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# Healthy School Environment Through Brainstorming, Buzz Group, and Simulation (BBS) Methods in Smoking Control Behavior

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## Abstract

**Background:** High school students are in adolescence, a transitional period between childhood and adulthood. This phase is characterized by heightened curiosity and increased susceptibility to health-risk behaviors, including smoking. Adolescent smoking remains a significant public health concern worldwide. This study examined changes in smoking-related knowledge and attitudes among students at SMA 22 Makassar after implementing the Brainstorming, Buzz Group, and Simulation (BBS) method.

**Methods:** A quasi-experimental study involved 30 adolescent smokers at SMA 22 Makassar. Data were collected using questionnaires, and changes in smoking-related knowledge and attitudes were analyzed using the Wilcoxon signed-rank test.

**Result:** The findings revealed statistically significant changes in students' smoking-related knowledge and attitudes following the BBS intervention ($p < 0.001$).

**Contribution for Practice:** The findings provide preliminary evidence supporting the integration of brainstorming, buzz group discussions, and simulation into school-based health education programs. School nurses, teachers, and health promotion practitioners may consider these interactive methods to enhance adolescents' smoking-related knowledge, foster healthier attitudes, and strengthen smoking prevention education in schools.

**Keywords:** Smoking, Behavior, BBS Method.

## BACKGROUND

Senior High School or SMA are entering adolescence, the developmental transition from childhood to adulthood. This period is characterized by intense curiosity about various things. Specifically, high school students are in their late teens (1). Adolescence marks the transition from childhood to adulthood. This period involves numerous changes within an individual, both positive and negative. One negative change that occurs in adolescents is the emergence of smoking habits (2).

Smoking is a health problem found in nearly every country in the world. Tobacco use kills nearly 8 million people each year, of whom 7 million are active smokers and 1.2 million are passive smokers (3). Indonesia is one of the Southeast Asian countries that has not yet adopted the World Health Organization Framework Convention on Tobacco Control (WHO FCTC). The prevalence of smoking in Indonesia is quite high, at 33.8%, with a prevalence of young smokers at 12.8% (4).

According to the World Health Organization (WHO), tobacco kills more than 5 million people annually and is projected to kill 10 million by 2020. of these, 70% are in developing countries, dominated by 700 million men, primarily in Asia. The WHO estimates that 1.1 billion smokers worldwide are aged 15 and over, representing a third of the world's population (5). Indonesia ranks fifth in global cigarette consumption after China, the United States, Japan, and Russia (6). Among adolescents aged 15-19, about 38.4% of males and 0.9% of females smoke. This age group includes students in the third grade of junior high school (SMP), senior high school (SMA), and early college. This group generally begins smoking to demonstrate their maturity (7).

The overall smoking prevalence in Indonesia is 24.3%. Similarly, the prevalence in South Sulawesi province is 22%. Data from the Basic Health Research (RISKESDAS) in 2023 indicates that the smoking prevalence in Makassar City is 21.01%. The prevalence of smokers in the 15-19 age group is 12.43% (8). Adolescents are a group that is vulnerable to various health-risk behaviors, including smoking, which requires appropriate health education and promotion efforts to change their attitudes and behavior (8, 9).

Epidemiological data show that the trend of teenage smoking in Indonesia, including in South Sulawesi, remains at an alarming level. Adolescents are an age group vulnerable to various health-risk behaviors, including smoking. Internal and external factors, such as the social environment, peers, and exposure to information on social media, influence this vulnerability (10). Most adolescents are aware of the impact of their smoking behavior, but they often assume that the consequences of smoking are not significantly impactful. This is because adolescents don't immediately feel the negative impacts of smoking when they start smoking (11).

The rise in smoking among adolescents is associated with the transition to adulthood. Teenagers are discovering their identity and are interested in trying new things. Teenage smokers are perceived as appearing more masculine and mature, and are more likely to attract the opposite sex. If left unchecked, adolescent smoking can have adverse effects on adolescents, including impaired concentration in learning, decreased academic performance, and health problems. The increasing prevalence of young smokers poses a significant burden of non-communicable diseases in Indonesia.15 Smoking also poses a high cost burden for smoking-related diseases in Indonesia, ranging from Rp. 17.9 trillion to Rp 27.7 trillion (12).

Early health education is essential to reducing smoking among adolescents. Previous research has shown that interventions are ineffective in minimizing smoking. Therefore, a combination of methods is necessary for health education for adolescent smokers. These methods must be tailored to adolescents' characteristics to increase engagement and create a greater, more meaningful impact. Based on this, researchers believe brainstorming, buzz groups, and simulations can serve as reference methods for health education (13).

The Brainstorming, Buzz Group, and Simulation (BBS) method was selected because it combines participatory learning strategies that address the cognitive, affective, and behavioral aspects of smoking prevention among adolescents. Compared with conventional lecture-based methods, which primarily deliver information one way and may place students in a passive role, brainstorming encourages students to actively share their knowledge, perceptions, experiences, and opinions about smoking. The buzz group component also provides opportunities for more intensive, egalitarian peer discussions in Senior High Schoolller groups, allowing students to express their views more comfortably and positively influence one another. This approach is particularly relevant for adolescents because smoking-related attitudes and behaviors are influenced not only by individual knowledge but also by social interactions and peer environments.

The simulation component further distinguishes BBS from methods that primarily emphasize information delivery or discussion. Through simulation, students can practice responding to realistic situations, such as being offered cigarettes or experiencing peer pressure to smoke, translating knowledge and attitudes into practical behavioral skills. Although other methods, such as lectures, audiovisual education, discussions, or role-play, can support smoking prevention, they may emphasize specific learning dimensions rather than integrating them into a single intervention. BBS combines brainstorming, peer discussion, and simulation so that students can explore smoking-related issues, exchange perspectives, and practice appropriate behavioral responses. Therefore, BBS is considered relevant to the present study because the intervention aims not only to improve students' knowledge and attitudes but also to encourage changes in smoking-related actions within the school environment.

Makassar City, as a metropolitan city in eastern Indonesia, reflects complex public health challenges. Data from the Makassar City Health Office show that active smoking prevalence in this region remains high, dominated by the productive age group. Meanwhile, local studies on controlling adolescent smoking behavior based on school environmental engineering are still very limited in Makassar City, especially participatory and experimental approaches. At SMA 22 Makassar, data showed that 9 out of 10 students are active smokers. However, no research on student smoking behavior has been conducted at the school, so no specific empirical data are available to inform targeted intervention planning. Therefore, this study aimed to evaluate the effectiveness of the Brainstorming, BBS method, integrated with school environmental engineering, in controlling adolescent smoking behavior at SMA 22 Makassar.

# METHODS

### *Study Design*

This study employed a quasi-experimental design with a two-group pretest–posttest approach to evaluate the effects of the Brainstorming, Buzz Group, and Simulation (BBS) method combined with school environmental modifications on smoking-related knowledge, attitudes, and behaviors among adolescent students. The study was conducted in March 2026 at SMAN 22 Makassar, Indonesia.

The study involved two groups: an intervention group receiving the BBS educational intervention combined with environmental modifications and a control group that did not receive the BBS intervention. Outcomes were assessed before and after the intervention to examine changes within each group and differences between the groups.

### *Participants /Sample*

The study population consisted of adolescent students who smoked and were enrolled at SMAN 22 Makassar, Indonesia. A total of 30 adolescent smokers participated in the study. Participants were selected using a total sampling technique, in which all eligible students meeting the study criteria were included. The participants were assigned to intervention and control groups according to the study

design. Eligibility was determined based on students' smoking status, enrollment at the study site, and willingness to participate in the research.

***Instruments and Data Collection***

Data were collected using a structured questionnaire to measure students' knowledge, attitudes, and behaviors related to smoking. The knowledge section assessed students' understanding of the health risks and harmful effects of smoking. The attitude section used a Likert scale to assess students' opinions and perceptions about smoking. The behavior section included questions about students' smoking habits and responses to smoking-related situations. The same questionnaire was administered before and after the intervention to measure changes in students' knowledge, attitudes, and behaviors.

***Intervention***

The intervention used the Brainstorming, Buzz Group, and Simulation (BBS) method combined with school environmental modifications. During brainstorming, students shared their knowledge, experiences, and opinions about smoking. In the buzz group sessions, students participated in small-group discussions about the dangers of smoking and ways to prevent smoking behavior. During simulations, students practiced responding to situations involving smoking, including peer pressure and offers to smoke. School environmental modifications included providing and installing anti-smoking posters and educational materials to support a smoke-free school environment. The intervention group received the BBS intervention, while the control group did not receive the BBS method.

***Data Collection***

Data were collected in March 2026 at SMAN 22 Makassar. Before the intervention, both groups completed a pretest questionnaire to measure their knowledge, attitudes, and behaviors related to smoking. The intervention group then received the BBS method combined with school environmental modifications, while the control group did not receive the BBS intervention. After the intervention, both groups completed a posttest using the same questionnaire. All completed questionnaires were checked for completeness before data analysis.

***Data Analysis***

Data were analyzed using descriptive and inferential statistics. Descriptive analysis was used to summarize participants' characteristics and smoking-related knowledge, attitudes, and behaviors. The normality of the data was assessed before statistical testing. Changes between pretest and posttest scores within each group were analyzed using the paired t-test or Wilcoxon signed-rank test, depending on data distribution. Differences in score changes between the intervention and control groups were analyzed using the independent t-test or Mann–Whitney U test, as appropriate. Statistical significance was set at $p < 0.05$.

***Ethical Consideration***

This study was conducted in accordance with ethical principles for research involving human participants. Ethical approval was obtained from the Research Ethics Committee of Universitas Muslim Indonesia (UMI), Makassar, Indonesia. Permission to conduct the study was also obtained from SMAN 22 Makassar. Participation was voluntary, and all participants were informed about the study objectives and procedures. Informed consent was obtained in accordance with applicable requirements for adolescent participants. Participants' confidentiality and anonymity were maintained throughout the study.

# RESULT AND DISCUSSION

## RESULT

### *Demographic and Baseline Characteristics*

A total of 30 adolescent students participated in this study. Respondents' demographic characteristics were described based on gender and age. The frequency and percentage distribution of these characteristics are presented in Table 1.

**Table 1.** Respondent Characteristics (n=30)

| Characteristics | n | % |
|---|---|---|
| Gender | | |
| Male | 30 | 100 |
| Age | | |
| 15 Years | 7 | 23,3 |
| 16 Years | 22 | 73,3 |
| 17 Years | 1 | 3,3 |
| Total | 30 | 100 |

Note. n = number of respondents; % = percentage. All respondents were male (100%), and the majority were aged 16 years (73.3%). Percentages may not total 100% due to rounding.

### *Changes in Smoking-Related Knowledge and Attitudes Before and After the BBS Intervention*

The differences in students' knowledge and attitudes toward smoking before and after the intervention were analyzed to assess changes following the implementation of the Brainstorming, Buzz Group, and Simulation (BBS) method. The analysis compared the mean scores, standard deviations, and mean differences between pretest and posttest measurements. The results are presented in Table 2.

**Table 2:** Differences in Knowledge and Attitudes Towards Controlling Smoking Behavior in Adolescents Before and After Intervention at SMAN 22 Makassar

| Variabel | | Mean | SD | Δ Difference | p-value |
|---|---|---|---|---|---|
| Knowledge | Before | 23,60 | 2,13 | 7,27 | 0,000 |
| | After | 30,87 | 1,83 | | |
| Attitude | Before | 13,83 | 2,32 | 3,74 | 0,000 |
| | After | 17,57 | 1,22 | | |

Note. SD = standard deviation; Δ = mean difference between posttest and pretest scores; p = statistical significance. A p-value of < 0.05 was considered statistically significant.

Table 2 shows that the mean knowledge score increased from 23.60 before the intervention to 30.87 after the intervention, with a mean difference of 7.27 ($p < 0.001$). Similarly, the mean attitude score increased from 13.83 to 17.57, with a mean difference of 3.74 ($p < 0.001$). These findings indicate significant improvements in students' knowledge and attitudes following the Brainstorming, Buzz Group, and Simulation (BBS) intervention.

## DISCUSSION

### *Differences in Adolescent Smoking Knowledge Before and After Treatment in the Intervention Group and Control Group.*

Education can increase a person's knowledge. Education can increase someone's knowledge. Education can be delivered through outreach, training, poster distribution, video screenings, leaflets, or

booklets. Knowledge results from a learning process a person acquires through what they do, hear, or see (14).

In the pre-intervention stage (pre-test), respondents' average knowledge score was 30.40. After the intervention, school environmental engineering through the Brainstorming, Buzz Group, and Simulation (BBS) method, the average score increased to 41.93. The statistical test showed a p-value of 0.000 (<0.05), indicating that the intervention significantly increased student knowledge. These results indicate that school environmental engineering through the Brainstorming, Buzz Group, and Simulation (BBS) method effectively increases students' understanding of controlling smoking behavior. This aligns with Bloom's taxonomy, where at the remembering stage (C1), individuals recall information previously acquired and stored in long-term memory. In the context of this study, adolescents began to recall information about the dangers of smoking after receiving intervention, thus strengthening their previously limited basic knowledge.Furthermore, at the understanding stage (C2), individuals cannot only remember but also explain and interpret the meaning of the information they receive. Adolescents begin to understand the health messages conveyed, including the negative impacts of smoking on their own health and the health of others. Thus, they no longer simply memorize the information but process it to form a deeper understanding.This is evident in increases in several key indicators: knowledge of smoking-related diseases rose from 23.3% to 83.3%, knowledge of the risks of secondhand smoke to others rose from 46.7% to 90.0%, and knowledge of cigarette ingredients rose from 60.0% to 93.3%. These improvements indicate that students are not only retaining information but also understanding it more deeply.

The results align with research which showed a difference in respondents' average knowledge before and after an intervention using interactive learning methods. The p-value was <0.05, indicating a significant effect. This study explained that interactive methods are more effective at increasing knowledge because they let participants be directly involved in the learning process (15).

***Differences in Adolescents' Smoking Attitudes Before and After Treatment in the Intervention Group and the Control Group***

A person's still-closed reaction to a stimulus is called an attitude. Attitudes are not concrete actions but perceptions and a person's readiness to react to stimuli around them. Attitudes can be measured directly and indirectly. Attitude measurement is the respondent's expressed opinion about an object (9).

In the pre-intervention phase (pre-test), the average respondent attitude score was 34.07. After the intervention, which involved school environmental engineering using the Brainstorming, Buzz Group, and Simulation (BBS) method, the average score increased to 45.43. Statistical tests showed a p-value of 0.000 (<0.05), indicating that the intervention significantly improved students' attitudes toward controlling smoking behavior. The results indicate that the Brainstorming, Buzz Group, and Simulation (BBS) method effectively fosters more positive attitudes toward smoking prevention. Student involvement in discussions, brainstorming, and simulations encouraged them to share their experiences and understanding, making learning more engaging and easier to understand than simply receiving or reading information.

Significant changes were seen in the increasing percentage of respondents who agreed and strongly agreed with statements describing the dangers of smoking. For example, for the statement "smoking is harmful to my health," agreement increased from 70.0% (agree) in the pre-test to 83.3% (agree) and 16.7% (strongly agree) in the post-test. The same trend was seen for the statement "smoking causes people to become sick," which increased from 46.7% (agree) to 80.0% (agree) and 13.3% (strongly agree). These changes indicate increased awareness and acceptance of the negative impacts of smoking among respondents.

Furthermore, there was a decrease in misconceptions in the intervention group, such as the belief that smoking can relieve stress or increase self-confidence. Before the intervention, 43.3% of respondents agreed, and 10.0% strongly agreed that smoking can relieve stress. However, after the intervention, this tendency began to decrease, indicating a shift in respondents' perspectives on smoking.

These positive changes were inseparable from the methods used: Brainstorming, Buzz Groups, and Simulation (BBS). This method encourages active student involvement in the learning process, influencing not only cognitive aspects (knowledge) but also affective aspects (attitude). During the brainstorming stage, students can express their initial opinions, including misperceptions. This process helps uncover initial awareness and serves as an entry point for attitude change.

Next, through buzz groups, students discuss in small groups, allowing them to exchange opinions and experiences. This interaction is crucial in shaping attitudes, as students receive information not only from teachers but also from peers, who strongly influence adolescents. These discussions help reinforce the belief that smoking is a dangerous behavior. The simulation stage then reinforces this change by providing a concrete illustration of smoking's impact on both themselves and others. When students can imagine or experience the situation directly, the message becomes more emotionally meaningful. This emotional involvement plays a significant role in attitude change, as attitudes are shaped not only by knowledge but also by feelings and experiences.

Researchersearchers also found that an environmental engineering ausing through visual mereinforcingement of social norms in schools had a greater impact on student attitude change than a short-term educational intervention. The study found that the average attitude score in the control group increased from 65.21 to 78.34, while in the intervention group it increased from 66.10 to 72.85. The statistical test showed a p-value <0.05, indicating a significant difference, with the control group's increase in attitudes higher than the intervention group's (16).

### IMPLICATION STUDY FOR PRACTICE

The findings suggest that the Brainstorming, Buzz Group, and Simulation (BBS) method, combined with school environmental modifications, may be a useful approach to improving adolescents' knowledge and attitudes toward smoking prevention. Schools can integrate these interactive learning methods into existing health education programs to encourage student participation, peer discussions, and practical skills in resisting smoking-related peer pressure. School nurses, teachers, and health promotion practitioners can collaborate to deliver BBS activities, supported by anti-smoking educational materials and smoke-free school policies. Regular education and follow-up activities are recommended to reinforce positive attitudes and support long-term smoking prevention efforts among adolescents.

## CONCLUSION

This study found that the integration of school environmental modifications with the Brainstorming, Buzz Group, and Simulation (BBS) method was associated with improvements in adolescents' knowledge and attitudes toward smoking prevention. These findings suggest that participatory educational approaches may support school-based health promotion programs by encouraging active learning and increasing awareness of smoking-related health risks. However, the small sample size, single-school setting, and limited assessment of long-term behavioral changes restrict the generalizability of the findings. Future studies should involve larger and more diverse samples, longer follow-up periods, and objective measures of smoking behavior to evaluate the long-term effectiveness of the BBS intervention. Schools are encouraged to integrate interactive educational activities and supportive smoke-free environments into their smoking prevention programs.

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### AUTHORS CONTRIBUTION STATEMENT

AVBL, MI, FPI, Y, AA, and AB: Conceptualization, Writing – Original Draft, Review & Editing. MI, FPI, and AVBL: Methodology, Manuscript Review. MI and FPI: Supervision. AVBL: Formal Analysis, Data Curation, Writing – Original Draft. MI, SPI, Y, AA, and AB: Validation, Investigation, Manuscript Review. All authors have read and approved the final manuscript.

### CONFLICT OF INTEREST

None.

### DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

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### DATA AVAILABILITY

The data may be obtained at any time from the corresponding author, if needed.

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