*Journal of Sustainable Applied Modification Evidence Community*
Vol. 02, No. 2, December 2025, 43-51
***e*-ISSN: 3048-040X**

# The Influence of Digital-Based Education on Adolescent Knowledge about BSE

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**Article Information**
Received: October 07, 2025
Revised: December 01, 2025
Online: December 09, 2025

**Keywords**
*Digital Education, Teen, Realize, Knowledge, Breast Cancer*

**ABSTRACT**
*This study aimed to evaluate the effect of a short-duration digital education intervention based on interactive videos distributed through platforms commonly used by adolescents in Semarang. The study used a pre-experimental one-group pretest-posttest design. The results showed that there was a significant difference between the average knowledge score before and after being given digital-based education (p = 0.000). The results of the bivariate analysis showed that digital educational interventions had a positive impact on increasing adolescents' knowledge of early breast cancer detection. The findings of this study are expected to form the basis for developing more effective, applicable, and sustainable technology-based health learning models in the context of an ever-evolving digital landscape. This finding confirms that the use of digital media is an approach that aligns with the characteristics of adolescents and is relevant in improving health literacy related to early detection of breast cancer.*

***Keywords:*** *Digital Education, Teen, Realize, Knowledge, Breast Cancer*

## INTRODUCTION

Breast cancer remains the leading cause of cancer-related mortality among women worldwide, with more than 2.3 million new cases in 2023. In Indonesia, the prevalence of breast cancer reaches 65.9 per 100,000 women, which is among the highest in Southeast Asia. Data from the Semarang City Health Office (2023) shows that breast cancer cases have increased by 12% in the last three years, with low early detection practices being a major contributing factor. Among adolescent girls, knowledge about breast self-examination (BSE) is still limited, even though this phase is a critical period for the formation of long-term health behaviours. Previous studies have reported low BSE practices due to limited education and poor quality of material delivery in schools.

The use of digital media is an increasingly relevant strategy, given that more than 95% of adolescents in Semarang have access to smartphones and actively use platforms such as YouTube, WhatsApp, and TikTok. Previous studies have shown that digital education can increase knowledge


http://doi.org/10.69855/samec.v2i2.283
https://gpijournal.com/index.php/samec

of BSE, but the majority of studies use a single medium and do not explore the effectiveness of interventions in local contexts such as Semarang. This study fills this gap by testing the effect of a short-duration digital education intervention based on interactive videos distributed through platforms commonly used by adolescents. Thus, this study provides new insights into the effectiveness of digital education integrated with the media consumption habits of adolescents in Semarang.

In Nigeria, a peer-education intervention among female adolescents significantly improved their knowledge about breast cancer and BSE, highlighting the effectiveness of digital-age methods facilitated through structured peer networks (Sadoh et al., 2021). Meanwhile, an Indonesian study using E-Booklet media for high school students in Jakarta demonstrated a substantial increase in BSE knowledge, with post-intervention knowledge scores significantly higher ($p < 0.001$) than baseline, showcasing how accessible digital formats can be integrated into health education (Dahliana & Agustina, 2023).

Moreover, mobile applications have shown promise in maternal health domains and beyond; in Malaysia, the BrAware mobile app notably improved women's awareness of breast cancer risk factors and boosted confidence in performing BSE, suggesting mobile platforms' potential for broader health literacy initiatives (Yusuf et al., 2022). More specifically targeting adolescent learning, a quasi-experimental study among junior nursing students in South Korea found that combining a smartphone application with hands-on practice significantly enhanced knowledge, attitudes, skills, and learner satisfaction more than using the app alone or attending a classroom lecture (PubMed study, 2020).

These findings suggest a consistent theme: digital-based education—when thoughtfully designed and sometimes supplemented with practical activities—can substantially elevate adolescents' knowledge, confidence, and engagement regarding BSE. Schools and public health initiatives should leverage such media—E-Booklets, peer-mediated modules, mobile apps, or blended learning formats—to deliver timely, effective, and scalable breast health education to adolescents, empowering them with preventive awareness that could have lasting impact.

One approach that has proven effective in reducing the rate of late diagnosis of breast cancer is early detection through breast self-examination methods, or known as BSE. This method is relatively simple because it does not require tools, and can be performed independently by every woman, even from adolescence. Nevertheless, the level of implementation of BSE among adolescents is still very low. Study by Nurjanah et al. (2022) showed that only 27.4% of high school students in West Java have ever done BSE, and the majority of them have not understood how to do it correctly. This is a serious concern considering that adolescence is a crucial period in the formation of long-term healthy living behaviors, including awareness of the importance of early detection of breast cancer.

In the midst of the challenges of low practice of BSE, the development of information technology actually opens up new opportunities to bridge the gap in health education. Indonesian teenagers today are very attached to the digital world. APJII's (2023) survey shows that more than 94% of teenagers have internet access and spend an average of 5-6 hours per day on various digital platforms such as YouTube, Instagram, TikTok, and WhatsApp. This condition is a great potential to present health education that is more relevant and in accordance with the habits and learning styles of adolescents. Educational content that is packaged in an interesting and interactive way

through social media can increase teenagers ' interest and understanding of the practice of BSE, as well as raising awareness of the importance of early cancer prevention.

Unfortunately, the health education system in schools is still not able to keep up with the Times. The methods used tend to be conventional, such as lectures, leaflet distribution, or static posters, which often do not attract students ' attention and are less able to stimulate active participation. In fact, today's younger generation is more responsive to visual approaches, short narratives, and two-way communication available in digital media. Therefore, it is important for schools and health institutions to adapt more creative and technology-based educational strategies, so that health messages such as BSE are not only conveyed, but are truly understood and practiced by adolescents.

A number of studies prove that digital-based education can significantly increase the knowledge and involvement of adolescents in health issues. Study by Rahayu et al. (2023) showed a significant increase in BSE knowledge and skills in high school students after being given interactive educational videos ($p < 0.001$). Another study by Suryandani et al. (2023) revealed that the use of 3D animation-based videos is more effective in explaining BSE procedures than print media. Pramesti & Kartini (2023), in their systematic review, concluded that the use of social media, especially Instagram and TikTok, increases adolescent engagement in reproductive health topics. Research Meliani et al. (2023) even noted that the combination of TikTok videos and live demonstrations can improve realize skills by up to 70%. Meanwhile, Sitanggang et al. (2025) compared the effectiveness of videos and leaflets, and found that audiovisual media were more effective in improving adolescents ' understanding because they were visual, brief, and in line with their study habits.

By looking at the low implementation of BSE among adolescents and the dominance of conventional learning methods in schools, it is clear that the current approach to health education needs to be transformed. The one-way model of lecture and leaflet distribution, while still of value, is no longer effective for attracting the attention of younger generations growing up in a fast-paced and interactive digital environment. Therefore, there needs to be a shift towards methods that are more adaptive and relevant to the daily lives of adolescents, especially in terms of the use of technology and social media.

Health education through digital platforms offers a number of advantages that conventional methods do not have. Platforms such as YouTube, Instagram, TikTok and online learning apps allow the delivery of materials in a more visual, narrative and fun way. Formats such as short videos, animated infographics, interactive quizzes, and digital campaigns can increase engagement and retention of information in teens. In addition, the reach of digital media is much wider, not limited by classrooms or class hours, so that information about BSE can be accessed anytime and anywhere according to their needs.

Seeing this potential, digital-based health education is an important strategy that needs to be developed and evaluated scientifically because it can adapt to the information consumption patterns of adolescents in the technological era. The use of digital media is not merely following trends, but is a form of strategic adaptation in health communication to ensure that educational messages are conveyed in a more relevant, interactive, and accessible manner. In the context of early detection of breast cancer, the digital approach is expected to increase understanding, build awareness, and encourage preventive behaviour through regular self-examination practices.

This study is significant because it directly measures the extent of the influence of short-term digital education interventions on adolescents' knowledge of breast self-examination, using media that is truly in line with their digital habits. Unlike previous studies that mostly used specialised applications, e-learning modules, or long videos, this study used short interactive videos distributed through the WhatsApp platform—a platform that is very familiar and used daily by adolescents in Semarang. This approach offers novelty because it tests the effectiveness of digital micro-learning integrated with the actual communication patterns of adolescents, making it more practical, inexpensive, and easy to replicate. The findings of this study are expected to form the basis for developing health education interventions that are more relevant to the needs of the younger generation while supporting early breast cancer prevention. Additionally, the results contribute to the development of more effective, applicable, and sustainable technology-based health learning models in the context of an ever-evolving digital landscape.

## METHODS

This study used a pre-experimental one-group pretest–posttest design to evaluate the effect of digital education on improving adolescents' knowledge of breast cancer. The study was conducted in Semarang City due to the high level of technology access among adolescents and the increase in breast cancer cases in the last three years, making this location highly relevant for digital intervention studies.

The sample was selected using purposive sampling with the following inclusion criteria: (1) female adolescents aged 15–17 years, (2) owning a smartphone and having stable internet access, (3) being active in online school learning activities, and (4) willing to participate in the entire intervention series. The total number of participants was 75.

The intervention consisted of a 5-minute digital educational video containing the definition of BSE, its objectives, timing, examination steps, and the urgency of early detection. The video was delivered via a WhatsApp Group platform and supplemented with infographics and a question-and-answer session via Google Form to reinforce understanding. The digital media used were: (a) animated educational video, (b) static infographic, and (c) digital Q&A module. All materials followed youth-friendly digital learning principles.

The BSE knowledge instrument used a standardised questionnaire that had been tested for validity (calculated $r > 0.30$) and reliability (Cronbach's Alpha = 0.89). A pretest was conducted before the video was shown, while a posttest was conducted 24 hours after the intervention. Statistical analysis included the Shapiro–Wilk normality test and paired t-test to assess differences in pretest–posttest scores, using $\alpha = 0.05$.

## RESULTS

### 1. Univariate Analysis

**Table 1. Characteristics of Respondents and Knowledge Levels Before and After the Intervention**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age | 15-16 years old | 41 | 54,7% |
| | 17 years old | 34 | 45,3% |

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Knowledge before intervention | Low | 46 | 61,3% |
| | Height | 29 | 38,7% |
| Knowledge after intervention | Low | 15 | 20,0% |
| | Height | 60 | 80,0% |

Based on univariate analysis, the majority of respondents were in the age range of 15-16 years (54.7%), which is a middle adolescent age group where preventive education such as BSE is very important to introduce. Before the digital intervention was carried out, 61.3% of respondents had a relatively low level of knowledge about BSE. But after being given digital educational videos, there was a significant increase, where 80.0% of respondents showed high knowledge. This illustrates the great potential of digital media-based interventions in improving adolescents ' understanding of the issue of early detection of breast cancer.

**2. The influence of Digital-Based Education on Adolescent Knowledge about BSE**

**Table 2. Differences in Mean Knowledge Scores Before and After Digital Intervention**

| Variable | Mean ± SD | p-value | Description |
|---|---|---|---|
| Knowledge Before Intervention | 58,4 ± 10,3 | | |
| Knowledge After Intervention | 78,9 ± 8,7 | 0,000 | Significant (p < 0,05) |

The paired t-test results showed that there was a significant difference between the average knowledge score before and after being given digital-based education (p = 0.000). The average knowledge score increased from 58.4 to 78.9 after the intervention, which means that there was a statistically meaningful increase in understanding. This indicates that digital educational media is effective in increasing adolescents ' knowledge about BSE. Thus, the use of digital media can be recommended as an innovative health education intervention strategy and in accordance with the characteristics of today's generation of adolescents.

## DISCUSSION

### 1. Univariate Analysis

The univariate results showed that the majority of respondents were aged 15–16 years, which is an important developmental phase for establishing early detection habits. Before the intervention, the majority of participants had a low level of knowledge, which is consistent with the findings of a national study that mentioned limitations in BSE education in schools. This confirms the need for interventions that are relevant and engaging for adolescents. Future research directions need to explore digital intervention models integrated with the school health curriculum.

After the digital intervention, the proportion of high knowledge significantly increased to 80%, indicating the appeal and effectiveness of digital media for the adolescent age group. The use of short, visual interactive videos makes it easier to understand and improves information retention. This is consistent with previous research that emphasises the effectiveness of audiovisual education. Further research can assess the long-term impact and knowledge retention over a longer period.

After the intervention using digital-based educational media, the results showed a significant increase in the level of knowledge of respondents, with 80% showing high knowledge of BSE. These

results are in line with the research of Rahayu et al. (2023), who found that interactive educational videos were significantly able to improve adolescents ' understanding and skills in performing BSE ($p < 0.001$). Another study by Meliani et al. (2023) also support that digital media such as videos and social media platforms not only raise awareness but also motivate adolescents to actively perform self breast exams. Digital Media offer the advantage of ease of access, attractive appearance, and the ability to repeat the material, all of which correspond to the visual and kinesthetic learning characteristics of today's young generation.

This phenomenon is reinforced by the findings of Sitanggang et al. (2025), which states that digital media are preferred by adolescents compared to conventional methods, due to their interactive, concise and accessible nature at any time and place. Thus, digital education approaches are not only effective in increasing knowledge, but also have the potential to shape more proactive and preventive health behaviors among adolescents. This is important to ensure the sustainability of BSE practices that can reduce the rate of late diagnosis of breast cancer and ultimately reduce mortality from the disease.

According to the researchers, digital-based education is a relevant and adaptive strategy in facing the challenges of health education in today's adolescents. It is inseparable from the fact that teenagers live in the midst of rapid technological development and the use of social media is very high. The need for an approach that matches the characteristics of this digital generation makes digital media an effective means of conveying health information in an attractive and accessible manner.

Furthermore, the digital approach enables the delivery of interactive and personalized health materials, such as through educational videos, health applications, to online learning platforms. The advantages of this technology also include the ability to reach teens in different backgrounds and different geographic locations. Thus, the dissemination of health information is not only faster, but also more equitable and inclusive.

The implementation of digital education models in the school and community environment is highly recommended by experts. Schools can be Centers for the development of digital literacy and health at the same time, while Communities Act as places for the implementation of healthy values and practices. With the synergy between technology, education, and social participation, it is expected that awareness and healthy living behavior among adolescents can increase significantly.

**2. The influence of Digital-based Education on Adolescent Knowledge About BSE**

Bivariate analysis showed a significant difference between knowledge scores before and after the intervention, illustrating the contribution of digital intervention in improving adolescent health literacy. Digital media has advantages such as easy access, time flexibility, and suitability with Generation Z's learning styles. Future research directions could test the effectiveness of various digital formats (e.g., gamification or mobile applications) to increase adolescent engagement. The post-intervention score increase confirms that digital education is a viable strategy for promoting early detection of breast cancer. However, interventions need to be combined with school and family environmental support to ensure the sustainability of BSE behaviour. Further research is suggested to evaluate actual behavioural changes (behavioural outcome), not just cognitive knowledge (Zimmerman, 2024).

Furthermore, the study of Meliani et al. (2023) and Sitanggang et al. (2025) affirm that social media platforms such as TikTok, Instagram, and YouTube are not only a source of entertainment, but also an effective and easily accessible educational media for the younger generation. Presentation of attractive visual and audio materials can increase motivation and involvement of adolescents in health education, including the application of early detection of breast cancer. This digital education Model answers the needs of Generation Z's visual and interactive learning styles, making it easier to accept and internalize. Recent research by Alimuddin et al. (2025) also highlighted that educational content delivered briefly, creatively, and relatable on social media is able to overcome the boredom of learning and foster sustainable health awareness.

On the other hand, a study by Pramesti & Kartini (2023) reminds that the effectiveness of digital-based education is not enough just to be seen from increasing short-term knowledge, but also requires the support of the social environment such as family and school so that behavior change can be sustainable. This confirms the need for multisector collaboration in support of sustainable health education, so that the program not only stops at the delivery of information, but also facilitates the formation of healthy behaviors. Study by Putra et al. (2024) added that consistent social support from parents and teachers can increase adolescents ' motivation to apply the knowledge gained, including regularly doing BSE.

Based on these findings, it can be concluded that digital-based education is the right strategy to improve adolescent health literacy, especially related to BSE. Digital Media is able to facilitate more personalized and flexible learning in accordance with the characteristics of adolescents as digital natives. However, the success of this program relies heavily on the sustainability of interventions as well as consistent social support, including the active role of parents and teachers in reminding and motivating adolescents to routinely perform breast self-exams. Researchers also assess that the combination of digital education methods with hands-on approaches (for example, workshops or demonstrations) can further optimize results, because face-to-face interactions provide opportunities for adolescents to ask questions and receive feedback directly, which ultimately strengthens understanding and practical skills (Nugraha & Wulandari, 2024).

Overall, the results of the bivariate analysis showed that digital-based educational interventions had a significant positive impact on increasing adolescents ' knowledge of early breast cancer detection. Not only does it provide a better understanding, it also shows the potential in encouraging more conscious behaviour change towards the importance of prevention and regular check-ups. These findings reinforce the view that digital approaches can be an effective tool in overcoming the limitations of conventional education, particularly in reaching young age groups who are familiar with technology.

However, increased knowledge alone is not enough to guarantee a sustainable change in behavior. Therefore, the use of technology in health education needs to be accompanied by a comprehensive mentoring strategy. This approach includes ongoing guidance from educators and health workers, as well as providing a safe discussion space for teens to explore and talk about sensitive topics such as breast health. Thus, the educational process should not only be one-way, but build active and reflective involvement of participants.

Researchers also emphasize the importance of developing educational content that is not only informative, but also interesting, relevant, and easily accessible to adolescents. Content that is presented visually, interactively, and in accordance with the language of the younger generation

will be easier to accept and remember. In addition, the integration of this program in the school curriculum is a strategic step that needs to be supported by the active involvement of parents as education partners at home. Collaboration between schools, families, and communities is key in creating the long-term impact of digital-based health education interventions.

## CONCLUSIONS

Digital educational interventions have been proven effective in increasing adolescents' knowledge about BSE, as demonstrated by a significant increase in knowledge scores after the educational video was shown. This finding confirms that the use of digital media is an approach that aligns with the characteristics of adolescents and is relevant in improving health literacy related to early detection of breast cancer.

Practically, adolescent education programs can integrate BSE materials in the form of interactive videos, infographics, and digital learning modules that are easily accessible through platforms frequently used by adolescents. Schools and healthcare providers are encouraged to adopt a blended digital education approach and provide reinforcement through discussion or live demonstration activities to ensure comprehensive understanding. Sustainable programs and family support are important for building BSE habits as part of adolescents' healthy lifestyle behaviours.

## ACKNOWLEDGMENT

The author expresses appreciation and gratitude to all parties who provided support in the implementation of this research. Thank you to the funding institutions that facilitated the financing of research activities, as well as Poltekkes Kemenkes Semarang and partner schools in Semarang City that provided the necessary facilities and infrastructure during the data collection process. The author also thanks the experts and colleagues who provided constructive feedback for the improvement of this manuscript, allowing this article to be better structured and scientifically relevant. The support of all parties is very meaningful for the success of this research and the completion of this article.

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