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Health Communication Strategies in School-Based Youth Anti-Smoking Education: A Qualitative Pentahelix Analysis

Agus Susanto, Dody Mulyanto, and Rizka Licia

Politeknik Indonusa Surakarta

ABSTRACT

Background: Adolescent smoking remains a significant public health challenge, particularly in low- and middle-income countries where prevention efforts are fragmented. Schools are strategic settings for health education, yet effectiveness increasingly depends on interactions with media, moral influences, and expert knowledge beyond the classroom.

Purpose: This study examined how adolescent anti-smoking communication is constructed, reinforced, and interpreted through interactions among schools, media, adolescents, moral actors, and health experts to develop an integrated health communication model.

Method: A qualitative study was conducted in Surakarta, Indonesia, in 2025 using focus group discussions and in-depth interviews with teachers, students, media practitioners, academics, health professionals, and religious leaders. Data were analyzed thematically to identify shared patterns.

Results: Schools shaped anti-smoking norms through curricula, activities, and institutional culture. Media reframed messages by linking health risks with moral values and future aspirations. Participatory communication increased adolescent engagement, while moral narratives complemented biomedical explanations. Expert involvement strengthened message credibility.

Discussion: Adolescent smoking prevention is strengthened when health communication operates as an interconnected, collaborative Pentahelix process.

Translation into Health Education Practice: Schools should function as hubs for participatory anti-smoking communication by collaborating with media, community leaders, and health experts to support scalable, culturally grounded prevention strategies.

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Background

Adolescent smoking remains a persistent public health challenge, particularly in low- and middle income countries (LMICs) where tobacco exposure intersects with social norms, media influence, and uneven health education efforts (Aryee et al., 2024; Mangrio et al., 2024; Murray et al., 2025). In Indonesia, the 2023 National Health Survey reported that 7.4% of individuals aged 10–18 years were current smokers, with the highest proportions observed among older adolescents (15–19 years) and a considerable share among younger adolescents (10–14 years) (Badan, Kebijakan Pembangunan Kesehatan [BKPK], 2023). At the same time, the total number of active smokers in the country is estimated at ±70 million, indicating that tobacco use remains a major burden across age groups (Megatsari et al., 2023). Comparable international evidence shows that the overall prevalence of adolescent smoking is around 10.24% across diverse global contexts, underscoring that youth tobacco use persists as a global issue despite decades of control efforts (Ihyauddin et al., 2023; Ilmaskal & Daswito, 2023). These data highlight that smoking initiation and continuation among adolescents remain significant concerns shaped not only by individual knowledge of health risks, but also by social dynamics, institutional contexts, and media influences that shape the credibility and reception of health messages (Susanto et al., 2023).

Schools have long been recognized as strategic settings for health education and smoking prevention (Susanto et al., 2020). Beyond formal curricula, schools function as social spaces where norms, values, and behaviors are continuously reinforced through teacher interactions, peer relationships, and institutional culture (Kumboyono et al., 2018). Evidence from systematic reviews indicates that school based smoking prevention programs are more effective when health messages are embedded within broader educational processes rather than delivered as isolated warnings (Ba-Break et al., 2025; Hossain et al., 2025). However, the effectiveness of school-based efforts is often constrained when messages are not reinforced by actors outside the educational system, particularly media and community institutions (Hwang et al., 2020).

CONTACT Agus Susanto agussus@yahoo.com Politeknik Indonusa Surakarta
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The contemporary media environment presents both challenges and opportunities for adolescent smoking prevention. Digital platforms have become dominant spaces where adolescents construct health related meanings, negotiate identities, and interpret social norms (Donaldson et al., 2022). Studies show that adolescents are more responsive to health messages delivered through familiar and interactive digital formats, especially when messages resonate with their lived experiences and peer cultures (Zhang et al., 2023; Zheng et al., 2024). At the same time, inconsistent framing of smoking in media content may weaken prevention efforts, as messages compete with entertainment driven narratives and commercial tobacco imagery (Vogel et al., 2024). This condition highlights the need for coordinated communication strategies that align educational, media, and community-based messages.

Health communication scholarship increasingly emphasizes that message effectiveness depends not only on exposure, but also on credibility, trust, and coherence across communicators (Lee et al., 2024). Adolescents are more likely to engage with health messages when they perceive the source as knowledgeable, authentic, and relevant to their social realities (Freeman et al., 2023; Mancone et al., 2024). Academics and health professionals play a crucial role in ensuring that smoking prevention messages are evidence based, ethically grounded, and developmentally appropriate (Demeshko et al., 2022; Engebretsen, 2024). Research suggests that expert involvement strengthens message legitimacy and supports the translation of complex medical information into accessible communication for young audiences.

In addition to educational and expert driven approaches, moral and community-based narratives continue to shape adolescent health behavior. Studies in health communication indicate that value-based framing, including ethical responsibility and concern for family wellbeing, can influence adolescents at an affective level that complements biomedical risk information (Bryce et al., 2026; Dudley et al., 2023). When moral perspectives are integrated thoughtfully, they may reinforce internal motivations for healthy behavior without relying solely on fear-based messaging.

Recent literature also underscores the importance of collaboration across multiple sectors in addressing complex health behaviors such as smoking. Tobacco prevention campaigns that involve schools, media, health professionals, and community actors are more likely to produce consistent and reinforcing messages across adolescents' daily environments (Demeester et al., 2025; Rifat et al., 2025). Nevertheless, many existing interventions remain fragmented, with limited attention to how different actors interact communicatively and how adolescents actively interpret and negotiate messages across contexts.

Within this evolving landscape, qualitative research plays a critical role in capturing how adolescents and key stakeholders experience, interpret, and evaluate smoking prevention communication. Qualitative approaches allow for deeper examination of meaning making processes, relational dynamics, and contextual factors that are often overlooked in outcome focused evaluations (Haryati et al., 2024; Sánchez-Franco et al., 2024). Understanding these processes is essential for developing communication models that reflect real world practices rather than prescriptive assumptions.

This study responds to these challenges by examining adolescent smoking prevention through a collaborative health communication lens that foregrounds interaction among schools, media, experts, community actors, and adolescents themselves. Conducted in an urban Indonesian context, the study explores how anti-smoking messages are constructed, disseminated, and interpreted across institutional and social settings. By focusing on adolescents as active interpreters of health messages and on collaboration among multiple actors, this research contributes to a more integrated understanding of health education and communication processes in smoking prevention.

The study aims to analyze how different actors contribute to the development, reinforcement, and credibility of anti-smoking communication among adolescents and how these contributions intersect to shape health related meanings. Through qualitative inquiry, the research seeks to inform health education practice by articulating a collaborative communication model grounded in empirical experiences and aligned with contemporary health communication theory.

Method

Study setting and period

The research was conducted in Surakarta, Central Java, Indonesia, between August and September 2025. Surakarta was selected as a medium-sized urban city where school- and community-based smoking prevention initiatives are present, yet communicative coordination across stakeholders remains limited. The city's urban scale and close interaction among schools, families, and community actors provide a relevant context for examining how adolescents interpret and negotiate smoking prevention messages across everyday social settings.

Participants and data sources

Data were collected through focus group discussions (FGDs) and in-depth interviews to ensure triangulation and analytical depth. One FGD involved 18 participants representing multiple stakeholder groups engaged in adolescent health communication. Participants included five members of the research team, five school teachers, one local media representative, five students, and two religious leaders.

In addition, in-depth interviews were conducted with 24 participants, consisting of eight school teachers and sixteen students. Teachers were selected based on their involvement in health education or student development activities, while students were purposively selected to reflect diverse peer and school experiences. The combination of FGDs and interviews enabled the exploration of both collective interactional dynamics and individual perspectives.

Data collection procedures

Data collection was guided by a flexible interview framework that allowed participants to articulate their views while maintaining thematic consistency across data sources. Both FGDs and interviews followed a flexible interview guide addressing:

(a) Perceptions of adolescent smoking behavior,
(b) The role of schools in health education,
(c) Communication strategies used in smoking prevention,
(d) Collaboration among educational, media, and community actors,
(e) Factors influencing message credibility and acceptance.

The FGD facilitated dialogue among participants from different sectors, enabling the identification of shared meanings and contrasting viewpoints. In-depth interviews provided opportunities for participants to elaborate on personal experiences and reflections that may not emerge in group discussions. All FGDs and interviews were conducted in Indonesian, audio-recorded with participants' consent, and transcribed verbatim for analysis.

Data analysis

In this study, the Pentahelix framework was applied as an analytic organizing structure involving five key actors: schools, media, adolescents, moral authorities, and experts, rather than as a predefined explanatory model. Its use was intended to support systematic interpretation of stakeholder roles emerging from the data. Data were analyzed using thematic analysis, beginning with repeated reading of transcripts to ensure familiarity. Initial coding focused on recurring patterns related to health communication roles, message framing, participation, and credibility. These codes were subsequently grouped into broader themes corresponding to the five actor categories within the Pentahelix framework. The analysis followed an iterative process, moving between data excerpts and evolving codes to maintain analytical consistency. At this stage, the Pentahelix framework functioned as an analytic lens to organize themes without predefining relationships or outcomes. The final thematic structure informed the subsequent construction of a collaborative Pentahelix-based health communication model.

Trustworthiness and ethical considerations

Trustworthiness was enhanced through data triangulation across participant groups and methods. Investigator discussion was conducted to review emerging interpretations and reduce potential bias. Verbatim quotations were used to support analytic claims. Ethical approval was obtained from the Health Research Ethics Committee of the Semarang Health Polytechnic, Ministry of Health, Indonesia (Ethical Clearance No. 1048/EA/F.XXIII.38/2025). Written informed consent was obtained from all participants, and confidentiality and anonymity were maintained throughout the study.

Results

The following results are presented by theme to reflect participants' perspectives on adolescent anti-smoking communication. Each theme highlights the contributions of schools, media, adolescents, moral authorities, and health experts, showing how these actors work in a complementary and interdependent manner. By framing the findings this way, the analysis emphasizes the collaborative strength of the Pentahelix model while preserving the richness of field data, including detailed observations, interviews, and focus group discussions.

Schools as central sites of health education and message reinforcement

Schools were consistently described by participants as primary environments where anti-smoking communication is produced and reinforced through everyday interactions. Rather than functioning solely as formal

instructional spaces, schools were experienced as social settings in which health-related norms were continuously negotiated through classroom discussions, peer interactions, and institutional routines. As one teacher explained,

> If the message only comes once, students tend to forget. But when it is discussed in lessons and activities, it becomes part of how they think about health.

Health education messages were embedded across subjects and extracurricular activities, allowing smoking prevention to be framed within broader narratives of responsibility and self-care. Students highlighted participatory activities such as drama, posters, and student clubs as particularly meaningful forms of message reinforcement:

> Through drama, posters, or student clubs, we are not just listening. We are involved, and that makes the message stronger.

Clear school rules and routine participation in health initiatives further contributed to the normalization of anti-smoking norms through repeated social practice rather than one-time instruction.

Media as framing agents in youth health communication

Media were recognized as influential in shaping adolescents' perceptions of smoking beyond school contexts. Participants noted that media framed smoking as a multidimensional issue linked to health, morality, economic consequences, and future life opportunities. A media practitioner explained,

> If smoking is only reported as a habit, people underestimate it. But when it is linked to health, family, and the future of young people, the issue becomes more serious.

Digital platforms emerged as critical spaces where health messages must compete with entertainment and commercial content. Collaboration with local influencers and content creators made messages more relatable, engaging, and accessible:

> Teenagers spend more time on social media than watching news. That is where the message has to appear.

Adolescents as active interpreters of health messages

Adolescents were consistently described as active interpreters rather than passive recipients. Smoking behavior was shaped by peer influence, social curiosity, and everyday interactions. Students expressed that traditional lectures or warnings were often repetitive or disconnected from their experiences:

> When adults just tell us not to smoke, it feels boring and repetitive.

Participatory and creative approaches, such as producing videos or performances, allowed adolescents to relate messages to their own social realities, making them feel more authentic and emotionally resonant:

> When we make videos or performances ourselves, the message feels closer to us.

Moral and spiritual dimensions of anti-smoking communication

Religious and moral perspectives added a complementary layer to anti-smoking messages, emphasizing ethical responsibility, self-discipline, and accountability to family and community. One religious leader explained,

> Smoking is not only harmful to the body, but it also affects the family. It is a responsibility to take care of what has been entrusted to us.

These narratives influenced adolescents' internal motivations and reinforced normative reasoning, enhancing the persuasiveness of biomedical and media-based communication.

Experts as anchors of credibility and message coherence

Experts, including academics and health professionals, ensured that messages remained scientifically accurate, ethically appropriate, and developmentally suitable. Participants consistently noted that expert involvement increased trust and consistency across schools, media, and community settings:

> If the information does not come from people who really understand health, it is easy for students to doubt it.

Academics provided conceptual clarity, while health professionals translated medical knowledge into understandable terms for adolescents:

> Doctors and health workers know how to explain the risks in a way that is real, not just theoretical.

Integration of findings toward a collaborative Pentahelix model

The findings illustrate a clear pattern of interdependent roles among schools, media, adolescents, moral

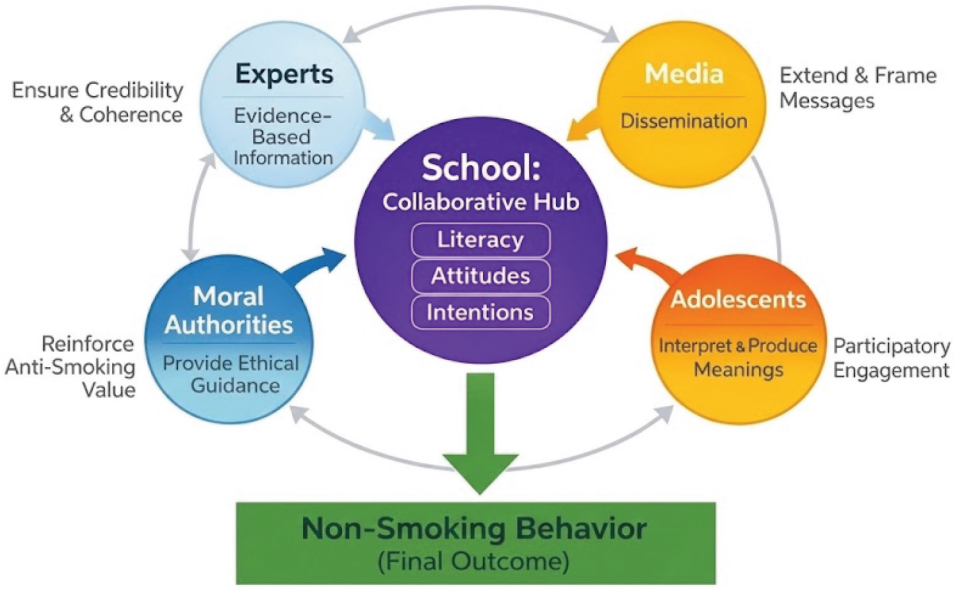


Figure 1. The school-based Pentahelix model for adolescent smoking prevention.

authorities, and experts, which collectively informed the development of the school-based pentahelix model presented in Figure 1. Schools emerged as the central locus of communication, serving as the primary environment where anti-smoking norms are introduced, reinforced, and experienced daily. Within this empirically derived structure, media extend and frame messages beyond the classroom, adolescents actively interpret and produce health-related meanings, moral authorities provide ethical guidance, and experts ensure credibility and coherence.

By positioning schools as the hub, the model synthesizes the thematic findings into a coherent representation of stakeholder interaction, highlighting how collaborative engagement among all actors creates a continuous communication ecosystem. Rather than functioning as a prescriptive framework, this configuration demonstrates that the effectiveness of adolescent smoking prevention emerges from the synergy of multiple actors operating in complementary roles. Schools anchor this network by linking formal health education with broader media exposure, peer engagement, moral reflection, and expert validation, thereby providing an empirically grounded framework for school-based health education programs seeking to deliver anti-smoking messages that are credible, culturally grounded, and impactful.

Discussion

Adolescent smoking prevention is increasingly understood as a socially embedded communication process shaped by interactions across institutional, interpersonal, and cultural contexts rather than as a direct outcome of individual knowledge acquisition.

This interpretation is grounded in a social ecological communication framework that emphasizes multilevel interactions in shaping health-related meanings and behaviors.

The findings of this study demonstrate that smoking prevention practices are produced through coordinated communication among schools, adolescents, media actors, moral authorities, and experts. These interactions highlight how adolescents' interpretations of smoking-related messages are shaped by the consistency, visibility, and social legitimacy of messages circulating across multiple contexts, rather than by isolated exposures to health information.

The centrality of the school environment reflects its function as a stable institutional space where norms related to smoking are repeatedly encountered and negotiated. Consistent with a social ecological perspective, schools operate simultaneously at organizational, interpersonal, and cultural levels, allowing prevention messages to be reinforced through formal instruction, peer interaction, and everyday routines (Chido-Amajuoyi et al., 2024). Recent systematic evidence shows that school-based interventions in LMICs are associated with lower odds of adolescent tobacco use, indicating that consistent school programs contribute to shaping anti-smoking norms across diverse settings, as demonstrated in a systematic review and meta-analysis (Hossain et al., 2025). Multilevel studies also demonstrate that more positive school tobacco control norms

are linked with lower odds of adolescent smoking, particularly when collective support for tobacco regulations is strong, reinforcing the idea that normative environments within schools influence smoking behavior and attitudes (Kim et al., 2020). Additionally, participation in school-based smoking prevention education has been shown to increase exposure to anti-tobacco media messages among adolescents, further narrowing gaps in normative messaging across peer groups and risk profiles (Hwang et al., 2020).

Adolescents' active involvement in interpreting and circulating prevention messages highlights the interactive nature of smoking prevention. Rather than acting as passive recipients, adolescents engage in meaning-making processes that connect institutional messages with peer norms and everyday experiences. This dynamic is supported by evidence showing that peer influence and peer group norms are strongly associated with adolescent smoking behavior and beliefs about smoking, indicating that adolescents' social interactions shape how smoking is interpreted within their social networks and influence smoking uptake (systematic review of peer influence and adolescent smoking) (Littlecott et al., 2023). School-based peer-led interventions have also been shown to affect adolescents' smoking-related normative beliefs and intention to smoke, underscoring the role of peer participation in modifying social expectations about smoking (Mohammadi et al., 2019).

Media-related communication functions as an extension of the school-based environment, contributing to the broader informational landscape in which adolescents encounter smoking-related narratives. From a social ecological standpoint, media messages shape the symbolic context of smoking by amplifying, reframing, or contesting messages encountered in school and peer settings. Recent empirical studies consistently show that adolescents' exposure to tobacco-related media content is significantly associated with smoking attitudes, perceived norms, and smoking initiation, indicating that media operate as a powerful normative environment alongside schools (Puspita Sari et al., 2024). Evidence further suggests that alignment between school-based prevention messages and media content enhances message coherence and strengthens anti-smoking norms, whereas inconsistent or contradictory media narratives may weaken normative clarity and increase susceptibility to smoking among adolescents (Addo et al., 2024; Vassey et al., 2022).

Peer dynamics emerge as a critical mechanism through which smoking-related norms are reinforced or challenged. Consistent with social cognitive theory, peer interaction provides opportunities for modeling, social comparison, and reinforcement of behavior-related meanings. Recent empirical evidence consistently shows that peer norms, peer approval, and peer communication are among the strongest predictors of adolescents' smoking attitudes and behaviors within school settings, where frequent interaction intensifies social influence (Lin et al., 2023; Skinner et al., 2024). Studies further demonstrate that peer-based communication enables nonsmoking norms to circulate in ways perceived as socially credible and relevant by adolescents, particularly in contexts where peer endorsement carries substantial weight in behavioral decision-making.

Moral and value-oriented messages add an interpretive dimension by embedding smoking behavior within culturally shared ethical logics rather than within explicit behavioral rules. Through references to responsibility, self-control, and social belonging, such messages invite adolescents to evaluate smoking in relation to who they are expected to be within their social world. Evidence from contemporary health communication research suggests that moral considerations shape how adolescents justify or reject smoking by influencing perceived legitimacy and moral acceptability, rather than by directly prescribing action (Wu et al., 2025; Yang & Yang, 2023). When prevention messages resonate with locally meaningful moral narratives, smoking is more likely to be interpreted as misaligned with valued identities and social roles, reinforcing health-related judgments through culturally grounded ethical reasoning.

Expert involvement contributes to coherence and credibility within the communication environment by anchoring smoking prevention messages in evidence-based interpretations of risk. Positioned within a social ecological framework, experts operate at organizational and community levels, where they help stabilize prevention narratives amid fragmented and competing information flows. Empirical communication research indicates that expert voices enhance message legitimacy and trustworthiness, particularly when adolescents and communities are exposed to mixed or contradictory health information (Park et al., 2020; van Westen-Lagerweij et al., 2025). Rather than replacing the influence of schools, peers, or cultural authorities, experts function as reference points that validate prevention messages and reinforce their consistency across settings, supporting a more integrated and credible communication ecosystem.

Taken together, the interaction among schools, adolescents, media, moral authorities, and experts reflects a collaborative configuration that aligns with a Pentahelix approach to health promotion. In this

study, the Pentahelix framework functions as an interpretive lens to explain communicative alignment across actors, rather than as a prescriptive intervention model. Rather than functioning as a rigid or prescriptive framework, this configuration illustrates how smoking prevention is produced through the dynamic alignment of communicative roles across multiple social domains. Contemporary public health and health communication research increasingly emphasizes that preventive outcomes depend on the integration and coordination of institutional, community, and knowledge actors, rather than on isolated interventions (Borland et al., 2010; Kuipers, 2022; Sjögren Forss et al., 2021). The findings therefore suggest that the effectiveness of smoking prevention is contingent on the coherence of communication processes embedded within existing institutional and cultural structures, highlighting collaboration and alignment as central conditions for sustainable health promotion rather than the dominance of any single actor or message.

Strengths and limitations

A major strength of this study lies in its qualitative and interpretive orientation, which enables an in-depth understanding of adolescent smoking prevention as a communicative and socially constructed process. By emphasizing interaction, meaning-making, and institutional context, the study moves beyond linear assumptions of behavior change and elucidates how prevention messages gain relevance, coherence, and social legitimacy in adolescents' everyday lives. The use of the Social Ecological Model in combination with Social Cognitive Theory strengthens the analytical grounding by situating individual interpretations within interconnected interpersonal, organizational, and cultural dynamics.

Another key strength is the inclusion of multiple stakeholder perspectives. Examining schools, adolescents, media actors, moral authorities, and experts within a single analytical frame allows for a more integrated understanding of how smoking prevention is negotiated and aligned across social domains. This multi-actor perspective is particularly valuable in contexts where formal public health interventions are limited and prevention efforts depend heavily on existing educational, cultural, and communicative infrastructures.

Several limitations should be considered. The findings are situated within a specific socio-cultural and institutional context and are therefore not intended for statistical generalization. Consistent with the qualitative design, the study prioritizes interpretive depth over representational breadth, and smoking-related behaviors were not measured quantitatively. As a result, the analysis does not estimate the direct effects of communication processes on smoking prevalence or cessation outcomes. Moreover, differences in actor configurations, media environments, and institutional capacity across settings may shape how similar communicative arrangements function elsewhere. These limitations highlight the need for contextual sensitivity when interpreting and applying the study's insights in other contexts.

Implications for intervention design

The findings suggest that adolescent smoking prevention interventions should be designed as ongoing communicative processes embedded within everyday institutional and social practices rather than as time-limited campaigns. Schools should be positioned as central coordinating environments where prevention messages are consistently reinforced through curriculum integration, peer interaction, and institutional norms. Such an approach supports continuity and allows prevention to become part of adolescents' routine experiences rather than an external directive.

Intervention design should also prioritize adolescent participation as active communicators rather than passive recipients of health information. Peer-led activities, collaborative message development, and participatory media production can enhance observational learning and strengthen self-efficacy. Aligning school-based communication with media narratives increases message coherence and visibility, particularly within digital environments where adolescents negotiate multiple and often competing influences.

Incorporating moral and value-based perspectives can further enhance intervention relevance when such messages are culturally grounded and institutionally supported. Expert involvement remains essential to ensure scientific accuracy and credibility, but expert knowledge should be translated into locally meaningful narratives rather than delivered as abstract authority. The Pentahelix configuration provides a flexible framework for integrating these elements, allowing interventions to adapt to local conditions while maintaining conceptual coherence.

Translation to Health Education Practice

The findings translate into health education practice by emphasizing the importance of integrating smoking prevention into routine educational and social processes. Health education practitioners should

collaborate closely with schools to embed prevention messages within daily learning activities, peer interactions, and school culture. Rather than focusing solely on information transmission, educational practice should facilitate dialogue, reflection, and shared meaning-making among adolescents.

Media can be leveraged as an extension of school-based health education by translating locally grounded norms and values into formats that resonate within adolescents' digital and social media environments. Youth-oriented platforms provide opportunities for participatory communication, enabling adolescents to engage with and reinterpret health messages in ways that align with their lived realities.

Health education practice should also recognize the role of moral and cultural values in shaping health-related interpretations. Collaborating with moral authorities and community leaders can help anchor prevention efforts within culturally resonant frameworks, while ongoing engagement with health professionals and academics ensures alignment with evidence-based standards. Through this integrated approach, health education practice can contribute to sustainable, context-sensitive adolescent smoking prevention that bridges local institutional settings and broader public health goals.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Agus Susanto http://orcid.org/0000-0003-1871-483X
Dody Mulyanto http://orcid.org/0000-0002-8528-6372

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