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Integration of Dengue Fever Prevention into School Learning: An Experimental Study-Interactive Media for Dengue Fever Prevention

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ABSTRACT

Introduction: The risk of contracting Dengue can affect anyone, including school students. This fact poses a threat because there is no specific program related to Dengue prevention in the school environment. This study aims to test the effectiveness of HyperText Markup Language 5 (HTML5) with Smart Apps Creator as an interactive medium for dengue prevention integrated into learning.
Methods: This research is divided into testing and evaluation stages. The testing stage was conducted through a true experimental design with a Pre-test, Post-test, and Control Group. The evaluation stage was conducted through a quasi-experimental design with a pre-test, post-test, and one-group intervention method. The research population was 5th-grade students of public elementary schools. The sample for the testing stage was 35 students for both intervention and control, and the sample for the evaluation stage was 396 students. The research sample was selected using simple random sampling. The research was conducted for 8 weeks. Data were obtained from filling out questionnaires for pre-test, post-test I, and post-test II. Ethical approval was obtained from Bhakti Kencana University ethics committee (98/09.kepK/UBK/VII/2023).
Results: There was a significant difference in motivation in the media test and evaluation before and after the intervention through HTML5-based interactive game media with a smart app creator, with a p-value of 0.000. The intervention significantly increased motivation with a p-value of 0.000 compared to the control group in the media test. Likewise, the evaluation results p-value of 0.000. Thus, the intervention was proven effective in increasing motivation. Another indicator of success was that during the 4 weeks of observation, the presence of larvae decreased significantly. Even in the 4th week, no larvae were found in all the containers.
Conclusion: The Dengue Prevention through HTML5 Interactive Media with Smart Apps Creator is significantly effective as an intervention because it can significantly increase motivation.

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INTRODUCTION

Dengue Hemorrhagic Fever is an environmental-based disease that is included as a Neglected Tropical Disease, which is often associated with social, economic, and health problems that spread in tropical areas. Tropical and subtropical areas, as endemic areas, increase the risk of contracting dengue fever, especially in those under 15 years of age (1). Controlling neglected tropical diseases requires long-term and sustainable efforts that are integrated into the national primary healthcare system (2). Various dengue vaccines are being developed as a continuous innovation. Accurate data is still needed to control dengue fever based on information from research results, health policies, and financial resources (3). Globalization, travel, trade, settlement, virus evolution, climate change, and socioeconomics increase the expansion of dengue fever. So, effective vector control is through the prevention and control of dengue fever (4). Important components in controlling dengue fever include advocacy, capacity building, political commitment, environmental management, increased surveillance, improved case management, sustainable vector control, vaccine research, and community involvement (5).

Indonesia is a high-risk tropical country with an increasing and widespread number of dengue fever cases. An environment that supports dengue breeding means the potential for larval density will be higher. The El Niño phenomenon also causes the annual cycle of dengue fever to become shorter, from 10 years to 3 years or even less. Rising temperatures cause mosquitoes to bite more often, resulting in a potential increase in dengue cases in the dry season in July and August (6). The school environment needs attention from the school community. Students can become agents of change so that they will grow and develop into individuals who behave appropriately in preventing and controlling an extensive dengue fever prevention program, considering the very low level of knowledge and inadequate prevention practices (7). Future health promotion targeting young people focuses on transforming knowledge into Dengue practice (8).

Based on Ratanawong's research, dengue infections cluster among schools and in classes in schools with different types of breeding places. The density of Aedes vectors in schools is related to dengue fever infections and breeding sites in schools. So it is necessary to implement vector control strategies in schools while maintaining vector control efforts at the household level (9). Dengue prevention in endemic areas requires the participation of all parties, including prevention efforts by individuals and families. Breaking the life cycle of Aedes aegypti can be done easily, such as practicing the 3M Plus (Draining, Covering, Recycling) practice: draining water reservoirs, tightly closing water containers, and recycling used items that could potentially become mosquito breeding grounds. These habits are essential for dengue prevention, including in the school environment. Habits will emerge when knowledge about dengue prevention is acquired and well understood. A good understanding requires the participation of all parties, including a sense of responsibility to provide good and targeted education. In the school environment, the participation of all parties from the school community is necessary. However, innovation is needed in dengue prevention efforts that are fun and do not disrupt the learning process.

Integrating digital platforms into daily activities effectively will change behavior, especially health behavior, by encouraging individual motivation and confidence. Digital interactions support Self-Determination Theory in gamification to master competencies and increase Autonomy in carrying out new behaviors. Perceived Benefits will have significant benefits, and Perceived Susceptibility will have feelings of vulnerability to certain health problems will encourage behavioral change from the Health Belief Model perspective. Ease of access to digital platforms acts as an Opportunity in the COM-B model. The combination of competence and increased autonomy encourages the formation of Motivation within individuals (intrinsic motivation) according to Self-Determination Theory, while increasing Self-Efficacy according to the Health Belief Model. The integration of intrinsic motivation and a sense of capability will result in successful integrated behavioral change and encourage sustainable behavior.

Audiovisual media have proven effective because they integrate a single, engaging information delivery channel. Providing information through video as an audiovisual medium has the potential to promote healthy behaviors (10). Video-based messages as an intervention to educate about prevention methods can build attitudes and intentions toward preventive behaviors and increase awareness of risky behaviors. Audio-visual media is experiencing increasing use in learning. Therefore, interactive audio-visual media provide a comprehensive tool for conveying health messages. Animation and interactive videos do not cause cognitive load on participants and tend to increase motivation (11).

An appropriate method is needed to prevent and control dengue fever. Based on this, researchers created an interactive medium that can be used in learning. HyperText Markup Language 5 (HTML5) Interactive Media with Smart Apps Creator as an interactive media for Dengue Prevention that is integrated with learning in schools. Practical, innovative, interactive, and engaging media are needed to facilitate delivery, along with learning support tools complete with audiovisual materials that are highly engaging for elementary school students. These media are certainly easy to use and support learning, especially in Indonesian language and physical education, sports, and health. A solution for increasing student understanding and participation as agents of change. Based on the above, the purpose of this study is to test HTML5 Interactive Media with Smart Apps Creator as an interactive medium for Dengue Prevention.

METHOD

This research is quantitative. This research is divided into testing and evaluation stages. The testing stage was conducted through a true experimental design with a Pre-test, Post-test, and Control Group to measure the effect of an intervention by comparing changes in the intervention group with the control group. The evaluation stage was conducted through a quasi-experimental design with a pre-test, post-test, and one-group intervention method.

The research population was 5th-grade students of public elementary schools in Bandung City. Through cluster sampling calculations, two public elementary schools were selected as the testing stage, and four public elementary schools were selected as representatives in the evaluation stage. Based on the Slovin formula, the sample for the testing stage was 35 students for each intervention and control group, and the sample for the evaluation stage was 396 students. The research sample was selected using simple random sampling. The research was conducted for 8 weeks.

The intervention was carried out through HTML5 interactive media with Smart Apps Creator. HyperText Markup Language 5 is a coding language for creating websites on the internet. In the development, HTML5 is used as an interactive medium that collaborates with a smart app creator to create interactive Dengue Prevention media. This HTML5 Interactive Media with Smart Apps Creator contains information about Dengue prevention that can be read or heard by students, accompanied by music, animation, color, and an attractive display. There is interesting information in various media, such as videos, posters, and jingles, to eradicate mosquito nests. As an interactive media, HTML5 Interactive Media with Smart Apps Creator is equipped with quizzes and games such as drag and drop, guess the word, and smack the mosquito, which are challenging because, in addition to the sound and tense timing, there are also sound games that can make children more challenged in the quiz answers.

Data was obtained from filling out questionnaires on the pre-test, post-test I, and post-test II. Intervention outcomes were then compared by measuring the motivation variable through pre-test, post-test I, and post-test II. The questionnaire measured motivation, and an observation sheet for the presence of larvae.

The questionnaire was tested for validity and reliability before use. Normality testing used the Shapiro-Wilk test ($n < 50$) for the media test and the Kolmogorov-Smirnov test ($n > 50$) for the evaluation. If the data distribution was not normal, the statistical analysis used was non-parametric. Data analysis used the Wilcoxon Signed Ranks test to find out the difference in Motivation Scores at each stage. The Mann-Whitney test was used to determine the effectiveness of HTML5 Interactive Media with Smart Apps Creator as an interactive medium for Dengue Prevention.

Ethical approval for this research was obtained from the ethics committee of Bhakti Kencana University with reference number 98/09.kepK/UBK/VII/2023.

Figure 1. HTML5 Interactive Media With Smart Apps Creator

RESULTS

The Testing Stage

The media testing was conducted at two elementary schools. This media testing was an intervention test using a true-experimental study method with a Pre-test, Post-test, and Control Group design. The intervention and control groups each had 35 students. The results of this media testing were as follows:

Table 1. Distribution of Motivation in the Intervention Group and Control Group

Motivation	n	Mean	Median	Min	Max	SD
Intervention						
Intervention Pre-test	35	20,31	20,00	18	24	1,549
Intervention Post-test 1	35	29,51	30,00	28	30	0,562
Intervention Post-test 2	35	34,49	38,00	15	40	5,447
Control						
Control Pre-test	35	20,49	21,00	18	24	1,552
Control Post-test 1	35	20,20	20,00	18	23	1,368
Control Post-test 2	35	20,14	20,00	19	22	1,216

Motivation in the intervention group showed an increase from 20.31 in the pretest to 29.51 in posttest 1, and reached 34.49 in posttest 2. In contrast, the control group did not show significant changes, with average motivation tending to stagnate or slightly decrease. This study used 35 samples in each group, so the Shapiro-Wilk test ($n < 50$) was used to test for normality. The data normality test is a hypothesis test to obtain a p-value that can facilitate decision-making. If the p-value $> \alpha$ (α: 0.05), then H0 is accepted, indicating a normal distribution of the data. Conversely, if the p-value $\leq \alpha$, then H0 is rejected, indicating a non-normal distribution of the data. The results of the normality test are as follows:

Table 2. Normality Test for Motivation Variables in the Intervention Group and Control Group

Motivation	n	P-value
Intervention		
Intervention Pre-test	35	0,000
Intervention Post-test 1	35	0,000
Intervention Post-test 2	35	0,000
Control		
Control Pre-test	35	0,004
Control Post-test 1	35	0,001
Control Post-test 2	35	0,000

The results of the Shapiro-Wilk normality test showed that all motivational variable data in the intervention and control groups at each stage (pretest, posttest 1, and posttest 2) had a p-value <0.05. This indicates that the data were not normally distributed. Therefore, the statistical analysis used in this study was the non-parametric Wilcoxon Signed Ranks and Mann-Whitney tests, as shown in the table below.

Table 3. Differences in Motivation Scores in the Intervention Group and Control Group

Motivation	n	Mean Rank	P-value
Intervention			
Intervention Pre-test	35	0,00	0,000
Intervention Post-test 1	35	18,00	0,000
Intervention Post-test 2	35	18,50	0,000
Control			
Control Pre-test	35	14,56	0,489
Control Post-test 1	35	14,42	0,489
Control Post-test 2	35	9,05	0,141

The results of the Wilcoxon Signed Ranks test showed that in the intervention group, there were significant changes in the motivation variable at each stage (pretest, posttest 1, and posttest 2). In the motivation variable, in the intervention group, where the mean rank increased from 0.00 in the pretest to 18.00 in posttest 1 and 18.50 in posttest 2, with a p-value <0.05, indicating that the intervention significantly increased student motivation. In the control group, there were no significant changes (p-value >0.05), with a relatively decreasing mean rank at all stages.

Table 4. Effectiveness Test

Motivation	n	Mean Rank	P-value
Intervention	35	52,00	0,000
Control	35	19,00	

Statistical analysis using the Mann-Whitney test showed a significant difference between the intervention and control groups in the motivation variable. For the motivation variable, the mean rank for the intervention group was 52.00, while the control group's was 19.00, with a p-value of 0.000. These results indicate that the intervention significantly increased motivation compared to the control group. Thus, the intervention was proven effective in increasing motivation. Based on the table above, media testing has proven effective in increasing student motivation.

The Evaluation Stage

This evaluation was conducted in 4 elementary schools. The implementation of the evaluation used the One-group pretest-posttest design method. The Dengue Prevention through HTML5-Based Interactive Media acts as a stimulus in Dengue Prevention, which is given as a health behavior intervention for Dengue Prevention. The intervention was given for a total of 8 weeks, with 2 post-tests after every 2 weeks of intervention. Students and

teachers collaborated using the media as a stimulus for changing dengue prevention behavior in the school environment. After the eight-week intervention, pre-test and post-test data were analyzed to determine differences in motivation for Dengue Prevention. The results of the analysis are as follows:

Table 5. Distribution of Motivation

Motivation	n	Mean	Median	Min	Max	SD
Pre-test	396	19,67	19,00	18	24	1,165
Post-test 1	396	29,14	29,00	28	30	0,641
Post-test 2	396	36,21	39,00	30	40	4,499

Based on Table 5, it is known that the sample size (n = 396) showed a significant increase in the average motivation score from pretest (Mean = 19.67) to posttest 1 (Mean = 29.14) and posttest 2 (Mean = 36.21). The normality test used was the Kolmogorov-Smirnov test (n > 50). The results of the normality test are as follows:

Table 6. Motivation Normality Test in

Motivation	n	P-value
Pre-test	396	0,000
Post-test 1	396	0,000
Post-test 2	396	0,000

Table 6 shows the results of the Kolmogorov-Smirnov normality test. All data, at each stage (pretest, posttest 1, and posttest 2), have a p-value <0.05. This indicates that the data are not normally distributed. Therefore, the statistical analysis used in this study was the non-parametric Wilcoxon Signed Ranks and Mann-Whitney tests.

Table 7. Differences in Average Motivation Scores

Motivation	n	Mean Rank	P-value
Pre-test	396	0,00	0,000
Post-test 1	396	198,50	0,000
Post-test 2	396	198,50	0,000

The Wilcoxon Signed Ranks test results showed a significant change in the average motivation score in the pretest and posttest. The mean rank increased from 0.00 (pretest) to 198.50 (posttest 1 and posttest 2), indicating a very strong intervention effect. Overall, the analysis results indicate that the intervention program, using the Dengue Prevention Through Interactive HTML5 Media with Smart Apps Creator, significantly increased motivation.

Based on the results in Table 7, the Wilcoxon Signed Ranks test shows a significant change in motivation between the pretest and posttest, as indicated by a p-value of 0.000 for both comparisons (pretest to posttest 1 and posttest 2). The mean rank also increased from 0.00 (pretest) to 198.50 (posttest 1 and posttest 2), indicating a very strong intervention effect.

Table 8. Effectiveness Test

Motivation	n	Mean rank	P-value
Intervention	399	297,50	0,000

The Mann-Whitney test results showed a significant difference in motivation with a p-value of 0.000. This means that the Dengue Prevention Through Interactive Media HTML5 with Smart Apps Creator significantly increased motivation. These results support the effectiveness of the intervention, indicating that the intervention successfully increased motivation.

Therefore, the Dengue Prevention Through Interactive Media HTML5 Games with Smart Apps Creator significantly increased motivation for Dengue Prevention. This means that the Dengue Prevention Through Interactive Media HTML 5 with Smart Apps Creator can be considered an effective and tested Dengue Prevention Through Interactive Media HTML 5 with Smart Apps Creator and can be used as a Dengue Prevention Program in other schools. The Dengue Prevention Through Interactive Media HTML5 with Smart Apps Creator can be illustrated as below:

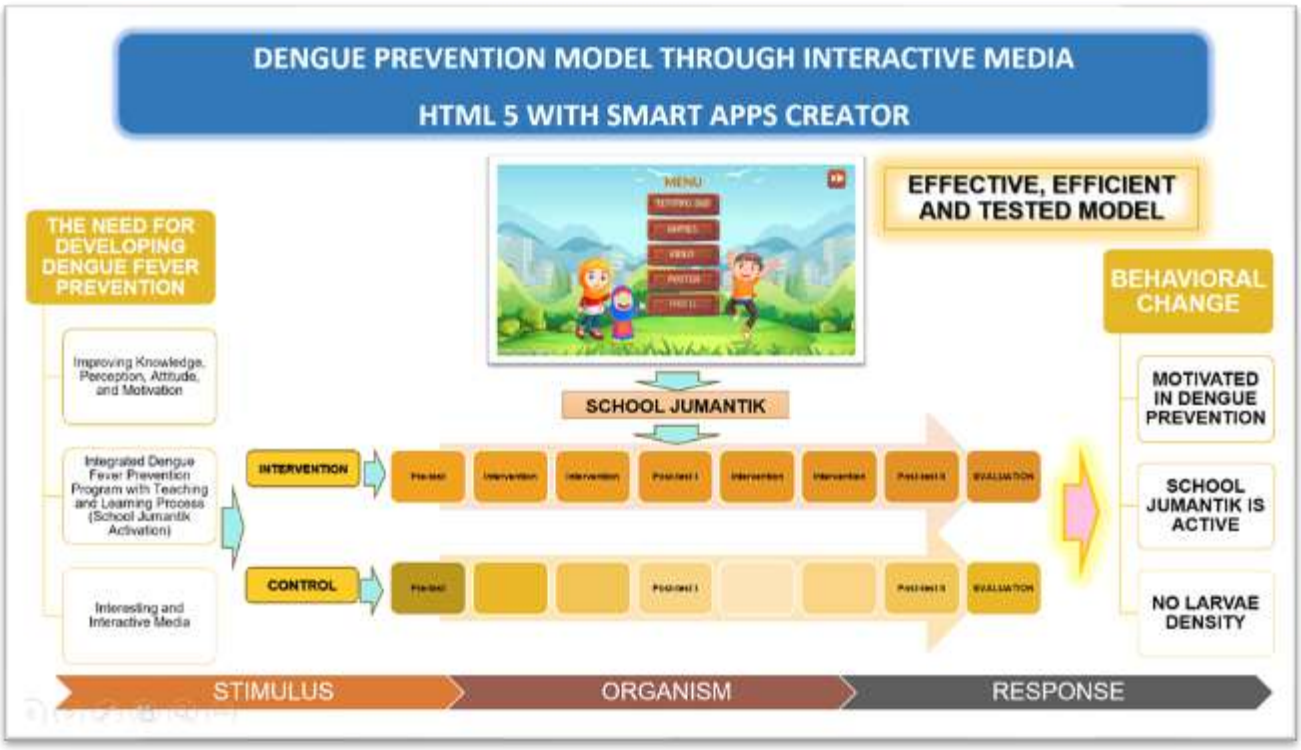

Figure 2. HTML5 Interactive Media with Smart Apps Creator

Dengue Prevention Program through HTML5 Interactive Media with Smart Apps Creator is effective in increasing motivation so that it can become a Dengue Prevention Program. HTML5 Interactive Media with a smart app creator is used as a stimulus in evaluation in 4 public elementary schools. This media contains interactive information spread across informative pages, posters, videos, and various games that children really like because they are supported by cheerful audiovisuals. Students can learn while playing, so that an increased understanding of Dengue Prevention can be easily achieved. Ultimately, students were motivated to volunteer to prevent dengue, including becoming school mosquito larva monitors. This reduced the number of larvae.

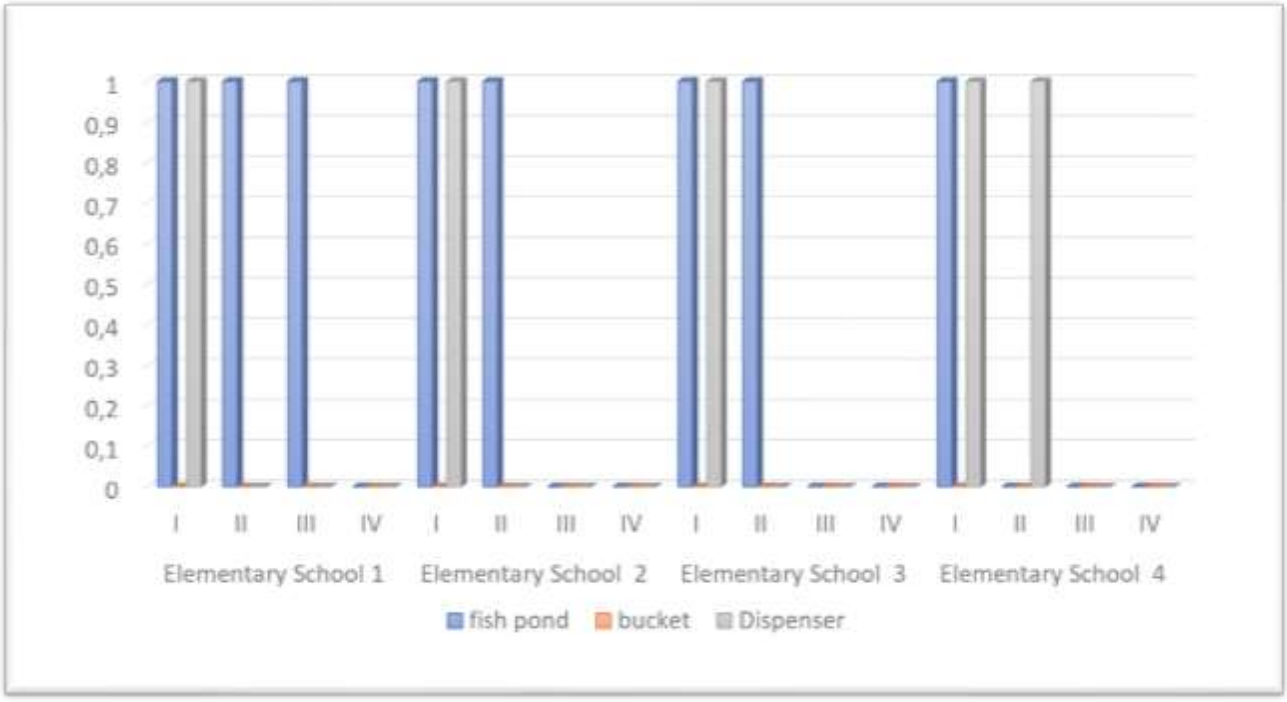

Figure 4. Presence of larvae

Based on the observation results, the presence of larvae observed for 4 weeks decreased significantly. In the 4th week, no larvae were found in any container.

DISCUSSION

Dengue Prevention through HTML5 Interactive Media with Smart Apps Creator

The delivery of health information on dengue prevention must consider the target audience. Health information for students should be presented as simply and attractively as possible. This ensures that it is targeted, easy to understand, and accessible. An engaging learning experience will foster motivation. Stimulation through integrated interventions in learning not only provides knowledge but can also encourage healthy behaviors in dengue prevention. Health information through digital technology is increasing along with developments in science and technology. The goal is to increase the effectiveness of technology use to address health challenges. Through digital pedagogy, Public Health Informatics is often utilized to improve data-based competencies in training public health practitioners. Approaches that utilize digital technology aim to enhance the learning experience so that community involvement will become an indicator of community empowerment and independence. Digital technology is developing alongside digital pedagogy, especially for health campaigns.

Policy is fundamental in determining a program or activity process. Motivation and commitment are needed in the Dengue Prevention program. Motivation is the dominant variable related to Dengue Fever Prevention. This needs to be pursued through appropriate stimuli so that it will encourage good behavior in preventing dengue fever (12). This motivation and commitment are a challenge in the midst of a dense population.

Population growth, densely populated urban areas, increased human mobility, increased local transmission, lack of community involvement, as well as budget cuts in the health sector and lack of vaccines contribute to the increased risk of dengue fever transmission (13). The school supports a clear, precise, effective, and efficient dengue prevention program with a policy of trialing HTML5-based interactive game media with Smart Apps Creator. Considering that there are breeding places such as flower vases, dispenser reservoirs, refrigerators, bathtubs, buckets, and ponds. Then there's a lack of lighting in the classroom and school environment, which makes the room damp and stuffy as a potential place for mosquitoes to rest (14). The environment can be one of the risk factors for the discovery of Aedes aegypti larvae, including the school environment. High density of Aedes aegypti larvae in the school environment has the potential to accelerate the spread of Dengue disease (15).

Preventing dengue fever as an effort to combat dengue fever outbreaks in endemic areas requires proactive and sustainable efforts that can bring about behavioral changes in the community (16). Interesting media as a health education effort will be a good stimulus if it gets a good response. This media contains information on dengue prevention, which students can read or listen to, accompanied by music, animation, and attractive colors. Information is also presented through videos, posters, and attractive mosquito nest eradication jingles. Apart from information, HTML 5 Interactive Media with Smart Apps Creator is equipped with quizzes and games such as drag and drop, word guessing, and mosquito clapping, which are challenging and fun. Equipped with music, sounds, and tense time settings, there are also sound games that can make children happy or disappointed in response to a quiz answer. Interactive Compact Discs as a teaching method are more effective in increasing student achievement when compared to traditional methods (17). Stimulus or stimulation will influence changes in behavior. Certain stimuli will produce certain behaviors. Knowledge, attitudes, and practices of dengue prevention can be influenced by the dengue experience of at-risk populations. These conditions can be used to develop more effective intervention strategies against dengue fever (18). Appropriate and sustainable programs as interventions to prevent incidents by instilling positive attitudes and perceptions in society (19).

Effectiveness Test of Dengue Fever Prevention through HTML5 Interactive Media with Smart Apps Creator

HTML5-Based Game Interactive Media with Smart Apps Creator is interactive media that can be applied in conjunction with or in harmony with the learning process. Useful creativity and intellectual capacity can be achieved if we can utilize technology and education properly (20). Media that has been tested with very suitable results for use as media in the Dengue prevention has a very dynamic appearance, full of color, and pleasant sounds. A longer duration of visual attention is elicited from attractive, full-color graphic images compared to less restrictive alternatives (21). A good stimulus will result in good behavioral changes, especially dengue prevention behavior. Individuals who receive the stimulus can estimate the suitability between the message and the communicator's reaction. Positive effects appear on students' positive emotions when learning with visually attractive and behaviorally interactive designs (behavioral positive emotion design and visual positive emotion design). Combining positive emotional behavioral design with positive visuals can facilitate learning (22). In line with Djuwitaningsih's research on application-based interactive reproductive health education, young women are interested in it because it is personal, easy to access, and a reliable source of information (23).

There are significant differences in motivation regarding dengue prevention before and after being given intervention through HTML5-based interactive game media with smart app creators. Knowledge, attitudes, perceptions, and motivation are related to preventing dengue hemorrhagic fever through PSN 3M Plus (24). Public education is necessary to address knowledge gaps to increase knowledge about dengue fever. If the public is given the right knowledge and receives the message conveyed accurately, the public will adopt the desired behavioral changes, especially preventing dengue fever (25). The level of public knowledge about transmission methods is quite high. People try to avoid mosquito bites, but mosquito breeding places still exist. Health promotion aims to increase public awareness about the importance of preventing mosquito bites while eliminating mosquito breeding places (26). Increasing knowledge, attitudes, and behavior regarding dengue prevention requires further efforts through regular dengue health education programs for elementary school students (18).

A positive attitude towards dengue fever prevention will encourage individuals to support mosquito control initiatives in the community. Sociodemographic factors, such as age, are one of the factors that significantly influence knowledge, attitudes, and behavior in preventing dengue fever (27). Html 5 HTML5-based interactive Game Media with Smart Apps Creator, which is attractively presented, can be the right stimulus in conveying information as knowledge about dengue prevention, so that it can change attitudes and perceptions. Digital audio-visual elements in public health interventions are very important in conveying the goals and strategies of health education messages (28). Individuals with bad perceptions about dengue fever are more likely to have poor behavior toward dengue prevention. So, bad perceptions about dengue fever increase the risk of bad behavior toward dengue prevention (29). Students like interactive media because it is more interesting in terms of sound, movement, material, interesting animations, and games that are both fun and tense. As one of the information media, audiovisual media is more communicative, with output that can be seen visually and heard audibly. Audiovisual media significantly increase changes in family attitudes and actions in preventing dengue fever (30).

HTML5 Interactive Media with Smart Apps Creator has been carried out successfully and can be applied. The presence of larvae observed during the 4 weeks decreased significantly, and in the 4th week, no larvae were found in any of the containers. So the dengue prevention can be implemented through HTML5 Interactive Media with Smart Apps Creator, which can significantly increase motivation regarding dengue prevention and eradicating mosquito larvae.

There were limitations in the evaluation process, which did not involve a control group. This was due to the media interactive HTML5-based game media with a smart app creator has been proven to significantly increase motivation and be effective as a dengue prevention tool in previous media trials. This evaluation was conducted to gain a broader perspective on developing the media for a larger field trial group.

Dengue prevention is a shared responsibility between the government and the community. HTML5 Interactive Media with Smart Apps Creator can be used as an appropriate cross-sector collaboration medium between the Health Department and the Education Department in preventing dengue in schools. This HTML5-based interactive game media can be distributed to all schools in Bandung City, in particular, and all schools in Indonesia in general, as a real contribution to schools in increasing understanding and active participation in dengue prevention.

The dengue prevention can be implemented through interactive HTML5-based game media with a smart app creator, which can significantly increase motivation regarding dengue prevention and eradicating mosquito larvae.

CONCLUSION

Dengue Prevention through HTML5 Interactive Media with Smart Apps Creator was highly effective in significantly increasing student motivation. The interactive media, which was well-received by students, was an appropriate intervention because it was integrated with learning. Students received a fun, interactive learning experience about Dengue Prevention without increasing the burden of class hours. Increased motivation drove students to actively participate in Clean Friday activities, and an indicator of achievement was that in the fourth week, no Aedes larvae were found in any container. This achievement could serve as a pilot project for other schools in dengue prevention efforts. Cross-sector involvement and collaboration are needed to comprehensively prevent dengue.

AUTHOR'S CONTRIBUTION STATEMENT

Ratna Dian Kurniawati: study design, conceptualization, funding acquisition, data collection, coding and analysis, original draft, writing, review, and editing. Martini Martini: study design, review, and editing. Nur Endah Wahyuningsih: study design, review, and editing. Dwi Sutiningsih: study design, review, and editing.

CONFLICTS OF INTEREST

There is no conflict of interest**.**

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

The author has used Grammarly during the manuscript preparation process to support language refinement and increase clarity.

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