



DEVELOPMENT OF SMART NUTRITION GAMIFICATION MEDIA TO IMPROVE NUMERACY LITERACY IN ELEMENTARY SCHOOLS

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Abstract. Nutritional problems and low numeracy literacy among elementary school students in Indonesia remain critical challenges that affect both academic achievement and health-related behaviors. This study aimed to develop a digital gamification-based learning media called Smart Nutrition to improve students' numeracy literacy in the context of the Free Nutritious Meal Program. The research employed the ADDIE development model, consisting of analysis, design, and development phases, followed by expert validation. The media content integrated calorie counting, portion estimation, and interpretation of nutrition labels into gamified missions featuring points, badges, levels, leaderboards, and instant feedback. Validation by experts in media and content resulted in an average score of 94%, indicating that the product was categorized as very valid. These results suggest that the Smart Nutrition prototype is a feasible and innovative digital learning tool that combines gamification and nutrition-based numeracy content, and is ready for further trials on practicality and effectiveness in classroom settings.

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INTRODUCTION

Nutritional problems among elementary school children in Indonesia remain a pressing public health concern. Both undernutrition and obesity within this population have been shown to significantly affect cognitive development, attention span, and academic achievement. Children who suffer from unbalanced nutrition are more likely to show reduced motivation to learn and face long-term health risks (Shao et al., 2025). Thus, school-based nutrition intervention programs are increasingly recognized as essential strategies for improving both health and learning outcomes (Rosati et al., 2025). Parallel to this challenge, the improvement of numeracy literacy has become a national educational priority in Indonesia. Numeracy literacy extends beyond basic arithmetic skills; it encompasses the ability to interpret, analyze, and apply quantitative information in daily life contexts (Ratnasari & Setiawan, 2022). This includes competencies such as reading and interpreting nutritional labels, calculating food portions, and estimating calorie requirements (Darmastuti et al., 2024). Through the direct consumption of healthy meals, children can learn the importance of balanced nutrition (Ženatý et al., 2024). However, the success of this program requires integration with innovative educational approaches (Rahmawati et al., 2025). Such integration is necessary so that children are not merely consumers but also develop a critical understanding of nutrition principles (Amjad et al., 2025).

On the other hand, numeracy literacy remains a fundamental challenge in Indonesian education. Numeracy is not merely confined to arithmetic skills but also encompasses the ability to apply mathematical concepts in real-life contexts, including calorie calculation, nutritional measurement, and food label interpretation (Koval et al., 2024; Wibowo, 2024; Norouzkhani et al., 2025). The low level of numeracy literacy among students undermines their capacity to make informed health decisions based on data. Consequently, integrating numeracy literacy into nutrition education has become essential (Hazin et al., 2025). With the advancement of digital technology, opportunities for educational transformation, including in the field of nutrition, have

become increasingly widespread. Digital technology enables learning processes that are more interactive, adaptive, and personalized (Andrao et al., 2024; Shao et al., 2025). Innovations in digital education have also promoted the adoption of gamification, namely the integration of game-based elements into the learning process, to enhance students' motivation and engagement (Mohammed et al., 2024; Rayan & Watted, 2024).

Gamification has been proven effective in enhancing student engagement, both in numeracy learning and in nutrition literacy (Pereira et al., 2024). By incorporating game elements such as points, badges, and challenges, students become more motivated to comprehend abstract concepts while simultaneously internalizing healthy behaviors (Patras et al., 2025; Sáez-López et al., 2024). In the context of nutrition, gamification also has the potential to transform calorie counting and food selection activities into enjoyable learning experiences (Norouzkhani et al., 2025). The concept of smart nutrition enriches the gamification approach by leveraging digital technology, nutritional databases, and personalized learning (Khattib & Alt, 2024; Park et al., 2025). Smart nutrition not only conveys theoretical knowledge but also provides real-life experiences through digital applications capable of calculating calories, monitoring dietary patterns, and offering personalized recommendations. When integrated with gamification, this concept has the potential to serve as an innovative, relevant, and impactful medium for nutrition education that directly influences students' behaviors (Koval et al., 2024; Utamayasa et al., 2025).

Previous studies by Nylén-Eriksen et al. (2025) have explored the application of gamification in both education and health domains. However, most of these studies have primarily focused on learning motivation or improving nutrition literacy and have not yet comprehensively integrated numeracy literacy (Amjad et al., 2025; Nylén-Eriksen et al., 2025). This highlights a research gap concerning the integration of numeracy literacy within the framework of digital gamification-based smart nutrition. The urgency of this research is further reinforced by the implementation of the Merdeka Curriculum, which emphasizes contextual, project-based learning oriented toward strengthening the Profil Pelajar Pancasila (Fransiska et al., 2025; Patras et al., 2025). The integration of numeracy and nutrition through digital gamification also aligns with the vision of Society 5.0, which positions technology as a tool to enhance the quality of human life (Amjad et al., 2025; Putri et al., 2022).

Through this approach, the present study is expected not only to improve children's nutritional status but also to strengthen numeracy literacy as a core competence of the 21st century (Meirijal et al., 2025). Furthermore, the integration of smart nutrition into the free nutritious meal program has the potential to serve as a model of integrated learning that can be replicated across different regions (Laksana et al., 2024; Hapsari & Wahyudi, 2025). Based on this rationale, the objective of this study is to develop a digital gamification-based smart nutrition model to enhance elementary school students' numeracy literacy within the free nutritious meal program. This study is expected to provide a theoretical contribution to the advancement of knowledge in the fields of education and health. In addition, it is also anticipated to offer practical contributions to the development of educational policies and national nutrition programs.

In light of these challenges and opportunities, the development of digital gamification-based Smart Nutrition media represents not only an educational innovation but also a strategic intervention in addressing the dual burden of malnutrition and low numeracy literacy among elementary school students. The combination of nutrition content and numeracy skills in a single platform provides a multidimensional approach that prepares students to become both health-literate and mathematically competent individuals. This integrated approach responds directly to calls from international frameworks such as UNESCO's Education for Sustainable Development, which highlights the importance of equipping learners with competencies that transcend disciplinary boundaries and address real-life challenges. Moreover, this initiative reflects the urgency of preparing Indonesian students to thrive in the era of Society 5.0, where data-driven decision-making and digital competence are crucial for both personal and societal well-being. By embedding culturally relevant examples of local foods and aligning with the



Merdeka Curriculum's project-based orientation, Smart Nutrition is designed to resonate with the lived experiences of students while fostering critical thinking and problem-solving skills. The project also has significant implications for teachers, who gain access to interactive and engaging resources that support curriculum implementation, as well as for policymakers, who can leverage such innovations to strengthen national education and health strategies. Ultimately, this study positions Smart Nutrition as more than just a pedagogical tool; it is envisioned as a scalable model of integrated learning that addresses the intertwined challenges of health and education, offering pathways for replication and adaptation in diverse school contexts across Indonesia.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach with the aim of developing the Smart Nutrition digital gamification-based learning media to improve numeracy literacy within the Free Nutritious Meal Program. The development process followed the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Fransiska et al., 2025). However, this research was limited to the stages of analysis, design, and development, and included expert validation to assess the feasibility of the product. This decision was based on the research objective, which primarily focused on designing and developing a feasible prototype, as well as obtaining expert validation of its content accuracy, interface design, and pedagogical relevance (Norouzkhani et al., 2025). In the analysis stage, students' needs related to numeracy literacy were identified, particularly in calorie calculation, portion estimation, and interpreting nutrition labels. Interviews with teachers revealed that the existing learning media were still conventional and lacked interactivity, making them less effective in capturing students' attention or linking numeracy concepts with real-life contexts (Montero Izquierdo et al., 2024). The design stage focused on constructing the learning framework based on learner-centered design principles. Gamification features such as points, levels, leaderboards, and instant feedback were integrated into the learning flow (Pathania et al., 2025). The numeracy content developed included calorie calculation, portion measurement, and daily meal balance, all contextualized with local foods to ensure cultural relevance and enhance students' learning experiences. During the development stage, a prototype of the Smart Nutrition media was created with a simple interface, local food illustrations, and interactive game-based missions. The prototype was then validated by two groups of experts: (1) content experts (nutrition and elementary school mathematics) and (2) media experts (educational technology). The validation instrument employed a Likert scale (1–5) to assess content accuracy, media design, gamification features, and language clarity.

Similar to prior studies, restricting the ADDIE model to the early phases has been recognized as a valid approach in development research, particularly when the primary aim is to produce and validate an initial version of a learning product (Khattib & Alt, 2024). By clearly defining the boundaries of the study, the research ensures methodological transparency and provides a solid foundation for subsequent investigations. The remaining stages of Implementation and Evaluation will be addressed in follow-up studies, where the developed prototype will be tested for practicality and effectiveness in authentic classroom contexts. This staged approach aligns with previous R&D practices in instructional technology, where early-phase development studies are often published separately to highlight the novelty and validity of the product (Crompton et al., 2024). Thus, although this study does not encompass all five ADDIE stages, it remains consistent with the model's principles by following a systematic, iterative, and evidence-based development process.

RESULTS AND DISCUSSION

1. Analysis Stage

The needs analysis conducted at SDN 1 Waruroyom in May 2025 provided a comprehensive overview of the initial conditions of sixth-grade students. Among 36 participants, the majority demonstrated low understanding of numeracy literacy in the context of



nutrition. Only 9 students (25%) were able to read and interpret simple nutrition labels, while 11 students (30%) could calculate calories from daily menus. These findings highlight a gap in applying numerical skills to real-life contexts. Classroom observations revealed that students tended to be passive when presented with text-based or conventional numerical learning. Teachers reported that the primary challenge was the lack of interactive and contextual learning media. This condition indicated the urgency for innovative learning tools that could bridge mathematics with health practices, particularly in calorie counting, portion sizes, and dietary analysis.

This situation resonates with broader evidence in the literature. Numeracy is not only a fundamental academic competency but also an essential life skill, particularly in health-related decision-making such as calorie counting, portion estimation, and dietary evaluation (Scerif et al., 2025). Nutrition interventions in schools are often limited to knowledge delivery, while neglecting the applied mathematical skills required for students to translate that knowledge into healthier behaviors (Norouzkhani et al., 2025). Without adequate numeracy literacy, children may struggle to interpret nutrition data or make informed food choices, potentially undermining public health programs like the Free Nutritious Meal initiative.

From a theoretical perspective, constructivist and experiential learning frameworks argue that numeracy is best developed when tied to meaningful and authentic contexts (Patras et al., 2025). Embedding numeracy in nutrition tasks—such as comparing calorie values, analyzing food labels, and balancing daily menus—creates opportunities for students to practice problem-solving that is directly relevant to their lives. Gamification can further enhance these experiences by motivating students through rewards, challenges, and feedback loops, thus transforming passive learning into active exploration. Therefore, the identified needs underscore the urgency of developing innovative digital media that not only conveys nutrition content but also strengthens students' numerical reasoning through contextualized, engaging, and culturally relevant tasks.

Moreover, the low level of numeracy literacy among elementary school students has broader implications for the achievement of cross-disciplinary competencies. Numeracy serves as the foundation for critical thinking, decision-making, and problem-solving skills across various contexts, including health (Rayan & Watted, 2024). Without sufficient numeracy skills, students are likely to struggle in interpreting data-based information such as nutrition tables, growth charts, or daily dietary recommendations. This limitation may reduce the effectiveness of school-based nutrition interventions, such as the Free Nutritious Meal Program, since students lack the ability to independently assess and apply nutritional information. Therefore, the development of learning media that integrates numeracy and nutrition in a practical manner is a strategic step in simultaneously supporting educational quality and children's health outcomes.

2. Design Stage

The design phase of the Smart Nutrition digital gamification media was guided by the needs analysis conducted at SDN 1 Waruoyom and framed within learner-centered design principles. This phase emphasized both pedagogical and psychological aspects to ensure that the media not only delivered content but also fostered active student engagement. The learning flow adopted a scenario-based learning approach, where students encountered real-life situations contextualized into missions. For example, learners were asked to choose a breakfast menu, calculate lunch calories, or compare the nutritional value of snacks versus sugary drinks. Each mission began with a contextual problem, which was then followed by a numeracy challenge requiring students to apply mathematical reasoning. Such structuring ensured that abstract numerical concepts were embedded in meaningful daily life contexts, aligning with research suggesting that numeracy is best acquired when connected to authentic problem-solving (Shao et al., 2025).

The design incorporated core gamification elements—points, badges, levels, leaderboards, and instant feedback. These elements have been consistently shown in educational research to increase student motivation and persistence. For example, Mohammed et al., (2024)



demonstrated that gamification features significantly enhanced students' engagement with numeracy tasks in elementary classrooms. In Smart Nutrition, students received points and badges for solving problems correctly, while progressive levels introduced increasingly complex challenges, such as shifting from single-food calorie calculations to whole-day menu evaluations. The leaderboard created a space for healthy competition, encouraging students to challenge themselves and others. Instant feedback provided short explanations or simulations—for example, an avatar with low energy when calories were insufficient or appearing overly full when excessive calories were chosen. This immediate response mechanism reinforced experiential learning principles, allowing learners to reflect on their actions and outcomes in real time.

The content design purposefully integrated numeracy skills with nutrition knowledge. Three key numeracy competencies were prioritized:

1. Basic calculations (addition, subtraction, multiplication) for calorie counting.
2. Data interpretation skills for reading and understanding nutrition tables.
3. Logical reasoning and comparison skills for evaluating portion sizes and caloric balance.

On the nutrition side, the content was aligned with the “Isi Piringku” guidelines from the Indonesian Ministry of Health and international WHO standards, ensuring both cultural relevance and scientific accuracy. Local foods such as rice, tempeh, fried fish, and tropical fruits were embedded within the scenarios. This cultural contextualization is crucial, as highlighted by [Koval et al. \(2024\)](#), who argued that numeracy becomes more meaningful when tied to familiar contexts, particularly in decision-making related to health. By situating mathematics within food choices that students encounter daily, the Smart Nutrition media narrowed the gap between classroom learning and real-world application.

Pedagogically, the design was grounded in constructivist learning theory, which emphasizes that learners actively construct knowledge through interactions with their environment. Constructivism asserts that meaningful learning occurs when students integrate new information with prior experiences. In this case, calorie counting or portion estimation built upon students' daily experiences with food. Moreover, the design adopted experiential learning principles, where learners undergo a cycle of concrete experience, reflection, conceptualization, and application. For example, when a student miscalculated caloric intake, the avatar simulation provided a concrete experience of imbalance; this led to reflection, conceptual understanding of energy needs, and better decision-making in the next task.

Additionally, the design incorporated self-determination theory [Latorre-Coscolluela et al. \(2025\)](#), which posits that intrinsic motivation is nurtured when learning activities satisfy three psychological needs: autonomy, competence, and relatedness. Autonomy was addressed by allowing students to choose menus and strategies; competence was supported through immediate feedback and progressive difficulty levels; relatedness was fostered through leaderboards and potential collaborative features. Research by [Rosati et al. \(2025\)](#) confirms that learning environments which satisfy these needs lead to higher engagement and sustained motivation.

Previous studies have explored the use of gamification and digital learning tools in either nutrition education or numeracy, but rarely both. For instance, [Gini et al. \(2024\)](#) found that gamification increased student motivation in general mathematics learning, but did not address its integration with health education. Conversely, [Gini et al. \(2024\)](#) showed that school-based nutrition programs could improve students' knowledge of healthy eating but failed to equip them with the numerical competencies necessary for practical application. Smart Nutrition addresses this gap by integrating numeracy and nutrition education into one platform, thereby extending the scope of gamified learning beyond motivation into functional life skills.

Furthermore, the design aligns with the vision of the Merdeka Curriculum, which emphasizes contextual and project-based learning, as well as the broader philosophy of Society 5.0, which envisions technology as a driver of human well-being. By embedding mathematical

reasoning within nutrition contexts, Smart Nutrition not only enhances academic skills but also contributes to public health outcomes.

In sum, the design phase produced a pedagogically sound, culturally contextualized, and theoretically grounded digital learning media. By leveraging gamification principles, constructivist and experiential learning theories, and integration of numeracy with nutrition, Smart Nutrition offers an innovative approach to addressing two pressing challenges in Indonesian elementary education: low numeracy literacy and poor nutrition awareness. The design outcomes also underscore the potential of technology to create meaningful, engaging, and transformative learning experiences, positioning Smart Nutrition as a promising tool for both educational and health-related interventions.

3. Development Stage

The development of the Smart Nutrition gamified application prototype was not only a technical process of creating interactive media, but also a pedagogical effort to ensure that the product aligned with students' cognitive and affective needs. The prototype was designed using a web-based authoring tool, allowing cross-platform accessibility via laptops, tablets, and smartphones, which is essential in Indonesia where device ownership varies widely. Accessibility was prioritized so that both teachers and students could operate the application without requiring high levels of digital literacy. This consideration echoes the findings of [Hapsari & Wahyudi, \(2025\)](#), who stressed that digital learning media for elementary students must minimize technical barriers while maximizing interactivity.

The user interface design was intentionally simple, relying on bright, contrasting colors and intuitive navigation menus. Icons were selected from familiar imagery—such as food items, stars, and medals—to create a sense of recognition among young learners. Usability testing in similar contexts ([Guntur et al., 2025](#)) has shown that intuitive interfaces significantly reduce cognitive load, allowing students to focus more on the content rather than struggling with navigation. The inclusion of a login page requiring name and class entry was designed not only for personalization but also to prepare for potential integration with classroom record systems. Personalization through avatars and names has been found to enhance learner identification with digital environments, fostering stronger engagement.

The content was divided into two main sections: Materials and Quizzes. The material section presented visual information about nutritious foods—fruits, vegetables, protein sources, and traditional Indonesian dishes—accompanied by nutritional values and health benefits. This mirrored recommendations by [Norouzkhani et al. \(2025\)](#), who argued that nutrition education in schools should be both knowledge-oriented and contextually relevant. By incorporating local foods such as tempe, nasi uduk, and tropical fruits, the application connected abstract nutritional guidelines to students' lived experiences, aligning with the constructivist principle of contextual learning.

The quiz section adopted a progressive leveling system, ranging from Level 1 (Basic Nutritious Food) to Level 5 (Master of Nutrition). Each level contained picture-based and multiple-choice questions, gradually increasing in complexity. Lower levels required recognition of healthy food items, while higher levels demanded calorie calculations and comparative judgments of portion sizes. This design drew upon Vygotsky's Zone of Proximal Development (ZPD), scaffolding tasks to ensure that learners advanced from simple to more complex challenges with adequate support. Gamification was central to the design. Points were awarded for correct answers, while incorrect answers triggered immediate feedback with explanations. The grading system categorized performance into A (Excellent), B (Good), C (Fair), and D (Needs Practice). This mirrors research by [Gini et al. \(2024\)](#), who found that graded feedback promotes metacognition by helping students reflect on their level of mastery. The use of leaderboards added a competitive dimension, encouraging students to repeat quizzes to improve their ranking. However, to maintain psychological safety, the leaderboard was limited to classroom peers rather than broader online rankings, following recommendations by [Xu et al. \(2025\)](#) that gamified education must balance competition with inclusivity.



Interactivity was emphasized through avatars, animations, and dynamic feedback. For instance, when students selected an unbalanced diet, their avatar might appear sluggish, while a balanced menu would result in an energized avatar. Such visual metaphors transform abstract nutritional consequences into relatable experiences, supporting experiential learning cycle. Moreover, the return-to-menu and logout features offered flexibility, recognizing that students may have limited time or device access.

Once the prototype was developed, it underwent expert validation by content and media specialists. Content experts, consisting of nutritionists and elementary mathematics educators, evaluated the accuracy of nutritional data and the integration of numeracy skills. Media experts, drawn from educational technology specialists, assessed interface design, navigation flow, and gamification quality. The Likert-scale validation instrument revealed an average score of 94% (Very Valid), echoing previous studies where digital gamified media scored similarly high in expert reviews. Suggestions included expanding numerical examples, ensuring cultural accuracy in food illustrations, and improving clarity of instructions. These recommendations guided iterative revisions, ensuring that the prototype met both pedagogical and cultural expectations.

The design and development also drew upon Self-Determination Theory [Ženaty et al. \(2024\)](#), ensuring that students experienced autonomy (freedom to choose menus), competence (progressive challenges with feedback), and relatedness (peer competition through leaderboards). These motivational components are essential in gamified environments to sustain student interest beyond novelty effects. Additionally, the system design considered cognitive load theory by breaking content into modular levels and minimizing unnecessary visual clutter, ensuring that students' working memory resources were focused on numeracy and nutrition tasks.

The prototype holds promise not only as a classroom tool but also as a potential supplement for national initiatives such as the Free Nutritious Meal Program. By teaching students to calculate calories, interpret nutrition tables, and compare food portions, the media equips them with transferable skills critical for lifelong health decisions. The integration of numeracy into nutrition education addresses the gap identified by Rosati et al. (2025), who observed that most nutrition interventions remain knowledge-based without emphasizing practical application. For more clarity regarding the product design, see the link <http://Quiz.gamer.gd> and see [Figure 1](#).

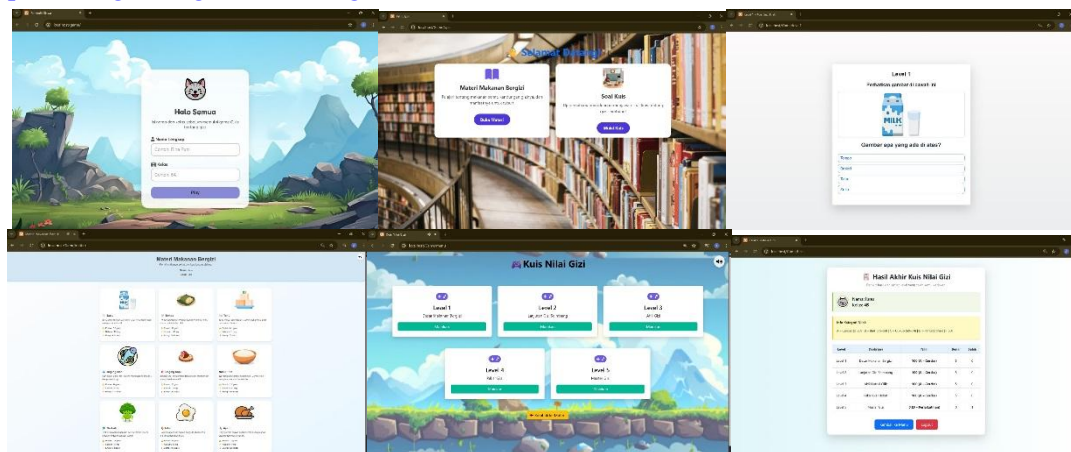


Figure 1. Products developed

Validation is a critical component in the development of educational media, as it ensures that the product meets both academic and technical standards before implementation. In this study, the prototype of the Smart Nutrition digital gamification application was validated by two groups of experts: (1) subject matter experts in nutrition and elementary mathematics, and (2) media experts in educational technology. The evaluation criteria included content accuracy, curriculum alignment, interface design, navigation, interactivity, and gamification features. Validation was conducted using a Likert-scale instrument (1–5), enabling experts to provide

both quantitative scores and qualitative suggestions for improvement. The following for the results of validation by experts can be seen in the [Table 1](#).

Table 1. Expert Validation Results

Aspect	Score (%)	Category
Media (interface & navigation)	95	Very Valid
Content (nutrition & numeracy)	90	Very Valid
Language (communication & readability)	97	Very Valid
Gamification (points, levels, leaderboard)	94	Very Valid
Creativity (innovation & interactivity)	96	Very Valid
Average	94	Very Valid

The results, presented in [Table 1](#), showed that the Smart Nutrition media received an average score of 94%, categorized as very valid. The highest rating was achieved in the language aspect (97%), followed by creativity (96%), media design (95%), gamification (94%), and content (90%). These findings confirm that the product was well designed, easy to use, and pedagogically sound for elementary school students.

The exceptionally high score in the language aspect (97%) highlights the effectiveness of simplifying complex nutrition and numeracy concepts into age-appropriate communication. This aligns with [Hortelano & Prudente \(2024\)](#), who emphasized the importance of readability and clarity in digital learning tools for younger learners. The creativity (96%) and media design (95%) scores further demonstrated that the application successfully integrated innovative and engaging features. Gamification, with a score of 94%, was also rated as very effective in sustaining student interest through mechanisms such as points, levels, and leaderboards.

Although the content aspect was rated very valid (90%), experts noted that it could be further strengthened by providing more diverse numerical examples and ensuring tighter integration of nutrition concepts. This observation is consistent with [Rosati et al. \(2025\)](#), who found that school-based nutrition programs often focus heavily on knowledge dissemination while neglecting the mathematical reasoning skills needed to apply such knowledge in real-life contexts. Thus, Smart Nutrition offers an opportunity to bridge this gap by embedding numeracy into nutrition education. A detailed summary of expert inputs is presented in [Table 2](#).

Table 2. Expert Suggestions

No	Expert Suggestions Included
1	Adding more varied examples of calorie calculations and numeracy-based tasks
2	Using culturally accurate illustrations and names for local foods (e.g., tempe, nasi uduk, tropical fruits)
3	Enhancing clarity of instructions and feedback to guide students during gameplay
4	Integrating collaborative features such as group leaderboards to encourage teamwork
5	Adjusting visual layouts to make nutrition labels easier to read for elementary students

Expert feedback is summarized in [Table 2](#). Recommendations included: (1) adding a greater variety of calorie calculation tasks, (2) using culturally accurate illustrations of local foods such as tempeh, nasi uduk, and tropical fruits, (3) enhancing clarity of instructions and feedback, (4) integrating collaborative features such as group leaderboards to promote teamwork, and (5) adjusting the visual layout to make nutrition labels more accessible for elementary students.

In response to these suggestions, several revisions were implemented. Food illustrations were enlarged to improve visibility, particularly for nutrition labels that had previously been difficult to read. Audio narration was added to feedback mechanisms, making the media more inclusive for students with limited reading skills. Additionally, the leaderboard was redesigned to include both individual and group modes, enabling the application to support collaborative learning in addition to individual competition. These adjustments not only improved the usability of the product but also aligned with [Amjad et al. \(2025\)](#), who argued that collaborative gamification features are essential for balancing competition with inclusivity.

The validation findings are consistent with prior research on gamification and digital learning. [Milutinović et al. \(2025\)](#) found that gamification elements such as points, levels, and

challenges significantly increased student motivation and persistence in learning tasks. Similarly, Gini et al (2024) emphasized that creative and interactive media foster greater intrinsic motivation among learners. The results of this study confirm that Smart Nutrition incorporates these motivational features effectively, making it an engaging tool for young students. The Smart Nutrition digital gamification media can be accessed online through the following link: <http://Quiz.gamer.gd>.

At the same time, the study addresses a gap identified in earlier research. While Rosati et al. (2025) highlighted the importance of nutrition education in shaping healthy eating behaviors, their work did not incorporate numeracy as a critical competency. Conversely, Koval et al. (2024) stressed the importance of numeracy in health decision-making but did not propose a pedagogical model for its integration into school curricula. Smart Nutrition responds to this gap by combining nutrition knowledge with numeracy practice in a single gamified platform, providing both academic and life skills.

From a theoretical perspective, the high validation scores demonstrate that Smart Nutrition adheres to the principles of constructivism and experiential learning. Students are not passive recipients of knowledge; rather, they actively engage with tasks that require reflection, problem-solving, and decision-making in authentic contexts. The gamified design supports experiential learning cycle, as students encounter real-world nutrition problems, receive feedback, and apply their understanding in subsequent challenges.

From a practical perspective, Smart Nutrition shows potential as a supplementary tool for the Merdeka Curriculum, which emphasizes contextual and project-based learning. It also contributes to the goals of Society 5.0, where digital technologies are harnessed to improve human well-being. By embedding numeracy into nutrition education, the media not only strengthens academic achievement but also supports national health programs such as the Free Nutritious Meal initiative.

In conclusion, the validation process confirmed that the Smart Nutrition digital gamification media is a highly valid product with strong potential for educational use. The feedback from experts was constructive and led to meaningful revisions, making the product more inclusive, culturally relevant, and pedagogically robust. While further testing on practicality and effectiveness is still required, the validation stage provides strong evidence that Smart Nutrition is ready for pilot implementation in elementary classrooms.

CONCLUSIONS AND SUGGESTIONS

This study developed the Smart Nutrition digital gamification-based learning media using the ADDIE model, limited to the stages of analysis, design, and development, followed by expert validation. The validation results showed an average score of 94%, categorized as very valid, indicating that the media is feasible to be used as supplementary learning material to enhance numeracy literacy in the context of nutrition education. While experts suggested minor revisions such as adding more varied numerical examples and improving layout clarity, overall the Smart Nutrition prototype can be considered valid, innovative, and culturally relevant, with strong potential for future practicality and effectiveness testing in classroom settings.

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