conducted using NVivo 12 software following the interactive model proposed by Miles et. al., (2014), as illustrated in Figure 2.

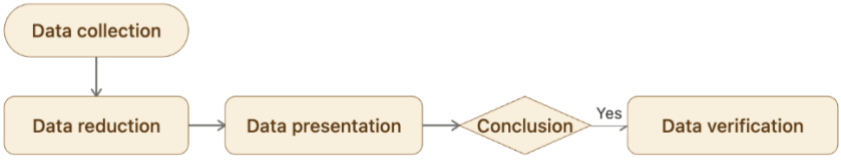

Figure 2. Data Analysis Procedure

As shown in Figure 2, the analysis comprised four interconnected stages: data collection, data reduction, data presentation, and conclusion drawing/verification. Questionnaire response data were imported into NVivo 12 as source files, after which nodes were created to organize and categorize participants' responses based on

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the research questions. For open-ended responses, content analysis was performed by reading all responses to identify salient points related to numeracy understanding, learning context, and classroom applicability. Responses were subsequently categorized and inductively fashioned into main themes. To ensure consistency and coherence, the researchers reviewed the themes and their corresponding data repeatedly. Each node represented a recurring theme or concept drawn directly from participants' answers, enabling a structured and transparent analytical process. Furthermore, a project map was developed within NVivo 12 to visually illustrate the relationships between themes and sub-themes, providing a comprehensive overview of the data structure and interconnections among emerging findings. Interview transcripts and observation field notes were analyzed alongside questionnaire data to confirm emerging themes and ensure consistency across data sources.

3. Results and Discussion

3.1. Result

3.1.1. Feasibility of Snack Food Composition Label Analysis as an Initial Numeracy Assessment

Table 1 presents the distribution of participants' perceptions regarding the feasibility of the snack food composition label analysis activity as an initial numeracy assessment.

Table 1. Perceptions of Activity Feasibility

Assessment Category	Frequency	Percentage (%)
Feasible	53	92.98
Less feasible	4	7.02
Total	57	100

As shown in Table 1, the majority of participants (92.98%) regarded the activity as feasible and relevant for initial numeracy assessment, while 7.02% perceived it as less feasible, citing time constraints as the primary concern. These results indicate that the majority of participants recognized the activity as a feasible and relevant approach to initial numeracy assessment. Figure 3 further illustrates the qualitative patterns of participants' responses based on NVivo 12 tree node analysis.

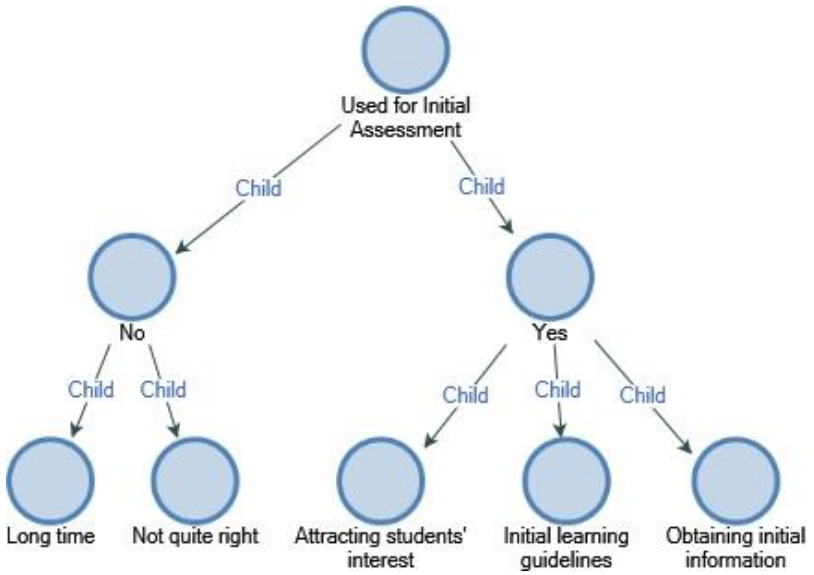

Figure 3. Participants' Responses on the Use of Snack Composition Label Analysis for Initial Assessment in Numeracy Learn

As presented in Figure 3, pre-service teachers held mixed perceptions regarding the use of snack composition label analysis for initial assessment in numeracy learning. Participants who responded negatively highlighted two concerns, namely that the activity requires a considerable amount of time and that it may not be entirely appropriate for initial assessment purposes. In contrast, participants who responded positively identified three key benefits: the activity is effective in attracting students' interest, provides useful guidelines for initial learning, and enables teachers to obtain initial information about students' prior knowledge.

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3.1.2. Cognitive and Practical Skills Developed through Snack Food Composition Label Analysis

The content analysis revealed that all participants described this activity as likely to be helpful with the interpretation and analysis of numerical data on food labels. Furthermore, the ability to calculate and compare proportions or percentages, as well as convert units, also emerged, albeit at a lower frequency. Figure 4 presents documentation of participants' engagement during the implementation phase, illustrating the hands-on and collaborative nature of the activity.

(a) (b)

Figure 4. Pre-Service Teachers Engaging in Snack Food Composition Label Analysis during the Implementation Phase

As shown in Figure 4, participants actively sorted, compared, and discussed nutritional data from snack food labels, demonstrating the practical application of numeracy skills in a real-world context. The content analysis further revealed that all participants described the activity as beneficial for the interpretation and analysis of numerical data, including the ability to calculate and compare proportions or percentages and convert units. Figure 5 presents an example of participants' work during the activity, in which they ranked the total energy values of six snack types.

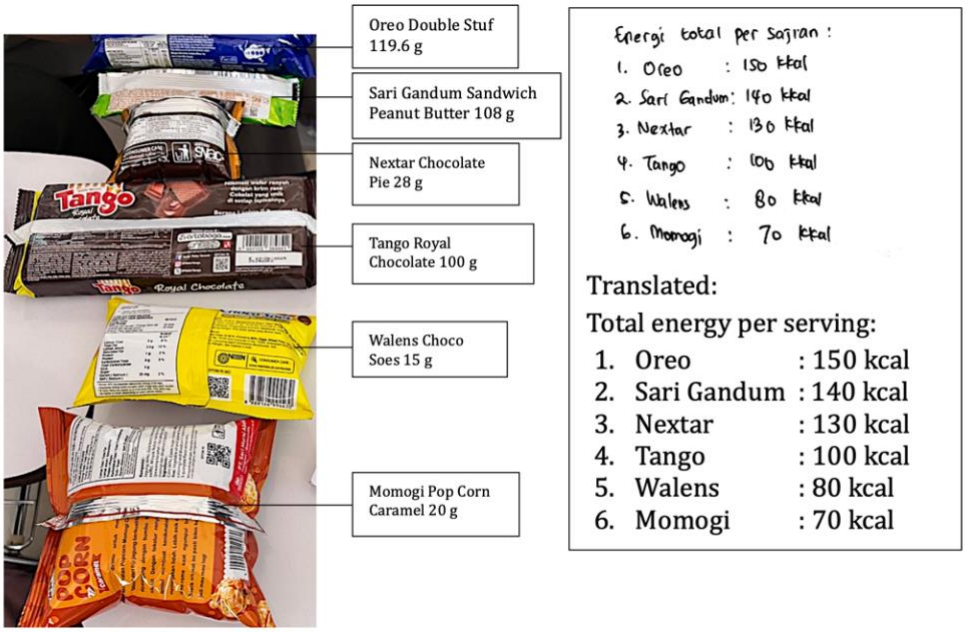

Figure 5. Total Energy Ranking of Six Snack Types

Figure 5 shows participants' work in ranking snack energy values and comparing them with daily energy requirements. The results indicate that participants successfully completed sequencing tasks, applied proportional reasoning, and interpreted nutritional data in a real-life context. Students ranked the snacks based on total energy per serving from highest to lowest as follows: Oreo Double Stuf (150 kcal), Sari Gandum Sandwich Peanut Butter (140 kcal), Nextar Chocolate Pie (130 kcal), Tango Royal Chocolate (100 kcal), Walens

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Choco Soes (80 kcal), and Momogi Pop Corn Caramel (70 kcal). Compared with an average adult daily energy requirement of 2,150 kcal, one serving of Oreo contributes approximately 7.0% of daily energy needs, Sari Gandum 6.5%, Nextar 6.0%, Tango 4.7%, Walens 3.7%, and Momogi 3.3%.

The study shows how reading the energy labels enables students to sort and evaluate data related to snacks, as well as how they contribute to their daily source of energy. Therefore, students apply their quantitative reasoning skills through a practical life situation. Figure 6 further illustrates the broader range of skills, based on NVivo 12 tree node analysis.

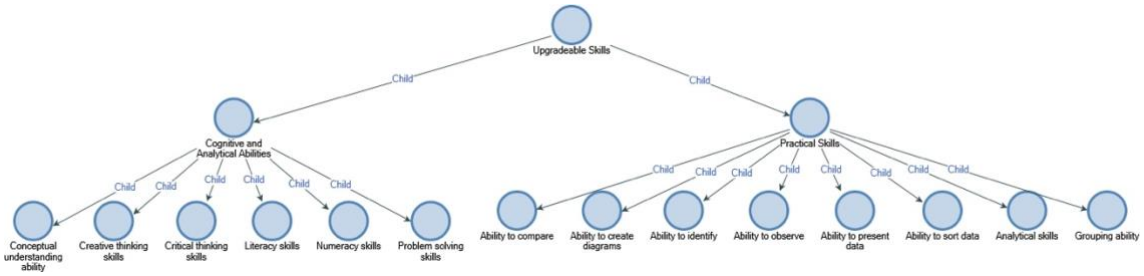

Figure 6. Pre-Service Teachers' Perceptions of Skills Enhanced through Snack Composition Label Analysis

As presented in Figure 6, the analysis revealed two broad categories of developable skills. In terms of cognitive and analytical abilities, the activity was perceived to foster conceptual understanding, creative thinking, critical thinking, literacy, numeracy, and problem-solving skills, reflecting its potential to stimulate higher-order thinking processes. Regarding practical skills, participants identified the ability to compare, create diagrams, identify, observe, present data, sort data, analyze, and group information as competencies developable through this activity, suggesting that engagement with real-world nutritional labels encourages hands-on and applied learning experiences

3.1.3. Cross-Curricular Application of Snack Food Composition Label Analysis in Elementary School Subjects

Figure 7 presents the NVivo 12 tree node analysis illustrating participants' responses regarding the subject areas in which snack composition label analysis can be applied

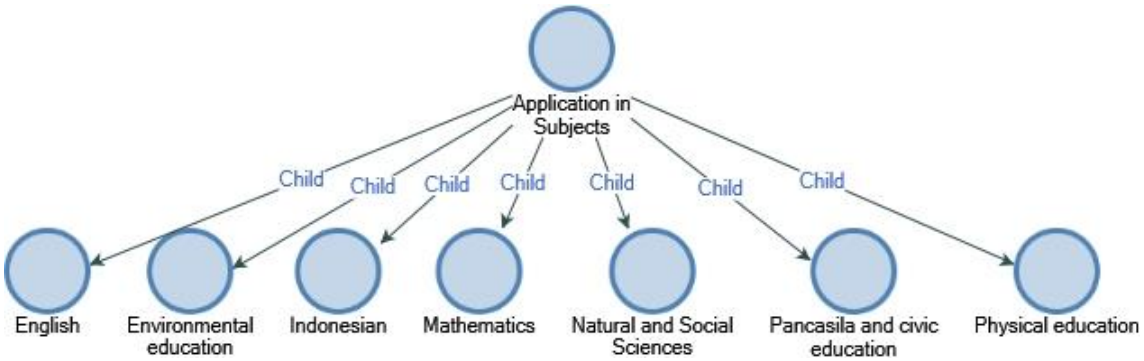

Figure 7. Pre-Service Teachers' Perceived Subject Applications of Snack Food Composition Label Analysis

As shown in Figure 7, participants perceived the activity as applicable across multiple elementary school subjects, including English, Environmental Education, Indonesian, Mathematics, Natural and Social Sciences, Pancasila and Civic Education, and Physical Education. In terms of mathematics content specifically, participants linked the activity to: (1) measurement and units such as grams, milligrams, and calories; (2) data presentation and processing in tables and diagrams; (3) basic statistics including mean, median, and mode; and (4) number concepts such as ordering and comparison. These connections demonstrate that the activity is not limited to numeracy or mathematics learning alone but serves as a versatile cross-curricular activity that can be meaningfully integrated into various subject areas.

3.2. Discussion

The high feasibility ratings presented in Table 1 indicate that pre-service teachers widely regarded snack food composition label analysis as an appropriate and meaningful initial numeracy assessment. This finding aligns with Silva and Bezera (2023), who reported that food-based numeracy tasks were perceived as highly

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accessible and motivating by learners, particularly because they draw on prior knowledge and everyday experience rather than abstract problem sets. Similarly, Mulders et al. (2018) found that contextual learning activities embedded in familiar real-life objects significantly reduced assessment anxiety and increased learner engagement compared to conventional numeracy tasks. This also shows the importance of contextual learning in numeracy, which is the integration of everyday social context with mathematics (Goos et al., 2020). The present study extends these findings to a teacher professional education context, demonstrating that such accessibility is not only valued by school-age students but also recognized by prospective teachers as a pedagogically sound entry point for numeracy instruction. Participants in this study specifically described the activity as inspiring and non-threatening, echoing Castagnoli et al. (2023), who noted that interdisciplinary interventions using food labels actively involve learners and foster content integration across subject areas. While a small number of respondents raised concerns about the time required for implementation, the overwhelmingly positive feasibility ratings suggest that with adequate planning, snack label analysis holds strong potential as a contextual assessment tool in elementary teacher education programs.

The cognitive and practical skills identified in Figure 6 suggest that authentic, real-life tasks enable students to develop applied numeracy practices, including the ability to read, interpret, and resolve quantitative problems. The concept of 21st-century numeracy requires people to understand and use numerical information in social situations, according to the OECD (2021). Food labels in the form of real-life examples allow humans to train their critical thinking skills they can use in their life decisions (Alordiah & Oji, 2024; Daulay et al., 2024; González-Polo et al., 2025). According to Tanzer et al. (2025), using this teaching method helps students understand math concepts by teaching them to use math skills in their daily life to solve problems. Previous studies indicate that awareness of the nutritional content on food labels is linked to better nutrition-related consumer choices (Seth, 2018, 2022). Overall, these findings suggest that snack composition label analysis provides a rich and contextual learning opportunity that simultaneously supports both cognitive and practical skill development among elementary pre-service teachers.

With respect to mathematics content, participants identified clear connections between snack food label analysis and several core elementary mathematics topics, including measurement and units (grams, milligrams, calories), data presentation in tables and diagrams, basic statistics (mean, median, mode), and number concepts such as ordering and comparison. These connections demonstrate that everyday experiences with food labels can serve as meaningful entry points for mathematics instruction. The numeracy development program enables students to learn through real-world situations, which connect mathematics and science across different subjects according to STEAM principles (Ajir & Ishak, 2025; Montés et al., 2023; Rakhmawati & Mustadi, 2022; Sukmawati & Rakhmawati, 2023). Students establish links between abstract ideas and real-world encounters through their learning of snack label material, which uses familiar media. Based on the Indonesian (2023) curriculum policy, students practised developing their numeracy because students expected to link their numeracy skills in real-world contexts. Through sustained engagement with familiar everyday media such as food labels, prospective teachers can develop not only their own numeracy skills but also the pedagogical insight needed to design and implement contextually rich mathematics instruction in their future classrooms.

3.3. Implications

This study has important practical implications for numeracy education, especially in teacher professional programs. It helps pre-service teachers think of numeracy in more abstract ways than they would without engaging with such topics as snack food composition labels. By interactively working with genuine data, the participants became increasingly aware of how assessment can be integrated into day-to-day contexts rather than being limited to formal testing environments. Just as importantly, this type of activity models for aspiring-teachers how to approach the design of learning experiences that are meaningful and accessible for elementary school aged children. When teacher candidates engage in contextual learning directly, they can better model and modify these practices for their own future classrooms. These findings highlight the importance of bridging social context into mathematics learning to support the development of critical and applied numeracy literacy (Geiger et al., 2022). It is also found that teaching of numeracy lessons based on real-world context was associated with better problem-solving skills and educational relevance (Aristiyanto et al., 2023; Muspita & Ningsih, 2024; Wahyudi et al., 2025). These findings collectively underscore the value of incorporating authentic, context-based activities into teacher professional education programs. By experiencing contextual numeracy learning as participants themselves, pre-service teachers gain not only content knowledge but also pedagogical insight into how numeracy can be taught in ways that are engaging, applicable, and connected to the realities of students' daily lives.

3.4. Limitations

This study has several limitations that should be acknowledged. First, the sample was limited to 57 pre-service teachers from a single private university in Bandung, Indonesia, which may restrict the generalizability of the findings to broader populations across Indonesia. Second, the study relied primarily on self-reported data, which may be subject to response bias and does not directly measure actual learning outcomes or instructional behavioral change. Third, although methodological triangulation was employed through questionnaires,

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interviews, and classroom observations, the absence of follow-up data limits the extent to which long-term impacts can be assessed. Future research is encouraged to employ larger and more diverse samples across multiple institutions, incorporate longitudinal or experimental designs, and investigate how pre-service teachers subsequently translate these experiences into their own classroom practice

4. Conclusion

This study examined the implementation of snack food composition label analysis as a contextual numeracy learning activity among elementary pre-service teachers in a Teacher Professional Education program, with the aim of exploring its feasibility, the skills it fosters, and its potential application across elementary school subjects. The findings demonstrated that the activity is widely regarded as feasible and relevant for initial numeracy assessment, capable of developing a broad range of cognitive and practical skills including proportional reasoning, unit conversion, critical thinking, and data interpretation, and applicable across multiple elementary school subjects, reflecting its strong potential as a cross-curricular instructional approach. These results collectively suggest that authentic, context-based learning activities represent a viable and meaningful alternative to traditional numeracy assessment, particularly within teacher professional education programs where developing candidates' pedagogical thinking is as important as building content knowledge. It is therefore recommended that curriculum developers and teacher educators consider incorporating snack food composition label analysis as a standard contextual activity in elementary numeracy frameworks, particularly within Indonesian teacher professional education programs, to support the goals of the Merdeka Curriculum in fostering contextually grounded numeracy instruction. Future research would benefit from employing experimental or longitudinal designs across multiple institutions to directly measure the impact of such activities on learning outcomes and to investigate how pre-service teachers subsequently translate these experiences into their own classroom practice.

Author Contributions

Siti Maryam Rohimah: Writing - Original draft preparation, Conceptualization. Dadang Iskandar: Methodology, Validation. Eggie Nugraha: Visualization, Investigation. Taufiqulloh Dahlan: Writing - Reviewing and Editing, Data Curation. Yuni Indriyani: Writing - Reviewing and Editing.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

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