ORIGINAL ARTICLE

Gamification of health classes: A quasi-experimental study of the diabetes monopoly game to enhance children's fruit and vegetable interest

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ABSTRACT

Low fruit and vegetable intake among school-aged children poses risks to health and development, often influenced by family habits and limited nutrition education. The Diabetes Monopoly (DIABETAMON) card game was developed as an engaging educational tool to promote balanced nutrition, emphasize the benefits of fruits and vegetables, and raise awareness of the consequences of unhealthy eating in a fun, child-friendly format. The objective of this study was to determine the effect of the DIABETAMON game on the interest in fruit and vegetable consumption among school-age children. A quasi-experimental design was employed, with school-aged children selected through purposive sampling and assigned to an intervention group (n = 47) and a control group (n = 52). Data were collected using a questionnaire, and statistical analysis was performed with a paired-sample t-test ($\alpha < 0.05$). The results indicated that the intervention group showed a significant increase in interest in consuming fruits and vegetables ($p = 0.001$), whereas the control group showed no significant change ($p = 0.085$). The education provided incorporates elements of learning and play, which enhance interest among school-aged children and facilitate faster absorption of information emphasizing the importance of fruit and vegetable consumption. Promotive and preventive initiatives can be implemented within health services, particularly through the School Health Services (SHS). For example, increasing the provision of interactive and engaging health education games can help promote fruit and vegetable consumption among school-aged children.

Keywords:
diabetes monopoly game, eating fruit and vegetables, interest school-age children

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INTRODUCTION

School-aged children, aged 6 to 12 years, represent the nation's next generation.[1] According to the SEANUTS II Child Nutrition Survey (2019–2021), 50% of Indonesian children (5–12 years) do not consume enough fruits and vegetables. This finding is also consistent across the school-age group 6–12, including the 8–10-year-old group.[2,3] Recent research indicates that children consume 59.3% fewer fruits and vegetables, 89.8% less protein, and 47.4% more fat, reflecting unhealthy dietary behaviors. Fruits and vegetables are essential components of a healthy diet, and adequate daily consumption can help prevent many chronic non-communicable diseases.[4] Previous survey results indicated that students' knowledge of safe food was 57.1%, reflecting deficiencies in selecting safe and balanced meals, as well as in food preparation and serving practices. Additionally, 49% of students exhibited less supportive attitudes toward making safe food choices, and 48.7% demonstrated inadequate practices, particularly in choosing healthy snacks and maintaining proper handwashing techniques.[5] It was found that 23.2% of the nutritional status values were overnourished, and 87.4% of students rarely ate fruits and vegetables.[5,6]

Low fruit and vegetable consumption among school-aged children has been linked to several serious health problems, including malnutrition, anemia, deficiencies in vitamins A, D, E, and folate, as well as stunting and childhood obesity.[7] Insufficient fruit and vegetable intake places children at a higher risk of long-term developmental issues, such as cognitive impairments, as well as chronic diseases in adulthood, including diabetes mellitus.[8] Fruits and vegetables provide numerous benefits for children's development, supplying essential vitamins and minerals—such as vitamins A, C, and E, and calcium—which support cell growth and the formation of body tissues.[9] Developing the habit of consuming fruits and vegetables from an early age can support optimal physical growth, cognitive development, and overall health in children, although some may resist vegetables due to their shape, color, or taste.[10] Therefore, it is necessary to provide a form of health education for schoolchildren to improve balanced nutrition and physical activity.[11,12] One of these is the increase in fruit and vegetable consumption.[13] Additionally, other research has reported that health education programs effectively increase knowledge of nutrition and food safety among elementary and high school children in China. This highlights the need for comprehensive health promotion programs that address nutrition and food safety, particularly in relation to children's snacking habits.[14,15]

School-aged children are at a developmental stage in which play is a central aspect of daily life, representing an inherent and naturally occurring behavior consistently observed in their everyday activities.[16] Games in early childhood education serve as a foundation for learning, helping children connect experiences at home and at school. Through play, children gain multiple benefits, including enhanced logical and cognitive skills, brain stimulation, and the development of imagination.[17] The DIABETAMON game in this study was not intended merely to introduce the concept of diabetes as a disease but was designed as a behavioral education tool that emphasizes the causal relationship between dietary patterns—particularly fruit and vegetable consumption—and diabetes risk from an early age.[18] Through a gamification approach, children gain not only cognitive knowledge but also engage in affective and behavioral learning

processes via simulations, challenges, and a reward–punishment system embedded within the game.[19] This learning mechanism works by increasing health awareness and outcome expectancy, where children understand that healthy food choices (fruits and vegetables) play a protective role against diabetes.[20] This understanding subsequently shapes eating attitudes and interests through a process of internalizing health values in a fun and non-patronizing way. Consequently, learning about diabetes through the DIABETAMON game provides a meaningful and relevant context for fostering healthy eating preferences in children.[21]

Educational games were chosen to improve school-aged children's understanding of the importance of consuming fruits and vegetables, as prospective cohort evidence indicates that each additional daily serving of fruit can reduce the risk of type 2 diabetes mellitus by approximately 7%.[22] Early diabetes prevention efforts benefit from engaging approaches that align with children's developmental characteristics, such as interactive and enjoyable educational games. Previous studies have demonstrated that game-based interventions, ranging from video games to cafeteria-based games, can successfully increase children's fruit and vegetable consumption in the short- and medium-term.[23,24] While the use of board games as a medium for health education, such as the nutrition-themed Snakes and Ladders game, has been widely reported in the literature, DIABETAMON has distinctive characteristics.[25] DIABETAMON goes beyond delivering general health messages by specifically integrating concepts of diabetes, risk factors, and healthy food choices into the game mechanics, storyline, and scoring system. Unlike conventional board games, which provide one-way information, DIABETAMON is designed around problem-based learning and behavioral reinforcement, where each player's decisions regarding food consumption have direct consequences in the game. This experiential approach enables children to learn through active participation, making health messages easier to understand, remember, and potentially translate into sustainable eating habits.[26]

Therefore, Diabetes Monopoly (DIABETAMON), a Monopoly-style game incorporating educational, competitive, and interactive elements, can serve as an effective tool for early diabetes education and prevention by promoting fruit and vegetable consumption. The interactive gameplay engages children, increasing their interest in learning and facilitating the absorption of educational messages. By actively participating in the game, children better understand the material, making the learning process more effective and enjoyable.[27–30] The objective of this study was to determine the effect of the DIABETAMON game on the interest in fruit and vegetable consumption among school-age children.

METHODS

A quasi-experimental design was employed. School-aged children were selected through purposive sampling and assigned to an intervention group (n = 47) and a control group (n = 52). The selection of schools and classes was based on several objective criteria, including alignment of students' age with the intervention objectives, the schools' readiness to support the study, and the ease of access and continuity of support throughout the intervention period. Furthermore, initial information from the schools indicated that students' fruit and vegetable consumption was relatively low and that they had not previously received structured game-based educational interventions. These factors made the selected schools suitable research sites for evaluating the effectiveness of the DIABETAMON game in increasing

interest in fruit and vegetable consumption among elementary school-aged children.

The inclusion criteria for the study were students in grades 2–4 (ages 8–10), parental consent, and willingness to participate. Participants were recruited from four elementary schools. The intervention was conducted twice weekly for 60 minutes, over a total of six sessions spanning three weeks. The DIABETAMON game was administered to the intervention group. To address potential ethical concerns and ensure equitable benefits, the control group received a single health consultation on healthy eating after the final measurement had been completed. This approach was adopted to address ethical considerations while ensuring that all participants received relevant health education without compromising the validity of the study's measurements. The DIABETAMON game intervention was developed by community nursing specialist students as a learning tool for delivering health promotion to school-aged children. The gameplay method of DIABETAMON is illustrated in Figure 1.

The first questionnaire collected data on respondent characteristics, including age, gender, and grade level. It also gathered self-reported information on physical activity, such as participation in morning exercise or light sports for 30 minutes, as well as habits related to fruit and vegetable consumption and daily mineral water intake. The pre-test questionnaire was administered directly by the researchers before the intervention, while the post-test measurement was conducted after a one-week internalization phase. The internalization phase is a follow-up period that occurs after participants have acquired knowledge and experience during the cognitive and affective phases, allowing the information or materials provided to be absorbed, internalized, and consistently applied to form relatively permanent behaviors at home.

The second questionnaire was adapted from previous research and focuses on consumer interest and knowledge regarding the role of fruits and vegetables in a healthy diet.[31] Questionnaire measurements were carried out by researchers before and after the intervention was carried out on both the intervention group and the control group. The validity test showed good internal consistency and intra-class correlation, with r values ranging from 0.421 to 0.852, all exceeding the critical r table value of 0.296, indicating that each questionnaire item was valid. The Cronbach's alpha was 0.874, demonstrating high reliability. The questionnaire assessing participants' interest in the importance of consuming fruits and vegetables consisted of statements with response options scored as follows: "No" or "Never" = 0, and "Yes" = 1. The final section of the health card addresses the importance of consuming fruits and vegetables, while the sick card contains questions and educational content on diabetes, including its signs and symptoms, causes and risk factors, prevention, treatment, and complications. Interest was assessed by calculating an index as the mean score across all participants. The level of interest was then categorized as follows: low/poor (mean < 56), sufficient (mean 56–75), high (mean 76–86), and very high (mean > 86).

Bivariate analysis was conducted to assess the increase in school-aged children's interest in consuming fruits and vegetables through the DIABETAMON game. A paired-sample t-test ($\alpha < 0.05$) was used to evaluate within-group differences, while a pooled t-test was employed to compare mean differences between the intervention and control groups after the intervention. Normality of the data was confirmed using the Kolmogorov-Smirnov test, yielding p-values of 0.334 for the intervention group

and 0.221 for the control group, indicating that the data were normally distributed. Researchers provided consent forms for participants and parents to sign.

RESULTS

The results of the questionnaire on respondent characteristics are presented as a frequency distribution. The table summarizes categorical data, including age, gender, grade level, exercise habits, fruit and vegetable consumption, and mineral water drinking habits. Based on Table 1, most respondents in the intervention group were 8 years old, while most in the control group were 10 years old. Females comprised 57.4% of the intervention group and 69.2% of the control group. The intervention group consisted of third-grade students, whereas the control group consisted of fourth-grade students. Most of the respondents in the intervention and control groups did not exercise for at least 30 minutes a day, did not have the habit of eating fruit and vegetables, and drank less than five glasses of mineral water per day.

Based on Table 2, the mean cognitive score of school-aged children in the intervention group increased from 48.27 before the intervention to 81.05 after the intervention. A smaller increase was observed in the control group, from 48.99 before to 50.18 after the intervention. Based on Table 3, a significant increase in interest was observed among school-aged children in the intervention group before and after participating in the DIABETAMON game ($p = 0.001 < 0.05$). In contrast, the control group showed no significant change in interest ($p = 0.085 > 0.05$), likely due to the differences in the interventions provided to each group.

Based on Table 4, cognitive improvements were observed in school-aged children across each game session, from the first to the third. Participants' responses increased with each session, likely because the educational activities incorporated elements of fun and play, which encouraged active engagement and enthusiasm.

DISCUSSION

The study on the implementation of the DIABETAMON game found that school-aged children's interest in consuming fruits and vegetables increased. Game-based educational interventions can promote fruit and vegetable consumption in this age group by enhancing knowledge, motivation, and collaborative problem-solving skills.[32] Educational game media, such as interactive quizzes, puzzles, and thematic board games, have been shown to significantly increase elementary school children's fruit and vegetable knowledge and consumption.[33] Other studies have reported that using game-based media can enhance the cognitive abilities of school-aged children, positively influencing their understanding of the importance of fruit and vegetable consumption and supporting the maintenance of healthy behaviors.[34] However, further research is needed to clarify the benefits of educational games, as evidence from previous studies remains mixed.[35] Additionally, the involvement of teachers is essential for the effective implementation of this game, as they guide participants while providing information on the importance of fruit and vegetable consumption.[36]

The DIABETAMON game is designed to raise participants' awareness of fruit and vegetable consumption through the use of interactive props. Each stage of the game includes questions featured on health and sickness cards, which are presented within a balanced nutrition box and a question mark box. The DIABETAMON game is grounded in the principles of game-based health education, which recognize educational board games as a promising tool for health promotion due to their integration of challenge,

collaboration, and role differentiation, thereby effectively enhancing participants' awareness and knowledge.[37] Furthermore, a recent systematic review demonstrated that gamification-based interventions incorporating question mechanisms, badges, challenges, and teamwork can significantly enhance knowledge, attitudes, and behaviors related to fruit and vegetable consumption among children and adolescents.[38] Consistent with previous studies, the use of the Snakes and Ladders board game was found to increase students' knowledge and attitudes regarding school snacks.[39,40] Another study using the board game Monopoly had a significant effect on student performance and interest.[41] This study reflects the outcomes of a game-based health promotion intervention aimed at increasing school-aged children's interest in consuming fruits and vegetables. Similarly, another study reported differences in scores between intervention and control groups in infection control education using the television-based game Family Feud.[37]

Health education and promotion using game-based media is highly recommended for nurses conducting interventions with school-aged children. As an alternative strategy for disseminating health information, game-based health education has been found to be more effective than traditional methods. This approach has the potential to stimulate participants' interest and motivation, enhance learning outcomes, and promote positive behaviors related to healthy living.[42] The primary advantage of game-based health education lies in its ability to leverage children's existing developmental capacities and learning mechanisms. The use of audiovisuals and videos within games plays a crucial role in supporting participants' cognitive and experiential development. In the context of nursing interventions for school-aged children, integrating games can serve as an effective tool to actively engage and educate them.[34]

The control group did not exhibit significant changes because they were exposed only to a single health consultation after the final assessment, which was insufficient to meaningfully influence their interest in healthy eating. In contrast, the intervention group demonstrated significant improvements, as the DIABETAMON game provided an active, repetitive, and enjoyable learning experience that reinforced understanding and fostered positive attitudes toward fruit and vegetable consumption. This difference in response confirms that changes in children's eating behaviors are more effectively achieved through experiential educational approaches than through passive information delivery. Furthermore, differences in grade levels (Grades 3 and 4) may have influenced the results due to variations in cognitive maturity and the ability to comprehend health-related concepts. However, the relatively balanced distribution of grade levels between the intervention and control groups is expected to reduce potential bias and enhance the methodological rigor of this study.

The existing literature provides encouraging evidence supporting the use of game-based health education among students. Previous studies have demonstrated that game-based teaching strategies, including interactive games, can effectively increase school-aged children's interest in consuming fruits and vegetables.[23] Emerging evidence indicates that game-based teaching strategies, including interactive games, hold considerable potential for enhancing active learning and effectively increasing school-aged children's knowledge and interest. Accordingly, teachers are encouraged to select learning methods that are appropriate to their instructional goals and students' needs.[43] Prior studies have demonstrated the promising potential of

incorporating game-based learning into nursing education.[44]

A limitation of this study is the absence of parental involvement in the DIABETAMON game, which restricted the ability to assess children's actual eating and snacking habits both at home and at school. In addition, there was no evaluation of the student notebooks used as home-based activity sheets. The lack of parental engagement and the absence of assessment of children's activities at home may have limited the internalization of healthy eating habits beyond the school environment. Without reinforcement from the family environment, changes in eating habits resulting from interventions are likely to be short-term and heavily influenced by the play context. This underscores the need for an ecosystem-based approach to sustaining healthy eating behaviors, one that actively involves both the school and the home. Therefore, future research is recommended to incorporate parental involvement and home-based activity monitoring to strengthen the internalization phase and support sustained long-term behavior change. In addition to the lack of parental involvement, another important limitation of this study concerns the follow-up duration. Because interest was measured immediately after the intervention, long-term changes in interest as well as actual dietary behavior were not assessed.

RECOMMENDATIONS

The study results demonstrated an increase in school-aged children's interest in consuming fruits and vegetables following education delivered through the DIABETAMON game. This improvement is likely attributable to the integration of learning and play elements, which enables children to more easily and effectively absorb information about the importance of fruit and vegetable consumption. Accordingly, the use of this approach is recommended for inclusion in school health policies and child nutrition promotion programs. Gamification-based educational games such as DIABETAMON have the potential to be integrated as mandatory modules within physical education, health education, or student profile–strengthening activities in elementary schools to foster interest in fruit and vegetable consumption from an early age. Furthermore, these findings may serve as a foundation for local health offices to adopt educational game–based media as part of diabetes prevention initiatives and balanced nutrition promotion programs for school-aged children. Cross-sector integration between schools and health services is expected to strengthen the sustainability of school-based interventions and promote meaningful changes in children's eating behaviors. In addition, future research should consider employing a true Randomized Controlled Trial (RCT) design by randomizing students within the same grade level to minimize potential bias.

FIGURES AND TABLES

This table presents the distribution of respondent characteristics in the intervention and control groups, including age, gender, grade level, exercise habits, fruit and vegetable consumption, and mineral water drinking habits. The majority of participants were aged 8–10 years, with a relatively balanced gender distribution. These data reflect the diversity of children's baseline characteristics prior to the intervention, as shown in Table 1.

Table 1. Distribution of Respondent Characteristics

Respondent Characteristics	Intervention (n=47)		Control (n=52)		p-value
	f	%	f	%	
Age					
8 years	20	42.6	15	28.8	0.007
9 years	16	34.0	17	32.7	
10 years	11	23.4	20	38.5	
Gender					
Man	20	42.6	24	46.2	0.073
Woman	27	57.4	28	53.8	
Class					
Class 2	12	25.5	7	13.5	0.036
Class 3	18	38.3	20	38.5	
Class 4	17	36.2	25	48.0	
Exercise habits (30 minutes)					
Yes	13	27.7	18	34.6	0.066
No	34	72.3	34	65.4	
Fruit & vegetable eating habits					
Yes	5	10.6	4	7.7	0.490
No	42	89.4	48	92.3	
Mineral water drinking habits					
< 5 glasses	41	87.2	48	92.3	0.128
> 5 glasses	6	12.8	4	7.7	

This table presents the mean changes in school-aged children's interest in fruit and vegetable consumption before and after the DIABETAMON game intervention. A significantly greater increase was observed in the intervention group compared with the control group. These findings demonstrate the effectiveness of the DIABETAMON game in enhancing children's interest in consuming fruits and vegetables, as shown in Table 2.

Table 2. The interest of school-age children before and after being given education through the DIABETAMON game

Group		Mean	Min-Max	SD	95% (CI)
Intervention	Before	48.227	24-76	15.11	19.73 – 24.18
(n=47)	After	81.054	56-96	9.60	37.12 – 41.09
Control	Before	48.993	24-76	15.15	19.47 – 23.27
(n=52)	After	50.183	24-76	15.30	19.46 – 23.23

This table presents the differences in children's interest levels before and after the intervention based on the results of the statistical analysis. The intervention group demonstrated a significant increase in scores ($p < 0.05$), whereas no significant change was observed in the control group. These findings indicate that the DIABETAMON game plays a significant role in enhancing children's interest in consuming fruits and vegetables, as shown in Table 3.

Table 3. Differences in the interest of school-age children before and after being given education through the DIABETAMON Game

Group	Mean	SD	95% (CI)	T	*p-value*
Intervention	32.826	13.514	28.859 – 36.795	16.653	0.001*
Control	1.190	4.88	0.171 – 2.551	1.756	0.085

**p-significant< 0.05*

Figure 1 illustrates the stages of the DIABETAMON educational game, which is designed to enhance school-aged children's interest in consuming fruits and vegetables. Each stage begins with an apperception activity, followed by reading the guide, explaining the game rules, and carrying out interactive gameplay. In addition, the game incorporates health cards, sick cards, and reflection activities to strengthen the educational message related to healthy eating behaviors.

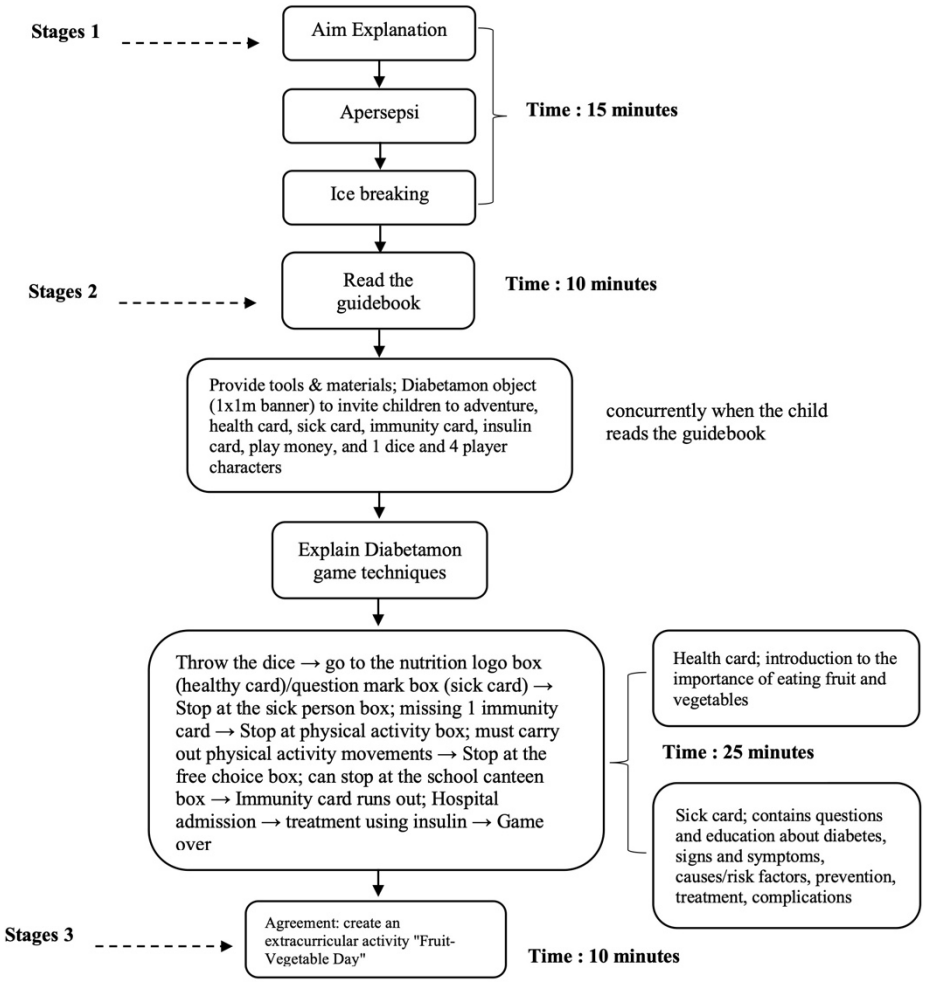


Figure 1. Stages of the DIABETAMON Game

AUTHORS' CONTRIBUTIONS

AA: Conceptualization, and Writing–original draft. AZ: Methodology, and Supervision. IR: Methodology. EVY: Data Curation. EW: Investigation, and Formal Analysis. SHB: Investigation, and Formal Analysis

ETHICAL CONSIDERATION

This study was approved by the Ethics Committee of Universitas Bina Sehat PPNI Mojokerto (Protocol No. IV.a/ 82/KE/VII/2024, approved on July 10, 2024). Ethical considerations in conducting the research included obtaining informed consent and assent, adhering to the principle of non-maleficence, ensuring confidentiality and privacy, providing age and developmentally-appropriate materials, respecting the right to refuse participation, ensuring relevant benefits, and maintaining supervision and protection throughout the study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest in this study.

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