



Improving Balanced Nutrition Knowledge Among Elementary School Students Through Interactive Game-Based Learning

Peningkatan Pengetahuan Gizi Seimbang pada Siswa Sekolah Dasar Melalui Edukasi Berbasis Game Interaktif

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Abstrak

Malnutrisi pada anak sekolah dasar di Indonesia masih menjadi masalah ganda, sehingga diperlukan intervensi edukasi yang inovatif. Program pengabdian masyarakat ini bertujuan untuk meningkatkan pengetahuan jangka pendek siswa mengenai konsep Isi Piringku dan pemilihan camilan sehat. Intervensi dilakukan pada 27 siswa kelas VI SDN 35 Parak Karakah, Kota Padang pada November 2025, menggunakan metode pre-post test dengan lima soal pilihan ganda per sesi. Edukasi diberikan melalui presentasi, media puzzle, permainan lempar bola, mading, dan buku saku selama tiga hari. Uji-t berpasangan digunakan untuk membandingkan skor pre-test dan post-test, dengan signifikansi statistik ditetapkan pada $p < 0,05$. Hasil menunjukkan peningkatan skor pengetahuan tentang konsep Isi Piringku dari 89.6 ± 12.9 menjadi 94.1 ± 10.8 ($p\text{-value}=0.05$) serta pengetahuan jajanan sehat dari 86.6 ± 21.3 menjadi 96.1 ± 12.0 ($p\text{-value}=0.047$). Temuan ini menunjukkan bahwa pendekatan edukasi berbasis permainan yang melibatkan multisensori efektif dalam meningkatkan pengetahuan jangka pendek gizi siswa. Kegiatan ini diharapkan dapat menjadi model intervensi promotif-preventif dalam upaya perbaikan perilaku gizi sejak usia sekolah dasar.

Keyword: edukasi gizi, gizi seimbang, games, siswa

Abstract

Malnutrition among elementary school children in Indonesia remains a double burden, highlighting the need for innovative educational interventions. This community service program aimed to improve students' short-term nutrition knowledge regarding the My Plate concept and healthy snack selection. The intervention was conducted among 27 sixth-grade students at SDN 35 Parak Karakah, Padang, in November 2025, using a pre-post test design with five multiple-choice questions per session. Educational activities included presentations, puzzle media, ball-throwing games, wall magazines, and pocket books delivered over three days. A paired t-test was used to compare pre-test and post-test scores, with statistical significance set at $p < 0.05$. The results showed an increase in knowledge scores on the "Isi Piringku" concept from 89.6 ± 12.9 to 94.1 ± 10.8 ($p\text{-value}=0.05$), and healthy snack knowledge from 86.6 ± 21.3 to 96.1 ± 12.0 ($p\text{-value}=0.047$). These findings indicate that interactive, multisensory learning approaches are effective in improving students' nutrition short term knowledge. This program may serve as a promotive and preventive model to support early dietary behavior improvement among school-aged children.

Keyword: balanced nutrition, games, nutrition education, students

1. Introduction

Indonesia faces a triple burden of nutrition problems, including undernutrition, overnutrition, and deficiencies in essential micronutrients [1], [2]. Malnutrition reflects a dietary imbalance that can have a major

impact on health and well-being [3]. This problem is driven by higher nutrient demands, poor eating habits, and inadequate nutrition knowledge and often occurs in developing countries [4].

Malnutrition in children can lead to impaired physical growth, hindered development and cognitive function, and weakened immunity, increasing the likelihood of illness and even mortality [5]. Malnutrition, characterized by inadequate nutrient intake, can impact growth and cognitive development, and increase the risk of disease and death [6], [7]. On the other hand, overnutrition due to excessive energy consumption, an unbalanced diet, and low physical activity can lead to overweight and obesity, as well as increasing the risk of non-communicable diseases such as diabetes and cardiovascular disease. This situation is further complicated by the presence of individuals who are overweight but still experience deficiencies in essential nutrients [8], [9]. Therefore, comprehensive and sustainable nutritional interventions are needed to address the double burden of malnutrition through improving diets, increasing physical activity, and providing access to nutritious food to support children's future health and quality of life.

Nutritional problems among school-aged children are strongly influenced by daily eating behaviors and practices, including the high consumption of energy-dense foods such as fast food and sugary beverages, which contribute to the rising prevalence of overweight [10], [11]. Evidence from recent systematic reviews and meta-analyses indicates that these dietary practices are associated with increased energy intake, higher body mass index (BMI), and a greater risk of overweight and obesity among children and adolescents [12], [13], [14]. The main mechanisms linking SSB consumption to the risk of weight gain are decreased satiety and incomplete energy intake after consuming liquid calories [14]. Therefore, nutrition knowledge plays a crucial role in shaping healthy eating behaviors to support optimal growth and development. Nutrition knowledge is an important determinant of children's food choices because it enables them to identify healthier foods, understand dietary recommendations, and develop positive eating habits from an early age. Higher nutrition knowledge has been associated with healthier dietary behaviors and improved dietary quality [15], [16].

School children also have the potential to act as agents of change in promoting healthy lifestyles, both for themselves and their surroundings. Although dietary guidelines are available, their implementation still faces various challenges, particularly due to environmental factors and limited education, highlighting the need for more effective efforts to instill balanced eating habits from an early age [4], [17], [18]. In addition, malnutrition among school-age children is a complex problem influenced by socioeconomic, environmental, and health factors, which poses significant challenges to their well-being and educational pathways [3].

SDN 35 Parak Karakah is a public elementary school located on Jl. Parak Karakah, Kubu Dalam Parak Karakah, East Padang District, Padang City, West Sumatra. The school is easily accessible and situated in an urban area. Students come from diverse socioeconomic backgrounds, which may limit access to reliable health and nutrition information. Many students lack awareness of the importance of balanced nutrition in supporting growth, development, and overall nutritional status. Preliminary observations of the school environment revealed the presence of street vendors selling foods high in sugar, salt, and fat. In addition, SDN 35 Parak Karakah is one of the beneficiaries of the Free Nutritious Meal Program (Makan Bergizi Gratis/MBG) provided by SPPG Parak Karakah. However, community service team observations on meal acceptance indicated that students rarely consumed fish and vegetables included in the MBG menu. Social stigma and limited access to accurate nutrition information further exacerbate this condition. Initial nutritional status assessment among students in grades 4–6 showed that 9% were undernourished and 17% were overnourished.

Schools provide a strategic setting for nutrition promotion because children spend a substantial amount of time in school and can be reached through structured educational activities. Evidence shows that school-based nutrition education interventions effectively improve nutrition knowledge, fruit and vegetable consumption, and healthy eating behaviors among children. Food-based dietary guidelines such as MyPlate and Indonesia's "Isi Piringku" are designed to help children visualize balanced meal composition and encourage adequate consumption of vegetables, fruits, protein sources, and staple foods. These visual approaches are considered more practical and easier for children to understand than nutrient-based recommendations alone [19], [20]. Children who understand the concept of balanced nutrition and recognize different types of nutrients tend to be more aware in making food choices. This knowledge also plays a role in shaping healthy eating habits from an early age, which then continue into later stages of life [21]. Currently, most children in Indonesia still have insufficient and inadequate knowledge of balanced nutrition [22], [23]. This is due to a lack of education and limited access to health information. Therefore, synchronization methods need to be tailored to children's characteristics to encourage greater learning activity. Furthermore, a lack of knowledge about balanced nutrition, which leads to unhealthy eating patterns and the consumption of unhealthy snacks, is often caused by insufficient educational engagement for school-age children, leading them to choose instant or sweet foods without realizing their effects.

The use of interesting and easy-to-understand media, such as interactive games, is considered effective in improving the understanding of balanced nutrition in school-age children [24]. Game-based nutrition education has been widely applied in community service programs and has shown effectiveness in improving knowledge and attitudes among school-aged children. Game-based learning has emerged as an innovative educational strategy that enhances student engagement, motivation, and knowledge retention. Interactive educational games allow children to actively participate in the learning process, making complex nutrition

concepts easier to understand and remember [25], [26]. Studies using educational games such as DEKAZI and Ziplock Games reported significant improvements in nutritional knowledge and behavior [24], [27].

Although game-based approaches have been increasingly used in nutrition education, their application in combination with supplementary leaflets within the context of the Free Nutritious Meals program in Indonesian elementary schools remains relatively limited. The combination was designed to engage students while reinforcing key messages about balanced nutrition and healthy snack choices in support of the school-based MBG context. The primary outcome of the activity was short-term nutrition knowledge.

2. Materials and Method

2.1 Design, Time, Location, Targets

Nutrition education activities were held on November 15, 22, and 26, 2025, at State Elementary School 35 Parak Karakah, Padang Timur Subdistrict, Padang City. The study used an intervention-based educational design that incorporated interactive games and PowerPoint presentations as the main educational approaches. The target participants were 27 sixth-grade students. The primary outcome was short-term nutrition knowledge, assessed before and after the educational intervention.

The methods used in these educational activities included interactive games, PowerPoint presentations, discussions, and question-and-answer sessions. Students were asked to choose between healthy and unhealthy snacks in the interactive games provided by the community service team. In addition to the interactive games, the balanced nutrition and My Plate leaflets were also used as supplementary educational materials. The educational materials were developed based on standardized nutrition education messages from the Indonesian Ministry of Health.

Anthropometric assessment was conducted directly by the community service team. Body weight was measured in kilograms (kg), and height was measured in centimeters (cm). Body mass index (BMI) was calculated from measured body weight and height and was interpreted according to age (BMI-for-age) to determine nutritional status. Nutritional status was categorized as underweight, normal, and overweight. Statistical analysis was performed using a t-test to compare nutrition knowledge scores before and after the intervention. Statistical significance was set at a p-value < 0.05.

2.2 Activity Stages

2.2.1 Preparation Stage

The preparation stage includes identifying problems, developing educational materials and media, and preparing evaluation instruments in the form of pre-test and post-test question sheets. The preparation stage begins with coordination activities with school stakeholders to determine the schedule and technical arrangements for the activity. The community service team also conducted initial observations on student nutrition issues and eating habits. The initial observations found that many students still consumed unhealthy snacks sold around the school and disliked processed fish and vegetable dishes. Educational materials were developed based on balanced nutrition principles and the *MyPlate concept*, tailored to the cognitive levels of elementary school students. In addition, various learning media were developed, including PowerPoint presentations, interactive educational games, wall displays, and a pocketbook. Evaluation instruments in the form of pre-test and post-test questionnaires were also prepared to assess changes in students' knowledge.



Figure 1. Preparation of educational media

2.2.2 Implementation Stage

The implementation stage consists of nutrition education activities held over three sessions. The first day focused on balanced nutrition and the My Plate concept. On the second day, the session addressed healthy snacking and the importance of making informed snack choices. On the third day, educational wall media and a pocketbook titled "Super Nutrition on My Plate: Do You Know Yet?" were distributed, featuring engaging narratives and fun facts that emphasize the importance of consuming eggs, fish, and vegetables.

The delivery of materials on the first and second days utilized visual media in the form of PowerPoint presentations, complemented by question-and-answer sessions to encourage active student participation. In

addition, the content was delivered in a more interactive and engaging way through educational games that involved all sixth-grade students. Through these game-based activities, students were encouraged to engage actively with the material, thereby facilitating better understanding and retention of the information.

The educational media were designed to be visually appealing, simple, and communicative, and were tailored to the characteristics of elementary school students. The design incorporated bright colors, illustrative graphics, and easily understandable language to support students' comprehension of the material delivered through wall media, educational games, and the pocketbook.

2.2.3 Evaluation Stage

To measure the impact of the nutrition education, students completed a pre-test at the beginning and a post-test at the conclusion of the program. There were two questionnaires, each consisting of 5 questions about "My Plate" and 5 questions about "Healthy Snacks." Each question was worth 20 points, a minimum score of 0 and a maximum score of 100. The results of the difference between the pre-test and post-test will be presented in the results section, along with the statistical analysis and graphical presentation.

3. Results and Discussion

3.1 Results

The community service at SD Negeri 35 Parak Karakah was carried out in several sessions. The activity began with directions from the homeroom teacher to create a conducive instructional atmosphere. This program was attended by 27 students as the subject of the activity.

The educational process used interactive games, specifically the "Isi Piringku" puzzle and a ball-throwing game, to classify healthy and unhealthy snacks (Figure 2). These games were chosen because elementary school students tend to grasp information more easily through visual, kinesthetic, and engaging approaches. In addition to serving as a means of delivering content, puzzles and interactive games also help improve students' concentration, interaction, and active participation during the learning process. This approach is expected to create a more effective learning environment and encourage students' direct engagement in understanding the nutritional concepts presented [28].



Figure 2. Nutrition Education

The characteristics of the subjects who participated in the educational program are presented in Table 1. The majority of the subjects were female (55.6%). The average weekly allowance of the students was IDR 84,185.19 ± 32,613.16. Based on the BMI-for-age indicator, most students (77.8%) had a normal nutritional status. The mean body mass index (BMI) of all subjects was 16.94 ± 3.14 kg/m².

Table 1. Characteristics of Subjects

Variable	n	%
Sex		
Male	12	44.4
Female	15	55.6
Weekly Allowance (IDR)	84,185.19 ± 32,613.16	
Nutritional Status		
Underweight	3	11.1
Normal	21	77.8
Overweight	3	11.1
BMI	16.94 ± 3.14	

The monitoring and evaluation of the Isi Piringku educational program found that the average pre-test score for participants was 89.6 ± 12.9 , while the average post-test score was 94.1 ± 10.8 (Table 2). This indicates that the use of the Isi Piringku puzzle media helped students understand the educational material presented. This was indicated by an increase in participants' knowledge levels after the educational implementation. An evaluation of the healthy snacks material found that participants' average pre-test score was 86.7 ± 21.3 , while the average post-test score was 96.2 ± 12.0 (Table 2). Descriptively, the increase in the average post-test score indicates that the educational intervention successfully improved participants' overall understanding of the criteria for healthy and unhealthy snacks.

Table 2. Statistical analysis results

Indicator	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Δ	Sig. (p)
Knowledge of MyPlate	89.6 ± 12.9	94.1 ± 10.8	4.4	0.05
Knowledge of healthy snacks	86.7 ± 21.3	96.2 ± 12.0	9.5	0.047

3.2 Discussion

The findings indicate that the nutrition education program was associated with improved students' short-term nutrition knowledge across both educational domains. Knowledge of the My Plate concept increased from a mean pre-test score of 89.6 ± 12.9 to 94.1 ± 10.8 , with a mean increase of 4.4 points ($p = 0.050$). Knowledge of healthy snacks showed a larger increase, from 86.7 ± 21.3 to 96.2 ± 12.0 , with a mean increase of 9.5 points ($p = 0.047$). These findings suggest that the intervention reinforced students' understanding of the nutrition messages delivered during the program. However, the relatively high baseline scores, particularly for the My Plate topic, indicate limited room for improvement and a potential ceiling effect. Therefore, the magnitude of the change should be interpreted with caution.

The 'My Plate' education session began with a pre-test to assess students' baseline knowledge before the intervention. This was followed by an interactive PowerPoint presentation, complemented by a question-and-answer session. After the material was delivered, students were divided into three groups. Each group took turns arranging and placing food item images on a plate model, following the My Plate guidelines previously explained. The group that demonstrated the most accurate composition was declared the winner. The session concluded with a post-test to evaluate the improvement in students' knowledge following the educational intervention.

The improvement in knowledge of "My Plate" gained through this activity is consistent with previous studies, which showed an increase in the average scores for knowledge and attitudes regarding nutrition in the intervention group after receiving education using puzzle-based media. The hands-on learning experience students gained through the practical use of the "Isi Piringku" puzzle intervention media, as well as the delivery of information through educational sessions, contributed to this increase in knowledge [29]. In this activity, the educational process used a lecture method combined with puzzle games, thereby stimulating various senses—such as sight, hearing, and touch—as it involved both motor and visual aspects [30]. This approach helped students absorb the information more easily. Additionally, the use of game-based media made the presentation of the material more engaging and less monotonous, thereby increasing student enthusiasm.

Games are one of the nutrition education tools for children and find that they are adequate educational tools [31]. Game-based educational methods can provide students with a better sense of engagement and can be used as a long-term teaching activity. Games can help convey knowledge in an entertaining format, thus providing an alternative to nutrition education[32].

The healthy and unhealthy snacks educational activity followed a similar process: a pre-test, a presentation of the material, and division into three groups. The game used was a ball-tossing game, which featured healthy and unhealthy snacks. The educational activity concluded with a post-test. Snack selection is a familiar activity for elementary school students, particularly in school, where they are regularly exposed to a variety of snacks. The intervention directly engaged students in identifying and distinguishing healthy from unhealthy snack options through interactive activities. This contextualized learning may have helped students connect the educational messages with situations they encounter in their daily lives. Nevertheless, the present evaluation measured knowledge only; therefore, the increase in knowledge should not be interpreted as evidence that students changed their actual snack-selection behavior. Children's snacking behavior is influenced by limited knowledge of snack foods, which hinders their ability to distinguish between healthy and unhealthy options [33]. The greater increase in knowledge scores observed in the healthy snacking education compared to the *My Plate* education indicates that snack-related material is more closely aligned with students' daily experiences. Elementary school children tend to understand better and retain information that they frequently encounter in their immediate environment, such as snacks available at school. Through this educational intervention, students are expected not only to differentiate between healthy and unhealthy snacks in theory, but also to begin applying this knowledge in their daily snack choices [34].

Nutrition education can significantly increase children's knowledge about healthy snacks at school. However, behavior change will be more effective if education is accompanied by changes in the school food environment [35]. This finding is consistent with several studies reporting that the sale of ultra-processed foods high in sugar, fat, and sodium is common in many primary and secondary schools worldwide. Furthermore, the widespread availability of unhealthy foods and beverages in school settings has been shown to reduce children's selection of healthier food options [36].

The findings also highlight the potential value of combining interactive learning with visual and printed educational materials. Rather than relying on a single educational method, the program integrated interactive games, PowerPoint presentations, discussions, question-and-answer sessions, and supplementary leaflets. This combination provided repeated exposure to the same core nutrition messages through different formats. The interactive components may have increased student participation, while the leaflets provided materials that students could review after the education sessions. Because several educational components were implemented simultaneously, however, the improvement in knowledge cannot be attributed specifically to the interactive games alone.

The program has practical implications for school-based nutrition education, particularly in the context of the Free Nutritious Meals program. Nutrition education can complement the provision of nutritious meals by helping students understand the principles underlying balanced food choices and healthy snacks. In this program, the combination of interactive games and standardized nutrition education materials provided an approach that was adapted to the characteristics and learning needs of elementary school students. Continued reinforcement by teachers and the use of the educational materials after the activity may help maintain students' exposure to these messages. Involving parents and the broader school food environment would also be important if the program is intended to progress from improvements in knowledge toward healthier dietary practices.

This study has several limitations. First, the nutrition knowledge questionnaire used in this community service activity had not undergone formal validity and reliability testing. However, the questions were developed based on the nutrition education materials delivered during the intervention, which were based on standardized balanced nutrition messages from the Indonesian Ministry of Health. In addition, the primary outcome was short-term nutrition knowledge; therefore, the findings should not be interpreted as evidence of changes in students' actual dietary or snack-selection behaviors.

4. Conclusion

Nutrition education delivered through interactive games significantly improved sixth-grade students' knowledge at SDN 35 Parak Karakah across both sessions. This multicomponent nutrition education program incorporating interactive games was associated with improved short-term nutrition knowledge. This nutrition education can also support the nutrition education initiatives that are part of the Free Nutritious Meal program.

For further development, this educational program can be implemented in other elementary schools with a larger sample size, accompanied by follow-up monitoring over 1–3 months to assess sustained dietary behavior changes. In addition, parental involvement through home-based training sessions is necessary to address family-related challenges, including economic constraints.

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