Jurnal Kesehatan Budi Luhur, Vol. 18, No. 1 (2025), Jan 2025
p-ISSN 1978-8479
e-ISSN 2581-0111

EFFECTIVENESS OF THE 'LUDO GENTING' EDUCATIONAL GAME IN IMPROVING ADOLESCENT KNOWLEDGE OF ANEMIA, NUTRITION, AND STUNTING: A PRE-EXPERIMENTAL STUDY

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ABSTRACT

Anemia and stunting remain critical public health concerns in Indonesia. In 2023, 32% of adolescent girls were affected by anemia, while 21.6% of children experienced stunting. These issues are primarily caused by poor nutrition and limited health education. Educational games are increasingly recognized as effective tools for improving knowledge and promoting healthy behaviors, particularly among adolescents. This study aimed to evaluate the effectiveness of the educational game "Ludo Genting" in increasing adolescents' knowledge about anemia, nutrition, and stunting in Bandung. A quantitative pre-experimental study was conducted using a one-group pre-test and post-test design. A total of 48 adolescents were selected through quota sampling. Structured questionnaires were administered before and after the intervention to assess changes in knowledge levels. Prior to the intervention, most participants showed low levels of knowledge: 11 out of 16 participants (68.8%) in the 10–14 age group, 10 out of 16 (62.5%) in the 15–19 age group, and 7 out of 16 (43.8%) in the 20–24 age group. After the intervention, significant improvements were observed: 12 out of 16 participants (75%) in both the 10–14 and 15–19 age groups, and 13 out of 16 (81.25%) in the 20–24 age group demonstrated good knowledge. "Ludo Genting" was proven to be an effective educational tool for increasing adolescent knowledge related to anemia, nutrition, and stunting. A statistically significant improvement was found ($p < 0.001$).

Keywords : Adolescent, Anemia, Nutrition, Stunting, Game Education

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INTRODUCTION

Adolescence is a transitional phase between childhood and adulthood, typically spanning the ages of 10 to 19. This stage represents a critical period of development that shapes the foundation of optimal health. During adolescence, individuals undergo rapid physical, cognitive, and psychosocial growth, which influences emotions, thinking patterns, decision-making, and social interactions (World Health Organization, 2023). According to the Indonesian National Population and Family Planning Agency (BKKBN), adolescence ranges from 10 to 24 years, divided into early adolescence (10–14), middle adolescence (15–19), and late adolescence (20–24) (BKKBN, 2020).

Data from the World Health Organization (WHO) in 2019 indicated that anemia affected 39.8% of children aged 6–59 months and 29.9% of women aged 15–49 years. In Africa, the prevalence reached 60.2%, while Southeast Asia had the highest global numbers, with 244 million women and 83 million children affected (Observatory, 2024). In Indonesia, adolescent girls are particularly vulnerable, with a prevalence of 32% in 2018 according to Statistics Indonesia and the Ministry of Health. Contributing factors include inadequate nutrition, tea and coffee consumption that inhibits nutrient absorption, and limited education about iron supplement programs. Globally, stunting affected 22% of children under five in 2020 (WHO), or approximately 149.2 million children. In Indonesia, stunting decreased from 24.4% in 2021 to 21.5% in 2023. In West Java, it dropped from 24.5% (2021) to 21.7% (2023), while Bandung saw a significant decrease from 28.12% (2020) to 16.3% (2023), with a target of 14% by 2024. Despite progress, further reduction requires multisectoral collaboration.

A key factor in these health challenges is the lack of engaging health education for adolescents. Traditional methods such as lectures are often ineffective. As a solution, educational games are emerging as an innovative approach, combining entertainment with health messaging to enhance learning outcomes. Games provide enjoyment while developing motor and cognitive skills. Educational games are tools that deliver knowledge in a more engaging way. According to GWI and Data Reportal, in Q4 2023, 84.7% of internet users aged 16–64 played video games, with Indonesia ranking second globally at 95.3%, just below the Philippines (96.5%) (Yonata, 2024).

In this context, the educational game Ludo Genting represents a recent innovation in delivering health information through play. The game was designed to effectively combine learning with entertainment, making the process of acquiring knowledge about health more engaging and accessible for adolescents. Ludo Genting was created by the researchers, mentors, and the team from PIK-M Rajawali as an effort to raise awareness and knowledge among adolescents about health issues such as anemia and stunting. In this study, the respondents were divided into three age groups according to the BKKBN segmentation: early adolescence (10–14 years), middle adolescence (15–19 years), and late adolescence (20–24 years).

Research by Baihaqi, Yuliantini, and Yulianti (2023) involving 40 students showed that the MONOGIA board game improved nutritional and anemia knowledge in adolescent girls more than conventional methods. Similarly, Panjaitan et al. (2023) found that an educational snakes-and-ladders game was more effective (72%) than lectures (32%) for adolescent girls aged 15–17. Agustina Siregar et al. (2022) also demonstrated significant improvements in knowledge using the GEMA anemia monopoly game, with a post-intervention average score of 84.55 in the experimental group versus 58.79 in the control group. In another study by Harahap, Fitriani, and Devita (2023), a quartet card-based EduGame significantly improved healthy snacking behavior among 71 elementary students in Pekanbaru, with average scores increasing from 55.14 to 69.31.

Anemia and stunting remain pressing health issues, particularly among adolescent girls. Poor nutrition and limited health education are primary contributors. Traditional educational methods often fall short in engaging youth. Research consistently supports the effectiveness of educational games in enhancing health knowledge and awareness, highlighting their potential as strategic tools in combating anemia and improving adolescent health.

METHOD

This study used a quantitative pre-experimental design with a one-group pre-test and post-test to assess the effectiveness of the Ludo Genting educational game. Statistical analysis was performed using the Wilcoxon Signed-Rank Test to evaluate the differences in knowledge before and after the intervention.

The target population consisted of adolescents aged 10 to 24 years, categorized into three age groups: early adolescence (10–14 years), middle adolescence (15–19 years), and late adolescence (20–24 years). The sample included adolescents who had never played the Ludo Genting educational game. Quota sampling was used to determine the sample size, with 16 participants allocated to each group based on the game's quota. The total sample size for the study was 48 participants, divided across the three age groups. The study was conducted at SMPN 27 Bandung for early adolescents, SMKN 7 Bandung for middle adolescents, and Rajawali Institute of Health Sciences for late adolescents. Before participating in the study, all respondents were asked to sign an informed consent form ensuring that they understood the purpose of the research and that their participation was voluntary. The form also explained confidentiality and anonymity, as well as their right to withdraw from the study at any time without consequences.

Data were collected using a questionnaire developed by the *Ludo Genting* educational game team, following the guidelines from the *Youth Education and Action Module for Nutrition and Anemia Prevention*, published by BKKBN in 2023. The educational intervention used in the study consisted of the *Ludo Genting* game, which included a 2m x 2m game banner, four game pieces, one die, and a booklet containing educational questions.

Figure 1. Ludo Genting Game

RESULTS

Table 1 shows the characteristics of the 48 respondents, divided into three age groups with 16 participants each. In the 10–14 age group, most participants were 13 (43.8%) and 14 years old (43.8%). In the 15–19 age group, 62.5% were 16 years old, and 37.5% were 17 years old. In the 20–24 age group, 62.5% were 20 years old, with the remaining participants aged 21 (12.5%), 22 (12.5%), and 23 (12.5%). Most respondents were female: 87.5% in the 10–14 group, 93.8% in the 15–19 group, and 81.3% in the 20–24 group.

Table 1. Frequency Distribution of Respondents

Category	Frequency (n)	Percentage (%)
Age 10-14 (years)		
12	2	12,5
13	7	43,8
14	7	43,8
Total	16	100,0
Age 15-18 (years)		
16	10	62,5
17	6	37,5
Total	16	100,0
Age 20-24 (years)		
20	10	62,5
21	2	12,5
22	2	12,5
23	2	12,5
Total	16	100,0
Gender R. 10-14 (years)		
Male	2	12,5
Female	14	87,5
Total	16	100,0
Gender R. 15-19 (years)		
Male	1	6,3
Female	15	93,8
Total	16	100,0
Gender R. 20-24 (years)		
Male	3	18,8
Female	13	81,3
Total	16	100.0

Before the intervention, adolescents aged 10–14 years showed low knowledge, with 68.8% in the poor category. The 15–19 years group had 62.5% in the poor category, and the 20–24 years group had 43.8% poor and 50.0% fair, as shown in table 2.

Table 2. Knowledge Score Distribution Before Intervention

Knowledge Level	Frequency (n)	Percentage (%)
Age 10-14 years		
Poor	11	68,8
Fair	5	31,3
Good	0	0,0
Total	16	100,0
Age 15-19 Years		
Poor	10	62,5
Fair	5	31,3
Good	1	6,3
Total	16	100,0
Age 20-24 Years		
Poor	7	43,8
Fair	8	50,0
Good	1	6,3
Total	16	100,0

Table 3 shows that after the intervention, a significant improvement was seen. In the 10–14 and 15–19 age groups, 75% reached the good knowledge category. In the 20–24 age group, 81.3% reached the good category.

Table 3. Knowledge Score Distribution After Intervention

Knowledge Level	Frequency (n)	Percentage (%)
Remaja Usia 10-14 Tahun		
Poor	0	0,0
Fair	4	25,0
Good	12	75,0
Total	16	100,0
Remaja Usia 15-19 Tahun		
Poor	0	0,0
Fair	5	25,0
Good	12	75,0
Total	16	100,0
Remaja Usia 20-24 Tahun		
Poor	0	0,0
Fair	3	18,8
Good	13	81,3
Total	16	100,0

Table 4 shows a significant improvement in knowledge levels across all age groups after the intervention. In the 10–14 age group, most respondents shifted from low to high knowledge, with 12 out of 16 participants reaching the high knowledge level ($p < 0.001$). For the 15–19 age group, the majority moved from low and moderate knowledge to the moderate and high

categories, with 12 participants in the high knowledge category after the game ($p < 0.001$). Similarly, in the 20–24 age group, 13 out of 16 participants reached the high knowledge level after the intervention, with a p-value of < 0.001, reflecting the effectiveness of the educational game in enhancing adolescent knowledge.

Table 4. Knowledge Comparison Before and After Intervention

		Knowledge After Intervention				
		Poor	Fair	Good	Total	*p*
		Age 10-14 Years				
Knowledge Before intervention	Poor	0	4	7	11	< 0,001
	Fair	0	0	5	5	
	Good	0	0	0	0	
	Total	0	4	12	16	
		Age 15-19 Years				
	Kurang	0	4	6	10	
	Cukup	0	0	5	5	
	Baik	0	0	1	1	
	Total	0	4	12	16	
		Age 20-24 Years				
	Kurang	0	3	4	7	
	Cukup	0	0	8	8	
	Baik	0	0	1	1	
	Total	0	3	13	16	

DISCUSSION

In this study, the respondents' characteristics covered adolescents aged 10 to 24 years, divided into three age segments. The 10–14 age group was represented by respondents aged 12 years (12.5%), 13 years (43.8%), and 14 years (43.8%). The 15–19 age group included respondents aged 16 (62.5%) and 17 (37.5%). Meanwhile, the 20–24 age group consisted of respondents aged 20 (62.5%), 21 (12.5%), 22 (12.5%), and 23 (12.5%).

The second characteristic examined was gender, which was categorized based on the three age segments. A preliminary study by the researchers showed that female respondents dominated the population at the research sites. At SMPN 27 Bandung, the gender distribution was 49% male and 51% female; at SMKN 7 Bandung, 24% male and 76% female; and at the Rajawali Health Institute, 20% male and 80% female.

A supporting study by Neny San Agustina Siregar et al. (2022) involving 33 respondents also showed a gender distribution dominated by females, with 33.3% male and 66.7% female. This supports the findings of the current study, where female respondents were the majority. At SMPN 27 Bandung, males accounted for 12.5% and females for 87.5% of the total 16 samples. At SMKN 7 Bandung, males made up 6.3% and females 93.7% of the 16 respondents. At the Rajawali Health Institute, males comprised 18.8% and females 81.2%.

The research results showed that among adolescents aged 10–14 years, 68.8% had poor knowledge. This finding highlights the need for schools to provide more comprehensive and accessible education for all students. Questionnaire results showed that questions about Body Mass Index (BMI) (18.75%) and hemoglobin levels (25%) were the least correctly answered, indicating gaps in knowledge related to nutrition and anemia. The question with the highest correct response rate (100%) was about child growth and development, related to stunting. This suggests

that students at SMPN 27 Bandung did not have a good level of knowledge about nutrition prior to the intervention.

Among adolescents aged 15–19 years, 62.5% were categorized as having poor knowledge. The lowest correct response rates were for questions about BMI (12.5%) and hemoglobin levels (12.5%), again pointing to limited understanding of nutrition and anemia. However, 93.74% correctly answered the question on general symptoms of anemia, indicating some level of awareness. Overall, students at SMKN 7 Bandung had slightly better knowledge than those at SMPN 27 Bandung.

The results from the Rajawali Health Institute showed that some adolescents aged 20–24 still had poor knowledge (43.8%), particularly regarding balanced nutrition (43.75%). Although this group had the fewest respondents in the poor category, they still require attention. Adolescents in this late age segment remain at risk for anemia due to poor nutrition, which may lead to giving birth to children affected by stunting. More in-depth education is necessary to prevent such outcomes.

The study across the three locations indicates that age is a factor influencing knowledge levels. Educational systems—particularly school majors or programs—may also contribute to low awareness, as not all curricula include materials on anemia, nutrition, and stunting. In conclusion, the study revealed that knowledge about anemia, nutrition, and stunting among adolescents in the three research sites still requires improvement. Students at SMPN 27 Bandung (ages 10–14) had 68.8% in the poor category, with their best performance in stunting-related questions (100%) but none in the good category. Students at SMKN 7 Bandung (ages 15–19) also showed poor knowledge (62.5%) but had high awareness of anemia symptoms (93.74%), indicating that age is a factor in knowledge development. Students at the Rajawali Health Institute (ages 20–24) mostly had moderate knowledge (50%), but were still at risk of anemia, indicating the need for deeper education at all levels to prevent anemia, malnutrition, and stunting.

Post-intervention questionnaire results revealed that some questions still had low correct response rates. Among adolescents aged 10–14 years, the questions about hemoglobin levels (25%) and total calorie needs (6.25%) had the fewest correct answers. For those aged 15–19, the lowest scores were on BMI (18.75%), hemoglobin levels (12.5%), child development (6.25%), and two questions about nutrition (0%). Among adolescents aged 20–24, the questions about BMI, balanced meals ("My Plate"), and hemoglobin were answered correctly by 43.75%. However, other questions in this age group were answered correctly by over 25% of participants.

A supporting study by Baihaqi et al. (2023) showed a 3.05% increase in knowledge among an intervention group using an educational game. Their research on the effect of the Monopoly Gizi Anemia (MONOGIA) game on knowledge and attitudes among adolescent girls in Bengkulu found that average scores increased from 15.65% to 18.70%, with a significance level of $p < 0.05$. This supports the conclusion that MONOGIA positively influenced nutritional knowledge and attitudes among junior high school students.

From the results of the current study and supporting literature, it can be concluded that the *Ludo Genting* educational game positively impacted adolescents' knowledge about anemia, nutrition, and stunting. This method offers a more engaging alternative to traditional lecture-based education, which is often less effective. The success of this study is demonstrated by the significant improvement in average knowledge scores after playing the game.

CONCLUSION

The findings of this study demonstrate that adolescents across all age groups initially had a low level of knowledge regarding anemia, nutrition, and stunting. Prior to the intervention, the majority of respondents in the 10–14, 15–19, and 20–24 age groups were categorized as having poor knowledge. However, following the implementation of the Ludo Genting educational game, there was a marked improvement in knowledge levels across all age groups, with most respondents shifting to the fair and good knowledge categories. The intervention proved to be effective, as indicated by a statistically significant increase in knowledge ($p < 0.001$). These results suggest that interactive educational tools such as the Ludo Genting game can serve as a valuable strategy for enhancing adolescents' awareness and understanding of key health issues, particularly anemia, nutrition, and stunting.

RECOMMENDATION

To enhance adolescents' health knowledge, educational strategies should be tailored according to age segmentation. Adolescents aged 10–14 years are encouraged to learn basic health concepts such as hemoglobin levels, caloric intake, and balanced nutrition through interactive media, educational games, and with the support of their families. Those in the 15–19 age group should focus on more advanced topics such as Body Mass Index (BMI), hemoglobin levels, child development issues related to stunting, and the importance of a nutritious diet, delivered through discussions, workshops, or digital platforms. Meanwhile, adolescents aged 20–24 years are recommended to engage in practical training and independent health campaigns that cover BMI calculation, the composition of a healthy plate (My Plate), and nutritional literacy. A holistic and age-appropriate educational approach, supported by regular evaluations and learning motivation, can improve outcomes significantly.

Schools and universities play a crucial role in promoting adolescent health literacy and are encouraged to integrate health education into formal curricula, organize seminars, and establish Youth Information and Counseling Centers (PIK-R). In schools, especially for younger adolescents, PIK-R can serve as a platform for engaging students through educational games, quizzes, and family-oriented activities. For older students, PIK-R can provide a space for in-depth learning through peer discussions, workshops, and digital content. At the university level, PIK-R can facilitate practical training and promote student-led health campaigns, empowering youth as agents of change in their communities. The institutional support of PIK-R enhances comprehensive health education and builds long-term skills in information access and counseling.

Future research should explore the effectiveness of the Ludo Genting game in different settings, particularly in community-based environments. Studies should be designed with systematically calculated sample sizes to ensure methodological rigor and generalizability. Further evaluation of the game's impact across diverse adolescent populations will help establish its potential as an innovative and scalable tool for health education.

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