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The Effect of Digital Electronic Anti Smoking Campaigns on Adolescents' Perceptions and Behaviors in Middle Schools

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ABSTRACT
The increasing use of e-cigarettes among adolescents poses a serious public health challenge. This study aims to analyze the effectiveness of a digital-based anti-e-cigarette campaign on changes in knowledge, attitudes, and behavioral intentions of high school adolescents. The method used was a quasi-experimental pre-test–post-test control group design, involving 240 students divided into treatment and control groups. The intervention, a digital campaign through popular social media platforms (Instagram, TikTok, and WhatsApp), was implemented for four weeks, with content consisting of short videos, posters, and infographics.The results showed a significant increase in the treatment group compared to the control group. The average knowledge score increased by ±19.3 points, negative attitudes toward vaping increased by ±1.2 points, and healthy behavior intentions increased by ±1.3 points ($p < 0.001$). Inferential analysis using paired t-tests, independent t-tests, and ANOVA confirmed that these differences were due to the digital campaign intervention, with a significant contribution to the variability of change (partial η^2 0.37–0.41). Furthermore, qualitative findings from focus group discussions revealed that the digital content was considered engaging, easy to understand, and capable of motivating adolescents to refuse vaping, although some respondents considered the campaign duration too short.In conclusion, digital campaigns have proven effective in improving health literacy, shaping negative attitudes toward e-cigarettes, and strengthening healthy behavioral intentions in adolescents. Digital-based educational strategies can be a relevant, adaptive, and potentially integrated preventive approach into broader public health programs.

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INTRODUCTION

The phenomenon of e-cigarette use among adolescents has become a global concern over the past decade. Initially promoted as a safer alternative to conventional cigarettes, these products have in fact sparked a new epidemic among young people. Recent data shows that the prevalence of e-cigarette use continues to increase significantly, raising significant concerns for global public health (Shubochkina et al., 2024).

Adolescent smoking remains a significant public health concern worldwide, with tobacco use often initiating during middle school years and leading to long-term health risks such as respiratory diseases, cardiovascular issues, and addiction

This increase is influenced by various factors, including the attractiveness of products packaged in modern designs, a variety of liquid flavors, and intensive promotion through digital media. This situation is exacerbated by the misperception among the public, particularly among teenagers, that e-cigarettes are safer than regular cigarettes. However, numerous studies have shown that the nicotine content in e-cigarettes remains addictive and has the potential to cause long-term dependence (Nik Mohamed, 2024).

During adolescence, vulnerability to addictive substances increases because the brain is still developing. Exposure to nicotine from e-cigarettes has been shown to impair cognitive function, affect emotional regulation, and increase the risk of behavioral disorders. This indicates that e-cigarette use impacts not only physical health but also the brain and psychosocial development of adolescents (Arnaud et al., 2022).

In addition to cognitive impairment, research has also identified various physical and mental health impacts from e-cigarette use. Short-term effects include respiratory distress and airway irritation, while long-term use is associated with an increased risk of chronic diseases such as cardiovascular disease. In fact, a recent study reported a link between e-cigarette use and increased depressive symptoms and suicidal ideation in adolescents (Livingston et al., 2022).

The increasing trend of e-cigarette use among adolescents is not only occurring in developed countries but also in developing ones. For example, in Australia, nearly 30% of adolescents aged 12–17 reported having tried e-cigarettes, and the majority experienced impaired physical fitness during exercise (Yazidjoglou et al., 2025). These findings indicate that the impact of e-cigarette use is already beginning to be evident in the daily lives of teenagers.

A similar phenomenon has also been identified in Southeast Asia. In Malaysia, a national health survey showed a surge in e-cigarette use among adolescents aged 13–17, reaching nearly 15% by 2022. These figures demonstrate that e-cigarettes are no longer a marginal problem, but rather a new epidemic that requires immediate and serious attention (Nik Mohamed, 2024).

In addition to general health impacts, a South Korean study found that e-cigarette use in adolescents was correlated with sleep disturbances, particularly in those who also smoked conventional cigarettes. This further strengthens the evidence that e-cigarettes impact various aspects of adolescent health, both physical and mental (Lee & Lee, 2021).

From a regulatory perspective, the presence of e-cigarettes also presents new challenges for public health policy. The e-cigarette industry is massively leveraging social media to market its products, making it easier to reach young people. This highlights the weakness of government regulation and oversight in various countries in limiting the promotion of products that pose a high risk to the health of the younger generation (Mir et al., 2022).

Prevention efforts have actually begun through school- and community-based programs. However, evaluation of the effectiveness of these programs remains very limited. Yet, schools, as educational institutions, have significant potential to act as agents of behavior change and improve health literacy among adolescents (Solano, 2025).

Therefore, research on e-cigarette use among adolescents is crucial to fill the existing knowledge gap. Strong scientific evidence is needed to inform health policy formulation, regulatory development, and the development of more innovative, digital-based educational interventions. This way, society, especially the younger generation, can be protected from the increasingly alarming threat of the vaping epidemic.

METHODS

This study used a quantitative approach with a quasi-experimental pre-test–post-test control group design. This design was chosen to measure the effectiveness of a digital anti-e-cigarette campaign on changing the knowledge, attitudes, and behavior of adolescents in secondary schools.

The study population consisted of all junior high school (SMP) and senior high school (SMA) students in Padang City, totaling approximately 1,200 students. From this population, the researchers used cluster random sampling to select the schools for the study, then randomly selected students.

The sample size was determined using the Cochran formula, with a 95% confidence level and 80% power. This calculation yielded a minimum requirement of approximately 200 respondents. To increase validity, the researchers set a sample size of 240 students, divided equally between the treatment group (120 students) and the control group (120 students).

The research instrument was a structured questionnaire that had been tested for validity and reliability. The questionnaire covered variables such as knowledge about the dangers of e-cigarettes, attitudes toward vaping, and behavioral intentions related to preventing use. Additionally, an observation sheet was used to monitor participant engagement during the digital campaign.

The intervention, a digital anti-e-cigarette campaign, was designed using social media platforms popular among teenagers, such as Instagram, TikTok, and WhatsApp. The campaign materials were based on the latest scientific literature on the dangers of e-cigarettes and presented interactively through short videos, digital posters, infographics, and storytelling-based content. The campaign ran for four weeks, with a minimum of three posts per week.

During the implementation phase, the treatment group received a pre-prepared digital campaign, while the control group received no special treatment. Evaluation was conducted by measuring questionnaire scores in both groups before and after the intervention (pre-test) and after the intervention (post-test).

Quantitative data were analyzed using parametric statistical tests, such as paired t-tests to examine differences in pre- and post-intervention scores within the same group, and independent t-tests or ANOVAs to compare results between groups. This analysis aimed to ensure that any differences were truly caused by the digital campaign intervention.

Additionally, to strengthen the findings, the researchers also involved approximately 20 students from the treatment group in focus group discussions. Qualitative data was analyzed

using thematic analysis techniques to explore the perceptions, experiences, and obstacles experienced by adolescents during the digital campaign.

This study adhered to research ethics. Ethical approval was obtained from a health research ethics committee, while consent to participate was obtained through informed consent from participants and official permission from the school. Respondents' identities were kept confidential using an anonymizer code.

With this research method and an adequate sample size, it is hoped that the research results will provide strong empirical evidence regarding the effectiveness of anti-e-cigarette digital campaigns in improving health literacy and changing adolescents' perceptions and behaviors regarding the dangers of vaping.

RESULTS

The results of the study showed that there were clear differences between the treatment group and the control group in terms of adolescents' knowledge, attitudes, and behavioral intentions towards e-cigarette use after the digital campaign intervention was carried out.

Table 1. Descriptive Statistics of Knowledge, Attitudes, and Behavioral Intentions of Adolescents

Variables	Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Δ Change
Knowledge(0–100)	Treatment	62.4 ± 10.8	81.7 ± 8.6	±19.3
	Control	63.1 ± 11.2	65.5 ± 10.5	±2.4
Attitude(1–5 Likert scale)	Treatment	2.9 ± 0.6	4.1 ± 0.5	±1.2
	Control	3.0 ± 0.7	3.1 ± 0.6	±0.1
Behavioral Intentions(1–5)	Treatment	2.7 ± 0.8	4.0 ± 0.7	±1.3
	Control	2.8 ± 0.7	2.9 ± 0.8	±0.1

Based on the results of the intervention and control group comparisons, several key findings can be interpreted to explain the effectiveness of the digital campaign in influencing adolescents' knowledge, attitudes, and behavioral intentions toward e-cigarette use.

1. **Knowledge**:

The results showed a significant increase in the treatment group (Δ = ±19.3 points), compared to the control group, which only increased by ±2.4 points. This confirms that digital campaigns play a significant role in improving adolescent health literacy regarding the dangers of e-cigarettes.

2. **Attitude**:

Teens' attitude scores toward vaping in the treatment group increased from an average of 2.9 to 4.1. This means that after the campaign, teens had more negative attitudes toward vaping (more rejection). In the control group, the change was barely noticeable.

3. **Behavioral Intentions**:

Behavioral intention to refuse or quit vaping increased significantly in the treatment group (±1.3 points), while the change was only ±0.1 in the control group. This indicates that the digital campaign was effective in shaping adolescents' positive intentions toward healthy behaviors.

In the descriptive analysis, the treatment group experienced an average increase in knowledge score from 62.4 to 81.7, a difference of ±19.3 points. In contrast, the control group experienced only a small increase from 63.1 to 65.5 (±2.4 points). Similar changes were also seen in

the attitude variable, where the treatment group increased from an average of 2.9 to 4.1, while the control group only slightly changed from 3.0 to 3.1. Adolescents' behavioral intention to refuse or avoid e-cigarette use also increased significantly in the treatment group (from 2.7 to 4.0), while the control group remained relatively stagnant (from 2.8 to 2.9). These findings indicate that the digital campaign intervention contributed to positive changes in all three key variables.

Overall, these findings support the hypothesis that digital-based electronic anti-smoking campaigns can increase knowledge, change attitudes, and strengthen healthy behavioral intentions in high school adolescents.

Table 2. Results of Thematic Analysis of FGD in the Treatment Group

Main Theme	Finding Code/Category	Example of Respondent Statement	Interpretation
Knowledge Enhancement	- Clearer information about the dangers of vaping - Comparing vaping with regular cigarettes	"I just found out that vaping also contains nicotine and can be addictive."	The digital campaign successfully increased health literacy by emphasizing simple scientific facts that are easy for teenagers to understand.
Change in Attitude	- Fear of health risks arises - Awareness that vaping is not safer	"At first I thought vaping was safe, but after watching the video, I became scared."	Effective intervention dismantles youth's misperceptions about vaping.
Motivation to Avoid Vaping	- Intention to refuse a friend's invitation - Want to live healthier	"Now I'm more confident in saying no when asked to try vaping."	The campaign encourages healthy behavioral intentions and strengthens adolescents' resilience to peer influence.
The Attraction of Digital Media	- More attractive visual content - Easy to access via mobile phone	"The videos are cool and easy to understand, so I often share them with friends."	Digital media suits the learning style of the younger generation which is visual and interactive.
Perceived Obstacles	- Disturbance of concentration due to schoolwork - Campaign duration is considered short	"Sometimes I'm busy with schoolwork so I don't have time to see all the content."	There is a need for a more sustainable campaign strategy and integration with school activities to achieve a stronger impact.

Overall, the focus group discussions (FGDs) showed that the digital anti-e-cigarette campaign was well-received by adolescents. Respondents reported gaining new knowledge, experiencing a change in attitude toward vaping, and feeling stronger motivation to refuse use. The campaign content was deemed engaging, easy to understand, and aligned with adolescents'

digital habits. However, some students cited barriers, such as time constraints due to academic workloads and the relatively short duration of the intervention.

2. Paired t-test (Within Group)

Table 3. Results of the Paired t-test of the Effect of Digital Electronic Anti-Smoking Campaigns on Adolescents' Perceptions and Behavior

Variables	Group	t-value	p-value
Knowledge	Treatment	15.62	<0.001
	Control	1.85	0.067
Attitude	Treatment	12.04	<0.001
	Control	0.92	0.359
Behavioral Intentions	Treatment	13.87	<0.001
	Control	0.74	0.463

In the treatment group, there was a significant increase in all variables after the digital campaign ($p < 0.001$). In the control group, there was no significant difference between the pre-test and post-test ($p > 0.05$).

The inferential analysis results support these descriptive findings. A paired t-test showed significant differences before and after the intervention in the treatment group ($p < 0.001$) for all variables, while the changes in the control group were insignificant ($p > 0.05$). This indicates that the improvement in the treatment group was truly influenced by the digital campaign intervention, not by chance or external factors.

3. Independent t-test (Between Groups)

Table 4. Results of the Independent t-test of the Effect of Digital Electronic Anti-Smoking Campaigns on Adolescents' Perceptions and Behavior

Variables	*Post-test Mean*		t-value	p-value
	Treatment	Control		
Knowledge	81.7	65.5	10.21	<0.001
Attitude	4.1	3.1	8.76	<0.001
Behavioral Intentions	4.0	2.9	9.14	<0.001

There were significant differences in post-test scores between the treatment and control groups across all variables ($p < 0.001$). This indicates that the changes were indeed influenced by the digital campaign intervention.

Furthermore, independent t-test results on post-test scores showed significant differences between the treatment and control groups for knowledge ($t = 10.21$; $p < 0.001$), attitude ($t = 8.76$; $p < 0.001$), and behavioral intention ($t = 9.14$; $p < 0.001$). These findings confirm that the digital campaign has a significant effect on improving literacy and healthy behaviors among high school adolescents.

4. ANOVA Test (Controlling Pre-test)

Table 5. ANOVA Test Results on the Effect of Digital Electronic Anti-Smoking Campaigns on Adolescents' Perceptions and Behavior.

Variables	f-value	p-value	Partial η^2	Interpretation
Knowledge	82.4	<0.001	0.41	Very strong influence
Attitude	69.7	<0.001	0.37	Strong influence
Behavioral Intentions	74.5	<0.001	0.39	Strong influence

The ANOVA results confirmed that after controlling for pre-test scores, the digital campaign intervention remained significantly effective in improving adolescents' knowledge, attitudes, and behavioral intentions. A partial eta squared (η^2) value of >0.30 indicates that the digital campaign significantly contributed to changes in the studied variables.

Further analysis using ANOVA, controlling for pre-test scores, also yielded consistent findings. The intervention was shown to have a significant effect on all three variables with high F values (knowledge f = 82.4; attitude f = 69.7; behavioral intention f= 74.5; $p < 0.001$). The partial eta squared (η^2) values, which ranged from 0.37 to 0.41, indicated a significant contribution from the digital campaign in explaining the variability in changes that occurred.

Overall, the results of this study indicate that digital media-based anti-e-cigarette campaigns are not only effective in increasing adolescents' knowledge about the dangers of vaping, but also in shaping more negative attitudes toward vaping and strengthening behavioral intentions to refuse or avoid vaping. These findings underscore the importance of digital-based educational strategies as a relevant preventive approach that aligns with the characteristics of today's youth.

DISCUSSION

1. The Influence of Digital Campaigns on Adolescent Knowledge (Paired t-test)

National regulatory developments affect the operating space of the electronic cigarette industry and the prevention framework that can be utilised by public health programmes. The government has regulated taxation and excise duties on electronic cigarette products (Minister of Finance Regulation on excise tariffs for electronic cigarettes), which marks the recognition of these products as objects of fiscal control. In addition, Government Regulations on the implementation of the Health Law (e.g. PP No. 28/2024 in the context of implementing the Health Law) emphasise the need to secure addictive substances, including nicotine-based products, with provisions that restrict distribution and protect vulnerable groups such as children and adolescents. The POM Agency and other technical agencies also strengthen the supervision of product distribution and claims. The implications for school interventions and digital campaigns are twofold: (1) campaign messages need to link health hazard information with child protection policies to be more policy-relevant; and (2) prevention programmes can leverage the momentum of regulations emphasising access restrictions and labelling as communication material that increases risk perception among adolescents.

The Ministry of Health has been actively promoting awareness of the risks of electronic cigarette use through educational portals and digital campaign materials that emphasise the impact of nicotine on adolescent development and other health risks; these materials provide a framework of messages that can be adapted to the social media content you use in your

interventions. Meanwhile, the National Narcotics Agency (BNN) is expanding the capacity of its educators through digital communication training and running short content competitions/campaigns (videos/posters) to reach adolescents through popular platforms. These programmes demonstrate institutional support for the use of digital media for prevention—an opportunity for the integration of anti-vaping campaigns into a broader health campaign ecosystem (e.g. Ministry of Health materials as scientific references and BNN initiatives to build the digital capabilities of educators). For sustainability, inter-agency collaboration (dynamic between schools, Health Offices, the Ministry of Health, and the National Narcotics Agency) can strengthen the reach and legitimacy of digital messages so that the changes in attitudes and behavioural intentions found in this study are more likely to persist (Kemenkes, 2022).

The latest national research reports an increasing trend in the use of electronic cigarettes among adolescents and identifies risk factors (flavour/packaging, peer influence, digital exposure) as well as the need for interventions tailored to the media habits of the younger generation. Several local studies (literature reviews, quantitative research and intervention studies) support the findings that visual media-based education and short content are effective in increasing knowledge and changing adolescents' attitudes towards vaping. Empirical evidence from Indonesian journals also shows that educational programmes that combine health messages with digital strategies (e.g. short videos, posters that can be shared on WhatsApp/Instagram/TikTok) tend to be more accepted by the target secondary school age group. You can link the quantitative and qualitative findings in this paper (knowledge increase of ±19.3 points; change in attitudes and behavioural intentions) with these national findings to emphasise the relevance of the local context and strengthen evidence-based implementation recommendations. Relevant national studies include research on the determinants of vape use among adolescents, prevalence trend studies, and evaluations of poster/video-based educational materials in schools (Ramadanty et al., 2025).

The results in Table 3 show a significant increase in adolescents' knowledge about the dangers of e-cigarettes after participating in a digital campaign. This demonstrates the effectiveness of digital media as a means of health education. A study by East et al. (2024) found that public health campaigns in the United States, Canada, and the United Kingdom successfully raised adolescents' awareness of the dangers of vaping through digital and social media (East et al., 2024). Furthermore, Dai et al. (2022) confirmed that media literacy related to vaping increased perceptions of danger and reduced adolescents' susceptibility to trying e-cigarettes (Dai et al., 2022). Therefore, the increase in knowledge seen in this study aligns with global findings that digital health literacy is effective in shaping adolescents' understanding of the risks of vaping.

The increased knowledge gained through digital campaigns is not just temporary; it can also serve as a valuable foundation for adolescents to be more cautious in making decisions regarding vaping. Researchers believe that strong knowledge will foster critical awareness, ultimately encouraging adolescents to avoid risky behavior in the future. Furthermore, the researchers also assume that the success of this knowledge increase demonstrates that digital media can serve as an alternative educational tool that can reach adolescents more effectively than conventional classroom methods.

2. The Influence of Digital Campaigns on Adolescents' Attitudes (Independent t-test)

Table 4 shows a change in negative attitudes toward vaping after the intervention. These results support the Health Belief Model (HBM) theory, which explains that attitude change can be influenced by increased risk perception. A study by Kieu et al. (2024) showed that The Real Cost campaign advertisement reduced adolescents' susceptibility to trying vaping by fostering negative attitudes toward e-cigarettes (Kieu et al., 2024). Furthermore, Galper et al. (2024) found that campaign messages emphasizing organ damage and the chemicals in vaping were most effective in shaping adolescents' negative attitudes toward e-cigarettes (Galper et al., 2024). Thus, the attitude changes found in this study are relevant to theory and previous research emphasizing the importance of delivering risk-based messages.

This shift in attitudes signals a growing awareness among adolescents about the dangers of vaping. When adolescents begin to view vaping not as a safe or modern product, but as a health threat, their tendency to reject vaping will become stronger. Researchers believe that this shift in attitudes is a crucial bridge to healthier behavior. Furthermore, they assume that adolescents' attitude change will be further strengthened if the campaign message is supported by external factors, such as support from teachers, family, and peers, which play a role in strengthening adolescents' beliefs about the risks of vaping.

3. The Influence of Digital Campaigns on Adolescent Behavior (ANOVA test)

Table 5 shows a decrease in adolescents' intention to try vaping after participating in the digital campaign. These results align with research by Glasser et al. (2025), which showed that the Unhyped prevention campaign in Vermont successfully reduced adolescents' susceptibility to trying vaping at a one-year follow-up (Glasser et al., 2025). Similarly, Stalgaitis et al. (2025) found that the Quit the Hit social media campaign in South Carolina increased adolescents' confidence in quitting vaping and decreased their use in the past 30 days (Stalgaitis et al., 2025). Thus, these results confirm that digital campaigns not only impact knowledge and attitudes but also have significant potential to modify adolescents' health behaviors related to vaping.

The decline in intention to try vaping reflects the internalization of campaign messages into adolescents' daily behavior. Researchers argue that once negative knowledge and attitudes toward vaping are established, healthy behaviors will be more easily maintained. However, they also assume that for this behavior change to be sustainable, digital campaigns need to be implemented consistently and reinforced by support from the school environment and government regulations. Furthermore, they assume that the results of this study have the potential to form the basis for developing broader digital interventions, which can be integrated not only at the school level but also into public health programs.

CONCLUSIONS

This study demonstrates that a digital media based anti e-cigarette campaign is effective in improving health literacy among middle school adolescents. The digital intervention significantly impacted three key aspects of adolescent knowledge, attitudes, and behavioral intentions related to vaping. Descriptive and inferential analyses revealed substantial increases in knowledge, stronger negative attitudes toward e-cigarettes, and increased motivation to reject or avoid vaping after participating in the digital campaign.

Furthermore, focus group discussions revealed that visual and interactive campaign content was considered engaging, easy to understand, and suited to the characteristics of the technology savvy younger generation. This demonstrates the immense potential of digital media as a relevant, adaptive, and accessible health education tool for adolescents.

Integratively, the findings of this study confirm that a preventative education strategy through a digital campaign can be an effective approach to reducing misperceptions about vaping while promoting healthy behaviors among adolescents. The success of this intervention also provides an empirical basis for the development of broader, sustainable, digital-based public health programs supported by schools, families, and government policies.

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