

Implications of video game-based education for adolescents' smoking knowledge and perceptions

Havizoh Havizoh¹, *Widyatuti Widyatuti², Sigit Mulyono²

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Abstract

Background: The ever-increasing prevalence of cigarette smoking in adolescents is considered a severe problem, especially in developing countries like Indonesia. Cigarettes are renowned for containing many harmful chemicals that generate various chronic diseases. Additionally, adolescents who are smoking cigarettes may have their emotions and behaviours disrupted. However, the current corrective acts are still orienting to the pictorial caution of how cigarette smoking can be dangerous. The pictures of damaged organs are displayed using simple media, such as modules, which are considered appealing and exciting, especially for adolescents. Accordingly, we propose video game-based education as one of the efforts to prevent cigarette smoking in adolescents.

Objective: To analyse the implications of video game-based education for adolescents' cigarette smoking knowledge and perceptions.

Method: This research used a quasi-experimental design with a pre-test and post-test with a control group.

Results: Using an independent t-test, we found a significant implication of video game-based education for adolescents' cigarette smoking knowledge ($p < 0.001$) and perceptions ($p < 0.001$).

Conclusions: Video game-based education was attested to more effectively elevate adolescents' cigarette smoking knowledge and perceptions than the module-based one.

¹Community Health Nursing, ²Nursing Department, Universitas Indonesia, Indonesia

*Correspondence: tuti_cw@yahoo.com



<https://orcid.org/0000-0003-0518-8885>

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Background

Indonesia is a country with the third highest number of smokers after China and India and the highest number of adolescent smokers¹. Data revealed that 30% of female adolescents and 21% of males began to smoke at an age less than 13 years and that 50% of male adolescents smoked more than ten cigarettes each day². Smoking adolescents maintained unhealthy lifestyles, low life satisfaction, intimidating behaviours, injury risks, and other health issues³. The consumption of cigarettes, alcohol, and marijuana in a school-based social networking context demonstrated a reciprocal correlation⁴, and was closely connected to crime, harassment, suicidal behaviour and free sex, increasing the risk of HIV and mental illness⁵.

Factors inducing smoking among adolescents can be classified as external and internal. External factors were having a family, colleague, peer, community around, teacher, etc.⁶. Internal factors were adolescents' personality traits, like age, sex, the amount of pocket money, psychological state, perception or judgment of smoking, and knowledge regarding smoking and its consequences⁷. Perceptions and knowledge are two internal characteristics that influence adolescents to initiate smoking. Adolescents started smoking when they perceived a glamour and cool side of tobacco⁸, assuming that smoking made them more convenient and acceptable in a celebration and society⁹, enhanced their academic performances¹⁰ and somehow constituted a way to be an adult¹¹, due to exposure to misleading information regarding the consequence cigarettes brought¹², inadequate knowledge regarding how cigarette could harm them¹³ and poor insight regarding harmful chemicals in cigarettes¹⁴. Adolescents' knowledge and perceptions affected their decision to agree or disagree with an invitation to smoke (self-efficacy) from their peers or people around, which then proceeded to actions or behaviours¹⁵.

Today's preventive efforts are focused on delivering messages regarding the harmful effects of cigarettes on health, utilizing pictures showing damaged body organs due to smoking in the form of posters, cigarette packs and modules. However, the efforts

are seemingly in vain as the smoking rate in adolescents increases. Education using those pictures frightens adolescents. Additionally, another education method that uses conventional media was not appealing, thereby diminishing their interest in being educated¹⁶.

One of the favourite applications among adolescents is video games. Video games were audiovisual media adolescents deemed as entertaining stress relievers and educational media¹⁷. Audiovisual merits in health education were more compelling, evoking adolescents' enthusiasm to acquire information¹⁸. Researchers in developed countries have made numerous studies of the effectiveness of video games as educational media. Nevertheless, there are none in Indonesia.

Objectives

To analyse the implications of 'Sign of Heroes' video game-based education for adolescents' smoking knowledge and perceptions.

Method

Study design and sample: This research used a quasi-experimental design with a pre-test and post-test with a control group. Respondents in the treatment group were 39 in number, whereas those in the control group were 30. We determined the sample size estimation formula for the differences by the paired group mean:

$$n = \left\{ \frac{(Z_{1-\alpha/2} + Z_{1-\beta}) \times \delta^2}{\mu_1 - \mu_2} \right\}$$

- n = the number of samples
- Z_{1-α/2} = the average standard deviation for α
- Z_{1-β} = the average standard deviation for β
- μ₁ - μ₂ = the significant difference in mean before treatment (pretest) and after treatment (posttest)
- δ = the estimated standard deviation by literature

Previous research acquired a standard deviation of 8 and mean difference μ₁ - μ₂ = 5¹⁶. Referring to the research, the minimal number sample of this research was (Z_{1-α/2} = 5% = 1.96, Z_{1-β} = 90% = 1.282) :

$$n = \left\{ \frac{(1.96 + 1.282) \times 8^2}{5} \right\} = 27$$

To anticipate the likeliness of respondents dropping out and loss to follow-up subject during the process, we added some samples using the following formula:

$$n' = \frac{n}{(1-f)}$$

n = sample size before quantified
 n' = sample size after added

f = estimated number of dropping out samples, i.e., 10-30%. That in this research was 30%.

$$n' = \frac{27}{(1-0.3)} = 38.6 = 39, \text{ rounded to be } 40$$

We used the cluster sampling method, with which two of 11 subdistricts in Depok were randomly selected. Schools in the two chosen subdistricts were randomized to select the research location.

Inclusion criteria: 1) In the early adolescent period (10-12 years old), 2) Willing to participate in all research activities, 3) Having parental/guardian consent, 4) Having a smartphone, 5) Having an android-based smartphone, and 6) Having had no information about chemicals in cigarettes.

Exclusion criteria: Adolescents with a history of alcohol and drug consumption.

Data collection instruments

The data collection instruments used comprised three types of questionnaires. The *respondent characteristic questionnaire* consisted of 16 questions referring to the Indonesia Global Youth Tobacco Survey (GYTS) questionnaire. The *educational questionnaire* was based on the education materials conferred, associated with chemicals in cigarettes, and comprised 28 questions (Cronbach's alpha = 0.858). And, *the perception questionnaire* contained 24 questions, consisting of 11 positive statements and 13 negative ones (Cronbach's alpha = 0.808). Six questions referred to the GYTS questionnaire, whereas the others were added and modified by us based on the HBM theoretical framework and pertinent literature^{8,9,16,19}. The three types of the questionnaire were combined in a single Google form link.

Procedure: The research was conducted online owing to the Covid-19 pandemic. The treatment group was given intervention in video game-based education whose download link was sent via WhatsApp. Moreover, the control group was assigned module-based education, and the module provided was in a PDF format. Data collection was conducted in three stages, which were pre-test, education, and post-test. The two groups shared the same protocols but with two different media.

The first stage, the pre-test, was performed by sending the Google form link to respondents. The second stage, education, was conducted by accounting for the procedures for playing the assigned video game at home for one week and discussing via WhatsApp group. After the discussion, respondents were given one week to study the information regarding video game playing procedures. After one week the post-test was convened. The control group shared the same techniques but used a module instead.

Ethics approval: Study was approved by the Nursing Research Ethics Committee at Universitas Indonesia (No:SK-58/UN2.F12D1.2.1/ETIK 2020). All respondents signed informed consent, declaring willingness to participate in this research. They were free to drop out of this study anytime. Those who took part in all of these research activities were granted a pulse compensation of IDR 50,000.00.

Results

Table 1 shows the distribution of respondents' characteristics.

Table 2 shows the distribution of the adolescents' smoking knowledge and perceptions before and after the video game-based education.

Table 3 shows the differences of respondents' knowledge and perception in intervention and control groups

Table 4 shows the effects of video game-based education on adolescents' knowledge and perception.

Concerning the knowledge variable, before the intervention, the treatment group had a slightly higher mean than the control group the difference

being 3.12. Both groups increased the mean after the intervention, but the mean was higher in the treatment group with a sharp difference of 13.62. The paired t-test indicated that the knowledge of the treatment group and the control group were both significantly increased after the intervention with p-value <0.001 (Table 3). However, the mean difference was higher in the intervention group compared to the control group (15 vs 4.5).

Concerning the perception variable, the treatment group had a p-value of <0.001, while the control group had a p-value of 0.978 (Table 3).

The independent t-test brought about a p-value of <0.001 for the knowledge variable and a p-value of <0.001 in the perception variable (Table 4).

Accordingly, we could sum up that video-game based education had a significant implication for adolescents' smoking knowledge and perceptions.

Table 1: Distribution of respondents' characteristics (n=69)

Characteristic	Intervention group		Control group		Total	%
	f (39)	(%)	f (30)	(%)		
<i>Age (years)</i>						
a. 13	08	20.52	08	26.7	16	23.2
b. 14	31	79.48	22	73.3	53	76.8
<i>Gender</i>						
a. Male	16	41.03	12	40	28	40.6
b. Female	23	58.97	18	60	41	59.4
<i>Economic background of the parent</i>						
a. <Regional minimum wage	17	43.6	19	63.33	36	52.2
b. ≥ Regional minimum wage	22	56.4	11	36.67	33	47.8
<i>Pocket allowances per week</i>						
a. <Rupiah 10.000	03	07.7	02	06.6	05	07.2
b. ≥Rupiah 10.000	36	92.3	28	93.3	64	92.8
<i>Previous smoking experience</i>						
a. Ever	05	12.8	07	23.3	12	17.4
b. Never	34	87.2	23	76.7	57	82.6
<i>Parent</i>						
a. Smoker	13	33.3	16	53.3	29	42.0
b. Not smoker	26	66.7	14	46.7	40	58.0
<i>Friends</i>						
a. Smokers	22	56.4	23	76.7	45	65.2
b. Not smokers	17	43.6	07	23.3	24	34.8
<i>Teachers</i>						
a. Smoker	18	46.1	15	50	33	47.8
b. Not smoker	21	53.9	15	50	36	52.2
<i>Cigarettes advertisement</i>						
a. Ever	38	97.4	27	90	65	94.2
b. Never	01	02.6	03	10	04	05.8
<i>Cigarettes availability</i>						
a. Available	39	100	27	90	66	95.7
b. Not available	0	0	3	10	3	04.3

Table 2: Distribution adolescents' smoking knowledge and perceptions before and after the video game-based education (n=69)

Knowledge	Group	Mean	SD*	95% CI
Before	Intervention	10.59	6.138	8.60-12.58
	Control	7.47	5.329	5.48-9.46
After	Intervention	25.59	3.338	24.51-26.67
	Control	11.97	6.835	9.41-14.52
Perception	Group	Mean	SD	95% CI
Before	Intervention	103.9	9.915	100.68-107.11
	Control	99.37	9.015	96.00-102.73
After	Intervention	111.72	6.245	109.69-113.74
	Control	99.33	11.115	95.18-103.48

Table 3: Differences of respondents' knowledge and perception in intervention and control groups (n=69)

Variable	Group	Mean	SD	Range	p-value
Knowledge	Intervention				
	a. Before	10.59	6.138	15	<0.001
	b. After	25.59	3.338		
	Control				
a. Before	7.47	5.329	4.5	<0.001	
b. After	11.97	6.835			
Variable	Group	Mean	SD	Range	p-value
Perception	Intervention				
	a. Before	103.9	9.915	7.82	<0.001
	b. After	111.72	6.245		
	Control				
a. Before	99.37	9.015	-0.04	0.978	
b. After	99.33	11.11			

Paired t-test

Table 4: The effects of video game-based education on adolescents' knowledge and perception (n=69)

Variable	Group	Mean	SD	P-value
Knowledge	Intervention	25.59	3.338	<0.001
	Control	11.97	6.835	
Perception	Intervention	111.72	6.245	<0.001
	Control	99.33	11.11	

Independent t-test

Discussion

Knowledge constituted an internal factor in adolescents' health behaviour. We figured out a mean of 10.59 for adolescents' smoking knowledge in the treatment group and 7.47 in the control group before the intervention. These two figures signified that knowledge of chemicals in cigarettes in both groups was low i.e. less than half of 28 questions on the knowledge. This result shows that nicotine was a popular drug among adolescents, whereas ammonia, benzene, and other substances were not¹⁴. A low level of knowledge would lead them to misleading judgments and temptations to smoke.

From the paired t-test, we obtained a p-value of <0.001 in both groups. It indicated a significant difference in the knowledge before and after the video game-based and module-based education intervention. However, the treatment group, which was given video game-based education, got a mean

higher knowledge score (25.59) than the control group (11.97). The first group had a higher mean difference (15) than the control group (4.5). Besides, the independent t-test result indicated a p-value of <0.001. Results attested to the higher effectiveness of video game-based education than module-based education in elevating adolescents' knowledge of smoking.

Video games have become potential educational media that could prevent adolescents from smoking initiation. The study of a role-playing game found adolescents' positive responses in the form of enhanced knowledge²⁰. Furthermore, Diaz conveyed that students learned better when they enjoyed the learning. Another qualitative research on 'A Health Hero' video game presented a positive effect in escalating knowledge despite players' critiques of game appearance¹⁸. Video games also

could significantly improve adolescents' knowledge of cigarettes and vape²¹.

An increase in knowledge level after education was standard. Education, by any method, was attested effective to elevate the knowledge level. However, several issues would likely appear when students did not pay much interest in the material or media used. Most health education materials promoting anti-smoking emphasized that smoking harms physical health using some disturbing, scary pictures. The pictures eradicated students' interests, making them afraid, ignorant, and reluctant. Additionally, the media used modules which were poor and old-fashioned, giving students the image of monotonous education techniques. As such, video games were the solution to this problem, enhancing students' focus on and attention to the materials given¹⁸.

Results also indicated that the mean of smoking perception in the treatment and control group between the intervention was 103.9 and 99.37, respectively, marking a slight difference in the range of perception between those groups (4.5). However, the range expanded after the intervention (12.39). The paired t-test analysis yielded a p-value of <0.001 in the treatment group and that of 0.978 in the control one. It proved that video game-based education was more useful to enhance adolescents' smoking perception scores than module-based ones. It was aligned a significant correlation between the administration of video game-based education and the perception of health risks due to electronic cigarettes and cigarettes²¹. A review also found 17 of 22 studies that analysed the video game's effect on smoking perceptions indicated a significant improvement²².

An increase in knowledge underpinned the significance of video games in influencing adolescents' smoking perception. The effectiveness of video games to prevent adolescents from risk behaviours, e.g., smoking or drinking alcohol, was related to elevated cognition and motivations²³. Equipping students with adequate knowledge was an excellent start to build healthy behaviour²⁴. As an audiovisual educational media furnished with music, texts, story plots, and moving characters, video games could boost students' will to learn. Using video games engaged players in a situation where they could interact with their gadgets, involved their emotions, and entertained visual feedback²⁵. Video games were an innovative health promotion approach that corresponded to adolescents' hobbies, thereby becoming alternative educational media¹⁸. Video games were not mere gaming instruments that had adverse impacts²⁶. Instead, they were potential learning media that could enhance learning motivations. Video games

brought a new paradigm in the world of health promotion as an innovative approach.

The use of video games as educational media had extended to other disciplines. A systematic review shed light on the finding that video games had been extensively used in diverse types of studies, including attitude, intellectual competencies, knowledge, and motor skills²². The majority of those studies indicated a significant finding. For instance, three studies of knowledge showed that knowledge escalated to the next level. In nursing, video games had also been used to deal with several health problems, e.g. prevention of adolescents from smoking initiation¹⁸. But, other studies also revealed its side effects.

The rejection of video games as educational media was provoked by the adverse effects they had. The game-addicted disorder was one of the diseases suffered by those addicted to games, consequently giving them negative impacts²⁷. The worst condition resulting from being addicted to games was damaged personalities, such as violent and aggressive behaviour and hallucination^{28,29}. However, other research on video games' implication on health and behaviour problem-solving figured out a positive finding.

Contradiction in video game acceptance and rejection as educational media was another challenge, similar to the challenge when we added educating content regarding how to use gadgets properly and what the impacts of operating devices excessively were in the primary material. "Killing two birds with one stone" was the accurate proverb for the notion of one media working out two health problems. Developing video games using a good concept was an innovative solution to adolescents' smoking behaviour and some health promotion challenges, e.g. insufficient health workers, burdensome workloads, and long distances. Video games could be regarded as one of the innovative approaches which prevented adolescents from smoking.

This research was limited to the clear implications of video games to improve adolescents' smoking knowledge and perceptions using univariate and bivariate analyses. Therefore, future researchers should also investigate the effectiveness of video games on adolescents' behaviours using multivariate analysis.

Conclusions

Video game-based education had a significant effect on adolescents' smoking knowledge and perceptions.

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