

Effectiveness of game board-based learning on improving nutrition knowledge about pedoman gizi seimbang and isi piringku in elementary school students

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Abstract

This study aimed to evaluate the effectiveness of board games in improving students' knowledge of the Pedoman Gizi Seimbang and Isi Piringku at the elementary school level, compared to the lecture method. The Pedoman Gizi Seimbang is a framework established to promote healthy eating behaviors and lifestyles in Indonesia, emphasizing variety, portion control, physical activity, and hygiene. A key component of this guideline is Isi Piringku, which visually illustrates the ideal composition of a balanced meal—consisting of staple foods, animal and plant-based proteins, vegetables, and fruits in appropriate portions. This study used a quasi-experimental design with pre-test and post-test involving two groups: an experimental group (n=29) that received the board game intervention, and a control group (n=29) that received the lecture method. The intervention in each group was conducted for 1 week with 45 minutes in one session. The results of the analysis using Wilcoxon test showed that the lecture method significantly improved students' knowledge ($p=0.041$), while the use of board game did not provide significant improvement ($p=0.33$). The Mann-Whitney test showed no significant difference between the two methods in increasing students' knowledge ($p=0.36$). In conclusion, the lecture method is more effective in the short term, while the board game requires a longer duration to produce a significant impact.

Keywords: Board Game, Pedoman Gizi Seimbang, and Isi piringku

INTRODUCTION

Childhood is an important phase in human development, during which physical growth is rapid (Matonti et al., 2020). However, challenges related to health and nutrition also arise. One of them is obesity in children and adolescents, which is a serious concern with increasing prevalence. By 2022, it is estimated that more than 390 million children and adolescents aged 5–19 years are overweight and 160 million are obese (World Health Organization, 2024). In Indonesia alone, in 2018 the

prevalence of overweight and obesity in adolescents and children increased to 20% from 18.8% in 2013. Meanwhile, according to the Central Java province Riskesdas report in 2018, cases of obesity in children aged 5–12 years reached 27.87% (Riskesdas, 2018). These rising rates of obesity are closely associated with lifestyle-related factors, particularly inadequate physical activity and poor dietary habits among school-aged children. Factors such as lack of physical activity in children aged 10–14 which reached 64.4% and lack of consumption of vegetables and fruits in children aged 10–19 years to reach 98% are the main causes of the problem (Badan Penelitian dan Pengembangan Kesehatan, 2019). Beyond these behaviors, children's cognitive development also plays a significant role in shaping their eating patterns. Children's lack of vegetable and fruit consumption is a form of poor eating behavior, which at this time is influenced by children's rapidly developing cognitive growth, thus affecting the habits and information they receive. During late childhood, children experience rapid cognitive growth, including improved reasoning, attention, and memory skills, which makes them more receptive to external influences such as peers, media, and educational content (Aly and Efendi, 2024). When nutrition-related information is not effectively communicated in a way that matches their cognitive level, children may adopt unhealthy dietary habits. Therefore, to improve eating behaviors, nutrition interventions must not only provide accurate information but also consider how children learn and process knowledge. Nutrition is fundamentally linked to education, as well-nourished children tend to have better cognitive function, concentration, and academic performance, whereas poor nutrition can impair learning ability and school attendance. Therefore, it is important to establish good eating attitudes and behaviors early on (Asakura et al., 2017).

To address these behavioral and cognitive challenges, schools are a strategic setting for delivering nutrition education. Although efforts have been made through curricula on nutrition in primary schools and nutrition education materials for primary schools by UNICEF (2019), but the implementation has been uneven across schools. This emphasizes the need for breakthroughs in learning methods that are more interactive and fun to meet the special needs of childhood. In recent years, several studies have highlighted the use of educational games as an effective learning method (Kim et al., 2017; Jin et al., 2018; Sabirli and Çoklar, 2020). Board games have been shown to maintain students' positive emotions, increase learning motivation, and integrate disciplinary content (Chen et al., 2020), even being an effective alternative during the pandemic to increase student engagement (Chans and Portuguese Castro, 2021). Several studies have shown that board games such as Kaledo can significantly improve nutrition knowledge ($p < 0.05$) (Amaro et al., 2006; Viggiano et al., 2015), even on specialized topics such as breastfeeding (Martins et al., 2018). Therefore, board games have been shown to have a positive impact on improving students' knowledge, learning motivation, and play experience (Byusa et al., 2022).

Although many board games are available, most are not suitable for classroom teaching and are limited in the context of health and nutrition, especially in Indonesia (Chiang et al., 2022). Moreover, many of these games lack alignment with national nutrition guidelines and fail to reflect local dietary patterns, reducing their relevance and effectiveness in Indonesian schools. Unlike previous studies, which focused on general nutritional concepts or specific topics such as obesity or breastfeeding, this research integrates national dietary guidelines—Pedoman Gizi Seimbang and Isi Piringku—into an educational board game aligned with the Indonesian primary school curriculum. The Pedoman Gizi Seimbang is a framework established to promote healthy eating behaviors and lifestyles in Indonesia, emphasizing variety, portion control, physical activity, and hygiene. A key component of this guideline is Isi Piringku, which visually illustrates the ideal composition of a balanced meal—consisting of staple foods, animal and plant-based proteins, vegetables, and fruits in appropriate portions (Kementerian Kesehatan Republik Indonesia, 2014).

This study aims to fill the gap by applying game-based learning theory, which incorporates the concept of Pedoman Gizi Seimbang, especially the Isi Piringku, into the daily curriculum

through board games. This research contributes to early childhood education by providing an innovative, developmentally appropriate learning tool that supports the formation of healthy eating habits through engaging, game-based experiences, ultimately promoting better health and academic outcomes. The results of the preliminary study conducted on December 6, 2023, involving 27 fifth grade students of SD Negeri Wates 01, showed that most students had a low understanding of the Pedoman Gizi Seimbang and the Isi Piringku, where 67% of students scored below 60%. In addition, 60.7% of students were categorized as overweight and obese. These findings further highlight the need for innovative and localized educational interventions that directly target the intersection of nutrition and learning outcomes in Indonesian children. Based on this background, the proposed problem formulation is: “How effective is the use of board games as learning media in improving students’ knowledge of Pedoman Gizi Seimbang and Isi Piringku at the elementary school level?”

MATERIALS AND METHOD

2.1 Materials

This research was implemented at SD Negeri Wates 01 and 02, which is located in an area that is easily accessible and has facilities that support the learning process. This research took place during the period of May 20 to 31, 2024. The type of research is quantitative with a Quasy experiment research design using a post-test – pre-test with control group approach. This research procedure involves dividing the subjects into two groups, namely the control and experimental groups. With a sample of 58 students in 5th grade selected using the purposive sampling technique. The sample consisted of 29 students for the experimental group and 29 students for the control group. In the experimental group, students were divided into two large groups, each of which was further divided into four small groups of three to four students. Each group underwent pre-test and post-test stages. The control group received the intervention of learning about Isi Piringku and Pedoman Gizi Seimbang through the lecture method. Meanwhile, the experimental group received the same intervention, but used board game-based learning media. The research design can be seen in the following table:

Table 1. Research design

		Pre-test	Intervention	Post-test
1	Experiment	1a	X1	1b
2	Control	2a	X2	2b
<i>1a</i> : Pre-test to the experimental group				
<i>1b</i> : Post-test to the experimental group				
<i>2a</i> : Pre-test to control group				
<i>2b</i> : Post-test to control group				
<i>X1</i> : Application of board game media				
<i>X2</i> : Application of lecture method				

Activities were carried out for 1 week, with 45 minutes per meeting for each group. The first week was used to implement the program for the experimental group and the second week for the control group. One day before and after the program, a pre-test and post-test were conducted using a questionnaire.

2.2 Research Instrument

2.2.1 Board Game

The game includes real-life simulations with the aim to teach the principles of Pedoman Gizi Seimbang and help students understand the importance of healthy food. Players explore 18 different locations on the board, including a food stall, weighing station, sports venue, and hygiene or physical

activity counters. They will walk along the game board, take turns rolling the dice, and collect food, drink, or item cards at several places. The main objective of the game is to complete the given mission, which corresponds to the 4 pillars of Pedoman Gizi Seimbang and Isi Piringku. Each mission encourages students to make healthy choices and apply nutrition knowledge throughout the game. Through this game, students are expected to achieve several learning outcomes, including increased knowledge about Pedoman Gizi Seimbang and appropriate food distribution in daily meals. In addition, the game aims to develop students' positive attitudes toward nutrition by enhancing self-efficacy and encouraging healthy eating behaviors in line with Isi Piringku.

A. Game Components

The game set, as shown in Figure 1, consists of several components. It includes a large-sized game board as the main playing area. There are mission cards that present four different missions based on the 4 Pillars of Pedoman Gizi Seimbang and the detailed contents of Isi Piringku. The set also includes food and drink cards, featuring 28 types of food divided into four categories: staple foods, side dishes, vegetables, and fruits. Additionally, there are 6 drinking water cards. A scale card is provided to show the results of the weighing process during the game. The game also includes activity tickets, representing 8 different activities grouped into hygiene and physical activity categories. Opportunity cards offer six types of functions, such as buying a card or ticket, exiting the dugout without answering a question, taking an opponent's card, exchanging cards, moving to a specific space, or stepping back a few spaces. Finally, there are question cards containing 10 questions related to Pedoman Gizi Seimbang and Isi Piringku.



Figure 1. Sketch of the game board set

B. Game rules

It is recommended that four groups of 3–4 players each. Each group places a representative token at the starting position. The opportunity and question cards are face down on the board. Every group begins with 50,000 in starting funds. To determine the order of play, each group rolls the dice once; the highest roll goes first, and play proceeds clockwise. On a player's turn, they roll the dice

and move according to the number rolled. Players may only purchase cards or tickets that match the location where they land—for example, buying a vegetable card at a vegetable stall—by paying the price shown. If a player lands on an opportunity space, they must draw and follow the instructions on an opportunity card. When a player passes the “start” box, they will get 10,000 from the bank. Then when someone lands on the break room then they have to answer the question on the stack of question cards. When answering questions, group mates can help but they have to pay a fine of 5,000. If the group cannot answer—or chooses not to answer—their turn is skipped for the next two rounds. The game continues in this manner until one group successfully completes their mission. If a group runs out of money and cannot sell any cards, the other groups compare their cards to the mission goals. The group with the most matching cards wins. In the event of a tie, each group adds up its remaining money, and that value is added to the score.

C. Principles of game design

Based on the key points in the literature review, the game incorporates three main elements: quantitative thinking, more operational knowledge, and social interaction. During the game, students must remember which food items and activity tickets are needed to complete their mission. This process supports memory reinforcement and encourages decision-making. When players land on the break room, they must answer nutrition-related questions, which requires them to recall and apply knowledge. This mechanism strengthens the connection between theoretical concepts and practical application. In alignment with the Pedoman Gizi Seimbang, students are encouraged to consume more staple foods and vegetables, and fewer side dishes and fruits. Therefore, students need to use strategies to get more mission-appropriate cards and leave unhelpful cards. The professional part of the game refers to the nutritious action teaching materials (UNICEF, 2019). Board games not only provide entertainment, but also provide significant learning benefits. Through enhanced social interaction, players learn to cooperate and communicate. They also develop cognitive skills such as strategic thinking and problem solving. These real-life experiences in games can stimulate creativity and imagination.

2.2.2 Questionnaire

The questionnaire used in this study contains Pedoman Gizi Seimbang and Isi Piringku that have been tested for validity and reliability first. With the results of the validity test, it is known that there are eight questions out of 20 items that are invalid (Sig.<0.05) so that the question is eliminated. While the reliability results of the 12 questions used said that the Cronbach's Alpha value = 0.707 (>0.7) so it can be said that the research questionnaire question items are reliable and can be used as research instruments.

2.3 Research Step

As shown in Fig. 3, students in the experimental group were divided into two large groups of 14–15 students and further divided into 4 small groups (each consisting of 3–4 students) to play the game. The activity lasted about 45 minutes. The game was led by a tutor who was in charge of selling the cards that the player groups had to buy and reading out the questions in the break box.

2.4 Data analysis procedures

Quantitative data analysis was conducted with the SPSS version 27 program, including normality and homogeneity tests in uni-variate analysis. Bi-variate analysis used Wilcoxon test to compare scores before and after the intervention. Comparison between groups used Mann-Whitney test, with significance at p value <0.05.

RESULT AND DISCUSSION

3.1 Result

The subjects involved in this study were 58 people. During the study, all fifth grade students were asked to provide general data including age and gender. Complete data on subject characteristics are presented in Table 2.

Table 2. Characteristics of Research Subjects

No	Characteristics	Total (N = 58)	
		n	%
1	Age (11.21±0.487)		
2	Subject by gender		
	Male	21	36.2
	Female	37	63.8



Figure 2. Game implementation

3.1.1 Students’ Knowledge After Board Game Intervention

After the intervention using the board game, the test results showed an increase in student knowledge, although statistically the increase was not significant. As shown in Table 3, the average student score increased, but the significance value is far above the threshold. This result indicates that while there was a numerical improvement, it cannot be conclusively attributed to the intervention due to the lack of statistical significance. In other words, this increase in knowledge is most likely due to other factors rather than the one-week board game intervention. This indicates that the board game, in the context of this study, did not have a significant impact on improving students’ knowledge.

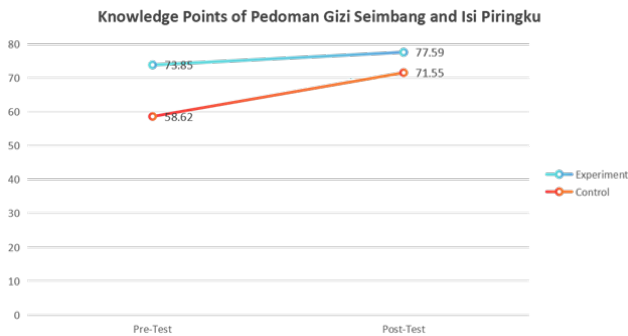


Figure 3. Students’ knowledge before and after intervention

3.1.2 Students' Knowledge After the Lecture Method Intervention

The intervention using the lecture method showed a significant increase in student knowledge, as seen in the test results in table 2 with a p-value of 0.01 ($p < 0.05$). The increase in the average score of students' knowledge indicates that the difference between the pre-test and post-test results is statistically significant. This result suggests that the observed improvement in knowledge can be confidently attributed to the lecture method intervention. In other words, the increase in student knowledge was not due to chance or external factors, but rather to the effectiveness of the lecture method itself. This indicates that the lecture method, within the one-week duration of this study, had a significant impact on improving students' knowledge.

Table 3. Students' knowledge of Pedoman Gizi Seimbang and Isi Piringku before and after intervention

Group	Type of test	Knowledge Points			p-value
		Min	Max	Mean $\pm$ SD	
Experiment	Pre-test	41.67	100.00	73.85 $\pm$ 13.68	0.18
	Post-test	33.33	100.00	77.59 $\pm$ 13.57	
Control	Pre-test	8.33	91.67	58.62 $\pm$ 18.16	0.01
	Post-test	25.00	100.00	71.55 $\pm$ 24.85	

Non-parametric test (Wilcoxon Test)

Significant at alpha value of 0.05

n Experiment = n Control = 29 people

3.1.3 Students' Knowledge after Board Game and Lecture Intervention

The results of the test comparing the effectiveness of the two methods showed that there was no significant difference between the board game and lecture interventions in improving students' knowledge. As shown in Table 4, the p-value of 0.77 ($p > 0.05$) indicates that the difference in knowledge improvement between the two groups is not statistically significant. This result suggests that, although the lecture method individually led to a significant increase in knowledge, when directly compared to the board game method, there was no clear statistical advantage. In other words, both methods resulted in knowledge gains, but the difference in their effectiveness was not large enough to be considered significant. This indicates that within the duration and context of this study, neither method proved to be superior to the other in improving students' knowledge.

Table 4. Comparison of students' knowledge of Pedoman Gizi Seimbang and Isi Piringku between intervention

Group	Pre-test	Post-test	Knowledge Point Change	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD ()	
Experiment	73.85 $\pm$ 13.68	77.59 $\pm$ 13.57	3.74 $\pm$	0.77
Control	58.62 $\pm$ 18.16	71.55 $\pm$ 24.85	12.94 $\pm$ 23.75	

Non-parametric test (Mann-Whitney Test)

Significant at alpha value of 0.05

Δ^* = The result of reducing the knowledge points for Pedoman

Gizi Seimbang and Isi Piringku (post - test - pre - test)

n(Experiment) = n(Control) = 29 people

3.2 Discussion

3.2.1 Interpretation of Board Game Intervention Results

The short duration of the intervention may be a contributing factor to the insignificance of the result. Previous studies have shown that board games take longer to have a significant impact. For example, a study by Chiang et al., 2022 reported a significant increase in knowledge after a six-week

board game intervention. This suggests that a longer time allows students to better engage with the material, integrate knowledge, and benefit from interactive learning. This contrasts with the present study, which was conducted over only one week, likely limiting the depth of students' knowledge acquisition and interaction with the material. A short intervention period may not allow enough time for students to become familiar with game rules, explore nutrition-related concepts deeply, or reflect on what they learned.

In addition, differences in students' individual characteristics, such as learning style preferences, may also affect the effectiveness of board games. Negara, 2017 found that students' learning styles can affect how they receive and process materials. In line with Negara, 2017, this study showed high engagement levels during game sessions, yet this engagement did not convert into statistically significant knowledge improvement. This differs from previous findings such as those of Ningtyas et al., 2024, who found a positive correlation between learning style compatibility and improved cognitive outcomes in game-based learning. A possible explanation is that the game mechanics used in this study may not have been adequately tailored to diverse learning preferences. For example, visual learners benefit more from colorful, interactive components, while auditory learners benefit more from spoken explanations, challenge-based questions, and reflective discussions that involve listening and verbal processing (Rogowsky et al., 2020; Kurdekar and Sushma, 2020).

Although the results in this study were not significant, board games still have potential as an effective learning tool, especially for increasing student engagement and motivation. Some research suggests that board games can help students develop cognitive and social skills, although the impact on knowledge may take longer to show (Sousa et al., 2023). These findings align partially with Sousa et al. (2023), who emphasized that board games enhance critical thinking, decision-making, and cooperation, but require continuous reinforcement for knowledge acquisition. Unlike this study, Sousa's intervention included weekly sessions over two months, along with guided reflection phases, which may explain the significant results they obtained. Therefore, while this study supports the motivational benefits of board games, the insignificant knowledge gain highlights a gap in implementation strategy and exposure time that differs from previous successful studies.

3.2.2 Interpretation of Lecture Method Intervention Results

The significant increase in students' knowledge after one week of intervention through the lecture method can be explained by the characteristics of this method, which allows the delivery of information in a structured and systematic manner. In addition, lectures allow the teacher or instructor to control the flow of material delivery, emphasize key points, and adjust the pace according to students' needs. These findings are consistent with previous studies that reported lecture methods as effective for short-term retention, especially when targeting factual or procedural knowledge, such as dietary guidelines or food grouping (Solomon, 2020).

This aligns with the study by Kohli et al., 2019, who found that structured lectures improved students' factual recall in less than one week, particularly in subjects requiring conceptual clarity and memorization. However, it should be noted that the larger standard deviation in the post-test (24.85) compared to the pre-test (18.16) indicates the variation in results among students after the intervention. This could be due to differences in individual learning styles, initial levels of understanding, or the ability to absorb material through the lecture method. Some students can process information effectively through lectures, while others need more interactive methods to understand the material well. Such variation aligns with previous findings indicating that while lectures often result in moderate knowledge gains, their effectiveness can differ considerably among students, particularly those with low intrinsic motivation or attention challenges (Yang et al., 2021; Kokoç et al., 2020).

While the lecture method is effective in increasing knowledge in a short period of time, this study also points out its limitations, particularly in relation to its ability to sustain student interest and engagement. This contrasts with Isohätälä et al., 2020 who emphasized that long-term knowledge

retention and student interest may decline without active participation or meaningful interaction. Although lectures serve well in structured knowledge transfer, they may not cultivate critical thinking, application skills, or long-term motivation unless supplemented with active components such as case-based learning.

3.2.3 Comparative Effectiveness of Board Game and Lecture Methods

Theoretically, the lecture and board game methods represent very different approaches to learning. The lecture method is a more traditional form of learning and tends to rely on direct transfer of information from teacher to student. This method is often associated with improving short-term knowledge due to its structured nature and providing clear and direct information (Kohli et al., 2019). The results of this study showed that the lecture method successfully increased students' knowledge significantly. This increase shows that lectures have high effectiveness in a short period of time, especially in the context of rapid information absorption. On the other hand, board games are a more interactive and participatory learning method, which encourages students to actively engage in the learning process through simulation, exploration and problem solving (Chen et al., 2020).

Although board games have the potential to increase student engagement and conceptual understanding, the results of this study showed that the increase in knowledge gained through board games was not statistically significant. This is different from the study conducted by Chang et al. (2022) which found a significant difference between board games and lectures in favor of game-based methods over longer intervention periods. Their success was attributed to the gamification of learning objectives, extended intervention duration, and use of feedback mechanisms. In contrast, the present study used board games without repeated exposure, which may have contributed to the lower cognitive impact. One of the reasons explaining the lack of significant difference between the two methods is the duration of the study, which was conducted over one week, especially for the board game method which can be seen from the results that it is more likely to require a lot of time for students to internalize the concepts better. The board game method requires several sessions to achieve optimal effectiveness, while the lecture method tends to provide faster results in improving knowledge due to its direct nature.

These results are consistent with Li et al., 2019 who emphasized that time-on-task and repeated engagement are critical factors in the effectiveness of experiential learning methods such as board games. Without adequate time, students may only interact superficially with the content. From a scientific perspective, although the lecture method showed a significant increase in knowledge in this study, the comparison results with the board game indicated that both methods did not differ significantly in their effectiveness at the end of the research period. This suggests that both methods have different advantages depending on the learning situation and context, as well as the time available for intervention. With a longer duration, board games have the potential to demonstrate a greater impact on long-term learning, while lectures can remain effective for short-term knowledge enhancement. Overall, these results indicate that both lectures and board games play a role in learning, but their effectiveness may depend on duration, context, and how these methods are implemented in the educational environment.

CONCLUSION

This study shows that the lecture method is more effective in significantly enhancing students' knowledge over the course of one week, as evidenced by the statistically significant increase in post-test scores. On the contrary, the use of board games during the same period did not show a significant increase in knowledge. Although board games are not effective in the short term, this indicates that the method requires a longer duration to have a significant impact on students' knowledge. Thus, lectures are more suitable for short-term knowledge enhancement, while board games have potential if implemented over a longer period.

AUTHOR CONTRIBUTION STATEMENT

S.A.R conducted the research, formulated the problem, determined the theoretical framework and research methods, analyzed the results and organized the discussion, and translated this article. Y.N.L helped develop the research methods and theoretical framework, and improved the article. All authors have contributed to the writing of this article.

DECLARATION

The authors of this study certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

DATA AVAILABILITY

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

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