



Development of snakes and ladders game to increase knowledge of the dangers of smoking among elementary school students: A quasi-experimental study in Malang, Indonesia

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ABSTRACT

Background: The smoking trend has now infected school-age children, with 19.2% of students aged 13-15 years in Indonesia and 2,859 children in Malang City recorded as active smokers, which is influenced by a lack of understanding of the dangers of smoking. Educational interventions such as Snakes and Ladders game-based health promotion media must be developed to build a culture of not smoking from an early age.

Objectives: The purpose of the study was to develop educational game media in the form of snakes and ladders as a tool for delivering health information about the dangers of smoking to students of Oro-Oro Dowo Malang State Elementary School.

Methods: Research and Development (R&D) type research with a one-group pretest and posttest trial aims to determine the effectiveness of the Snakes and Ladders game as a health promotion media on the dangers of smoking behavior. The subjects needed in this study are media experts, material experts, and students aged 9-13 years as research samples.

Results: The average result of increasing knowledge is 0.000 using the Wilcoxon test, so there is a difference in the average value of knowledge in the pretest and posttest data. In the feasibility test results, the assessment results were obtained in the very feasible category. Game media is effective and very feasible to be a health promotion media in efforts to promote the dangers of smoking in children.

Conclusions: The Snakes and Ladders game media developed is feasible to be a health promotion media in efforts to promote the dangers of smoking behavior in children. The Snakes and Ladders game media influences increasing students' knowledge of Oro-Oro Dowo Malang State Elementary School about the dangers of smoking. Further research needs to evaluate media's long-term impact and adaptation in various socio-cultural contexts.

Keywords: dangers of smoking, health promotion, snakes and ladders game media.

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INTRODUCTION

A major health dilemma occurring in many countries today is smoking behavior. In 2017, the World Health Organization (WHO) revealed that tobacco consumption is increasing worldwide; as many as 1.3 billion people out of 6.7 billion of the world's population are smokers (Sholihah & Novita, 2021). Indonesian people have the highest cigarette consumption behavior in the ASEAN region, which is 65.19 million people (Tan & Dorotheo, 2018). The data presented by GYTS / Global Youth Tobacco Survey Indonesia in 2019 showed that out of 5,125 school students aged 13-15 years, 19.2% of students were recorded as active smokers. Smokers are dominated by male students with a percentage of 35.6% (Badan Penelitian dan Pengembangan Kesehatan Nasional, 2019).

Currently, the trend of smoking behavior extends to the adolescent and child age groups (Sholihah & Novita, 2021). The results of the National Basic Health Survey (Riskdas) in 2018 found that the prevalence of adolescent smokers increased to 9.1% from 7.2% over the past five years (Almaidah et al., 2020). East Java is one of the regions with a relatively high number of adolescent smokers, ranked 8th in Indonesia (BPS Indonesia, 2020). Based on data from the Central Statistics Agency, Rachmawati et al. (2023) stated that the average teenage and child smoker in Malang City consumes more than 60 cigarettes in one week. The Malang City Health Office in 2022 screened smoking behavior in children aged 10-18. In Malang City, out of 111,016 children, 2,859 (2.6%) of them are active smokers. Among the 16 Puskesmas working areas in Malang City, the Arjuno Puskesmas working area has the highest number of active smokers aged 10 to 18 years in Malang City, namely 403 (8.9%) children with smoking status (Dinas Kesehatan Kota Malang, 2023).

The background of children in choosing to smoke is based on the inner self who wants to try cigarettes for reasons of curiosity. Then, there are also factors from the social environment around children who smoke, such as parents, siblings, and peers. Children's curiosity about cigarettes will be huge when they see that few social environments smoke (Oqui et al., 2022). Smoking behavior in the age group of adolescents and children is also based on the lack of dissemination of information that clearly states the dangers and long-term effects of chemicals in cigarettes (Munir, 2019). Chemicals such as tar, nicotine, arsenic, carbon monoxide, and nitrosamine in cigarettes are the main causes of a person developing non-communicable diseases (Yuningrum et al., 2021). In addition, nicotine in cigarettes can affect brain function and psychological health, causing addiction and toxic effects on cognitive function (Atmasari et al., 2020). As a result, if no efforts are made to prevent smoking behavior in adolescents, the effects of dependence will continue to be felt until adulthood (Muslim et al., 2023).

Given the many risks and side effects of smoking, it is necessary to carry out health promotion efforts to build a culture of non-smoking behavior in school-age children (Mujito et al., 2022). In implementing health promotion efforts, consideration must be given to selecting media and methods tailored to the target group (Rahmawati & Fitriyah, 2020). Simple language using fun elements is undoubtedly needed to help school-age children understand and understand the health information presented (Mujito et al., 2022). The selection of targets in this study, referring to the recommendation of the Arjuno Health Center, chose Oro-Oro Dowo Malang State Elementary School because of its location in the middle of the city, which allows children to be more exposed to an environment where smoking is more common,

both through advertisements, media, and associations in the surrounding environment.

Based on the results of the needs analysis conducted by the researcher, the Snakes and Ladders educational game is a suitable media used as a promotive effort for the dangers of smoking behavior because it can attract interest in participating in health promotion activities and increase student knowledge with a new atmosphere about the dangers of smoking behavior for school students. The specifications of the Snakes and Ladders game media regarding the dangers of smoking are expected to display interesting text and images about smoking behavior, the selection of background colors that present the characteristics of the target, namely children and pastel color combinations, medium media size, and the material contained in the snakes and ladders game media, namely the definition of smoking, the content in cigarettes, and the impact of smoking.

Various studies have shown that game-based approaches effectively improve health behaviors and knowledge. A [Zhou et al. \(2020\)](#) meta-analysis showed that narrative game-based interventions significantly increased the adoption of healthy behaviors, particularly among children and adolescents. Similarly, systematic studies by [Cuevas-Lara et al. \(2021\)](#) and [Shiau et al. \(2021\)](#) confirmed that game-based interventions positively impact improving health understanding and management across different age groups, including children and the elderly. This effectiveness can be explained through the learning-through-play theory approach, which emphasizes the importance of emotional engagement, hands-on experience, and interactivity in the learning process ([Piki et al., 2016](#); [Nijhof et al., 2018](#)). In addition, play is also known to support cognitive reinforcement, creativity, and learning motivation, which are essential in behavior change-based learning ([Kinder et al., 2019](#)). Therefore, developing educational media such as Snakes and Ladders games is visually appealing and supported by strong theoretical foundations and scientific evidence in health promotion.

Research and development conducted by [Mujito et al. \(2022\)](#) also used Snakes and Ladders game promotional media to improve children's smoking prevention behavior. The study used game media that used practical instructions and game support facilities, namely playing board sheets, dice, and pawns. Meanwhile, the Snakes and Ladders game media used in this study consists of practical instructions with supporting facilities in the form of a playing board using game card instruments, dice, and pawns. The novelty of this research lies in the technical details of the game, which stimulates the target to discuss further to find answers to the questions in the game. The advantages of Snakes and Ladders game educational media are that it is more practical and learning takes place in a relaxed atmosphere, allowing faster absorption of health messages ([Mujito et al., 2022](#)).

Research conducted by Hafif Hamdalah in [Thaha et al. \(2022\)](#) stated that the Snakes and Ladders educational game media is superior in increasing target knowledge compared to picture story media. The Snakes and Ladders game material will be more imprinted on the target's memory because all students' senses are actively used as a result of packaging the material with engaging visualizations that children easily accept. Children can understand information when reading 10%, hearing 20%, seeing 30%, and half based on what is heard and seen, 70% of what is said, and 90% of what is done ([Thaha et al., 2022](#)).

Although play-based health interventions have demonstrated effectiveness in improving children's health knowledge and behaviors, there are significant gaps in

the literature regarding integrating deep learning theory and long-term evaluation of such interventions. Most existing studies focus on short-term outcomes and lack consideration of motivational aspects and children's emotional engagement in the learning process through play. According to [Baranowski et al. \(2016\)](#), many game-based interventions do not fully utilize game design principles that can increase intrinsic motivation and user engagement. In addition, Peng et al. (2019) emphasized the need for a more holistic approach to designing game-based interventions, including integrating learning theory and evaluating the long-term impact on children's health behaviors. Therefore, further research is needed that combines strong learning theory with engaging game design to create more effective and sustainable health interventions for children.

Based on the description above, efforts to promote the dangers of smoking behavior in school-age children need to be made. Researchers want to develop educational game media in the form of snakes and ladders to deliver health information about the dangers of smoking to Oro-Oro Dowo Malang State Elementary School students.

METHODS

Study Design and Participants

This type of research is research and development through a pre-experimental approach in the form of one group pretest and posttest. The development stage in this study consists of 10 stages, namely the first stage of potential and problems, the second stage of data collection, the third stage of product design, the fourth stage of design validation, the fifth stage of design revision, the sixth stage of product trials, the seventh stage of product revision, the eighth stage of usage trials, the ninth stage of product revision, and the tenth stage of final production ([Sugiyono, 2013](#)). However, in this study, the stages used were up to the eighth stage, namely the usage trial. The purpose of this development is to determine the effectiveness of educational game media in the form of snakes and ladders to deliver health information about the dangers of smoking. The research was implemented for approximately 3 months, from March to May 2024, and carried out at the State Elementary School Oro-Oro Dowo Malang City.

The total population of this study was 60 students from grades 4 - 6 at Oro-Oro Dowo State Elementary School, Malang City. Researchers used a total sampling technique to determine the sample. The total sampling technique was chosen because the entire population was based on the inclusion criteria: active students of Oro-Oro Dowo State Elementary School, Malang City, grades 4-6, aged 9-13 years, and willing to become respondents. As for the exclusion criteria, they were not registered as active students at the State Elementary School Oro-Oro Dowo Malang City, could not speak and read, could not speak Indonesian, and were not present during data collection. However, the use of total sampling techniques has limitations, namely potential representation bias and limited generalization of results to a broader population. Therefore, it is recommended that future studies use random sampling techniques to obtain more representative results and allow stronger generalization to the general school-age child population.

The sample in this study amounted to 53 respondents. The sample was divided for the needs of product trials with as many as 15 respondents from respondents in grades 4, 5, and 6, with each class represented by five students. Then, for the needs

of the usage trial, the number of respondents who met the inclusion and exclusion criteria was 38, with the distribution of respondents from class 4 totaling one student, class 5 totaling nine students, and class 6 totaling 18 students.

Ethical approval statement

This research has obtained ethical approval from the State University of Malang Health Research Ethics Committee, with certificate number 6.2.4/UN32.14.2.8/LT/2024. All stages of the research, including collecting data from elementary school students, have been carried out by the principles of research ethics that uphold the protection of child subjects and guarantee confidentiality and approval from related parties.

Research Instruments

The research instruments used consisted of two types, namely quantitative data collection instruments and media validation instruments. Quantitative instruments in the form of pretest and posttest questionnaires were developed in the form of multiple choice, totaling 15 items to measure students' level of knowledge about the dangers of smoking before and after treatment. Scores were given based on correct (score 1) and incorrect (score 0) answers and analyzed using the Wilcoxon test to determine the effectiveness of the media.

In addition, a validation sheet was used by material experts, media experts, and respondents to assess the feasibility of the media. Validation was carried out on material content, message delivery, visual design, ease of use, illustrations, color, typography, and symbolism. The validation sheet uses a quantitative rating scale converted into a feasibility percentage. All instruments have been developed based on relevant theories and adapted to the characteristics of elementary school-age children respondents.

Data Analysis

This research data produces quantitative data obtained from the validity test results to determine the feasibility of the media and the Wilcoxon test to determine the increase in target knowledge. Qualitative data comes from suggestions and input from media and material experts.

RESULTS

Respondent Characteristics

Based on the data in [Table 1](#), the majority of respondents in this study were male (53%) and came from grade 6 (47%). The highest age was 12 (42%), while the least was 9 (5%). Most respondents (84%) had never smoked, but there were 16% who already had smoking experience. This shows the importance of early education regarding the dangers of smoking for elementary school children.

Material and Media Validity Test

Media and material experts in this study are two lecturers of public health sciences at the State University of Malang who are competent in health promotion media development. This validity test is carried out to determine the feasibility of the material and media developed so that the media can be used as educational media for target groups, especially regarding the adverse effects of smoking. [Table 2](#) shows the results of the assessment of the material and media experts.

Table 1. Respondent Characteristics

No	Characteristics	Frequency	
		n	%
1.	Gender		
	Male	20	53%
	Female	18	47%
2.	Class		
	4	11	29%
	5	9	24%
	6	18	47%
3.	Age		
	9 years old	2	5%
	10 years old	6	16%
	11 years old	11	29%
	12 years old	16	42%
	13 years old	3	8%
4.	Smoking Experience		
	Ever	6	16%
	Never	32	84%

Source: Primary Data, 2024

Table 2. Material and Media Expert Validity Assessment Results

	Total Score	Percentage	Category
Material Expert	40	90.91%	Very Feasible
Media Expert	89	92.71%	Very Feasible

Source: Primary Data, 2024

Table 2 shows that the Snakes and Ladders game media was rated "very feasible" by both experts. The material expert gave a score of 90.91%, while the media expert gave a higher score of 92.71%. This finding shows that in terms of material content and media design, this game has met the eligibility standards to be used as educational media about the dangers of smoking.

Product Design

This study's Snakes and Ladders game development was designed using graphic design software. Table 3 shows the initial design image of the Snakes and Ladders game media development. In the first revision stage, carried out by material experts and media experts on the front, the game's title is added, and black lines are used in the game box. Meanwhile, on the back are additional images of the background and the researcher's identity. Moreover, at the second revision stage, which respondents carried out, there were no design revisions, so the Snakes and Ladders game media could be continued at the next stage.

Product Trial Results (Small Group)

At this stage, the respondents assessed the feasibility of the media and the validation and reliability of the instruments to be used. The respondent's feasibility test was carried out by 16 respondents at Oro-Oro Dowo State Elementary School, Malang City, to assess the material and media that had been developed. The following Table 4 shows the results of the feasibility test for respondents.

Table 3. Snakes and Ladders Game Board Design

	Front Section	Back Section
Preliminary Design		
First Revision		
Second Revision	There were no design revisions.	There were no design revisions.

Table 3. Respondents' Assessment

No	Aspects	Indicators	Maximum	Validation Score	Percentage	Category
1.	Material	a. Ease of material understanding	64	47	73,43%	Feasible
		b. Message delivery	192	158	82,3%	Very Feasible
2.	Snakes and Ladders Game Media	a. Ease of use	128	103	80,46%	Feasible
		b. Illustration	64	56	87,5%	Very Feasible
		c. Color	64	55	85,93%	Very Feasible
		d. Typography	64	48	75%	Feasible
		f. Symbolism	64	54	84,37%	Very Feasible
Percentage of overall average					81,28%	Very Feasible

Source: Primary Data, 2024

Table 4 shows that the respondents rated the Snakes and Ladders game media very feasible, with an overall average percentage of 81.28%. The assessment was carried out on two main aspects, namely material and media. In the material aspect, the ease of understanding indicator obtained a score of 73.43% which was included in the feasible category. In comparison, the message delivery indicator scored 82.3% and was included in the very feasible category. In the media aspect, several indicators received very high ratings, such as illustrations (87.5%), colors (85.93%), and symbolism (84.37%), all of which were included in the very feasible category. Meanwhile, the indicators of ease of use (80.46%) and typography (75%) fell into the feasible category. These findings indicate that the Snakes and Ladders game media is considered attractive, easy to use, and able to convey health messages well, so it is very feasible to use as an educational media for elementary school-age children.

Effectiveness of the Snakes and Ladders Game

In assessing the effectiveness of the Snakes and Ladders game, the data used is data from the trial use stage. The trial used 38 respondents who fit the research criteria. At this stage, respondents were given a pretest question to determine their initial level of knowledge. Furthermore, respondents were given treatment through snakes and ladders games. Then, after 14 days, respondents were given posttest questions to see the increase in respondents' knowledge from before and after being given treatment in the form of Snakes and Ladders game media.

The research instrument was a pretest and posttest questionnaire using a Likert scale in the form of questions with four multiple-choice answers: a, b, c, and d, with one correct answer choice. [Jatmika et al. \(2019\)](#) state that Likert scales can measure a person's response to possibilities or problems. In the form of multiple-choice questions, the highest answer score (correct) is worth one, and the lowest (wrong) is worth zero. After obtaining data from the pretest and posttest results, the following is the average knowledge of respondents before and after being given the intervention.

	N	Min	Max	Mean	Std. Deviation
Pretest	38	13	67	45,82	14,869
Posttest	38	33	87	63,53	15,156

Source: Primary Data, 2024

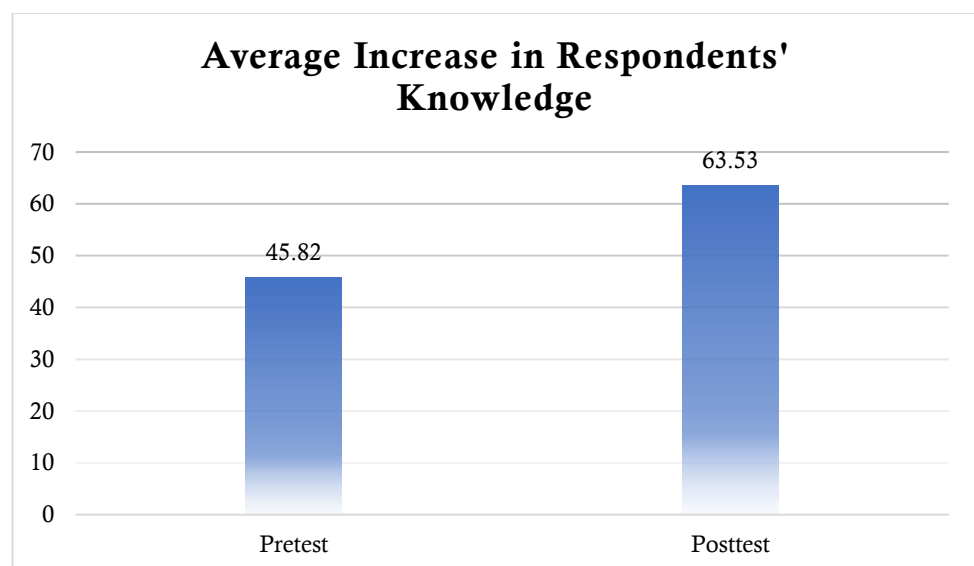


Figure 1. Average Increase in Respondents' Knowledge

Table 5 and Figure 1 show an increase in respondents' knowledge after an intervention in the form of a snakes and ladders game. The pretest mean score was 45.82, with a minimum score of 13 and a maximum of 67. After the treatment, the posttest mean score increased to 63.53, with a minimum score of 33 and a maximum of 87. This increase indicates that the Snakes and Ladders game media effectively increases students' understanding of the dangers of smoking. Figure 1 visually reinforces these findings by showing a significant difference between pre and post-intervention scores. This finding supports that a game-based educational approach can positively impact the knowledge of primary school-aged children.

Table 5. Wilcoxon Test Results

	N	Mean Ranks	Sig. (2-tailed)
Negative ranks	0	0,00	,000
Positive ranks	33	17,00	
Ties	5		
Total	38		

Source: Primary Data, 2024

From the data in Table 6, the p-value is 0.000. It means that respondents' knowledge has increased after being given treatment in the form of snakes and ladders games.

DISCUSSION

The results showed that the majority of respondents were males aged 13 years and in grade six, which is an age group vulnerable to smoking behavior. [Sulastri & Rindu \(2019\)](#) stated that the highest prevalence of smokers occurs at the age of 13-15 years, with the first experiment generally starting at the age of 12-13 years. Individual factors, such as easy access to cigarettes without understanding the risks ([Hamdan et al., 2015](#)), as well as environmental factors, such as the influence of parents, siblings, or peers who smoke, influence children's behavior. In this study, two respondents aged 9-13 years reported already having a smoking habit. Therefore, it is important to instill an understanding of the dangers of smoking from an early age through education at school ([Rahman et al., 2021](#)).

The Snakes and Ladders Game Media as Health Promotion Media

The Snakes and Ladders game media was designed using graphic design software and printed on Art Paper 230 gsm paper measuring 42 x 59.4 cm, consisting of 38 game boxes and three command boxes equipped with pictures, snakes, and ladders according to the theme of the dangers of smoking. Game equipment includes a playing board, dice, four color pieces, and 23 cards of questions, true-false, and information. The cards are printed with thematic illustrations on 4 x 6 cm paper. The design and content of the media received excellent ratings from material experts and media experts. Respondents' results of the feasibility test also showed a very feasible category. [Jannah et al. \(2020\)](#) stated that the material in the game can stimulate children's motor skills and increase interest in learning. Meanwhile, [Fithri et al. \(2022\)](#) added that this media attracts children's attention because it is organized with simple language in a fun atmosphere.

The Effectiveness of the Snakes and Ladders Game

This study assessed the effectiveness of the Snakes and Ladders game in improving students' knowledge of the dangers of smoking through pretest and posttest questionnaires. The results showed increased knowledge after the

intervention, which was supported by students' enthusiasm and interesting visualization of the game media. According to Maksum et al. (2022), the Snakes and Ladders game is a communicative and easy-to-understand educational media, mainly because it relies on visual language suitable for school-age children. This finding is in line with Rosmini et al. (2023), who showed an increase in the knowledge and motivation of adolescents after using the MANGKOK game media. Astutik & Herlinadiyaningsih (2023) also noted that snakes and ladders games are more effective than leaflets in delivering health information. Fitriyah & Rahmawati (2021) supported the idea that this game significantly improved students' knowledge.

Limitations of the study

However, this study has limitations, such as the use of total sampling in one school, the absence of a control group, focus only on the knowledge aspect, and short-term evaluation. Therefore, future studies are recommended to use random sampling, add a control group, expand variables such as attitudes and behaviors, and conduct long-term evaluations to assess the sustainable impact of game media on children's healthy living behavior.

CONCLUSIONS

The Snakes and Ladders game media proved feasible to be used as a health promotion media to increase children's knowledge about the dangers of smoking. Educational institutions are expected to play an active role through the School Health Effort (UKS) program. In contrast, health agencies such as the Community Health Center (Puskesmas) and education offices are expected to collaborate to promote their efforts. Health promoters are advised to develop media similar to other games, and future researchers can explore more interesting methods and add variables and control groups. The Ministry of Health can also consider integrating this game into the School Health Effort (UKS) program.

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DATA AVAILABILITY

The data used in this study were obtained from the results of trials and usage tests of game media on students of Oro-Oro Dowo State Elementary School, Malang City. Data is limited and not publicly available to maintain the privacy of learners. However, data can be provided by the correspondence author upon reasonable request and with the consent of the school and related institutions.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in conducting research or in preparing and publishing this article.

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