Development and evaluation of an Android-based multimedia application to promote healthy lifestyles in physical education: A study at State Junior High School 29 Semarang

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Received: 2025-04-01
Accepted: 2025-07-16
Published: 2025-07-23

A – Research concept and design
B – Collection and/or assembly of data
C – Data analysis and interpretation
D – Writing the article
E – Critical revision of the article
F – Final approval of article

ABSTRACT

Background: The integration of interactive, technology-based media in Physical Education, particularly for teaching health-related content, remains limited despite its potential to enhance student engagement and learning outcomes.

Objectives: This study aims to address this gap by developing and evaluating the effectiveness of an Android-based multimedia learning application, "Healthy Habits," designed to support the delivery of healthy lifestyle materials in Physical Education, Sports, and Health (Physical Education) subjects at the junior high school level.

Methods: The research employed a research and development (R&D) approach, involving expert validation from media and content specialists and usability trials with teachers and students.

Results: Validation results indicated a "Good" rating from the material expert (average score: 4.05) and a "Very Good" rating from the media expert (average score: 4.24), confirming the application's content quality and technical feasibility. Teacher evaluations also yielded a "Good" rating (average score: 4.07). Student trials produced positive responses, with small group testing receiving a "Very Good" rating (average score: 3.29), which increased to 4.23 ("Very Good") in large group testing. An effectiveness test assessing cognitive, affective, and psychomotor learning outcomes showed an average score of 85.6%, categorized as "Very Good." These findings demonstrate the feasibility and effectiveness of "Healthy Habits" as a digital learning tool for promoting healthy lifestyles in secondary school students.

Conclusions: The application offers practical value for educators and curriculum developers seeking to integrate mobile technology into Physical Education. Future studies are encouraged to explore the implementation of this application in varied educational contexts and its potential integration across other subject areas.

Keywords: android, effectiveness, healthy habits, healthy lifestyle, multimedia learning, physical education.

How to cite this article: Pujiyanto, G. Y., Royana, I. F., & Wibisana, M. I. N. (2025). Development and evaluation of an Android-based multimedia application to promote healthy lifestyles in physical education: A study at State Junior High School 29 Semarang. *Physical Education and Sports: Studies and Research*, *4*(2), 162-174. https://doi.org/10.56003/pessr.v4i2.607

INTRODUCTION

The importance of a healthy lifestyle for adolescents cannot be denied, considering that adolescence is important in forming future habits and lifestyles (Carrizales et al., 2024; Yuliani et al., 2022). Early recognition and understanding of healthy lifestyles will contribute significantly to long-term health outcomes (Anggela et al., 2022; Billah & Sarwanto, 2021). A healthy lifestyle includes various aspects, from balanced nutrition, regular physical activity, adequate rest, to effective stress regulation (Kang et al., 2024; Sayekti et al., 2020). However, information on reproductive health is often poorly conveyed to adolescents, resulting in various problems that stem from a lack of knowledge and awareness (Nasution & Manik, 2020; Sayekti et al., 2020). However, delivering health education—especially regarding healthy lifestyle habits—remains monotonous and less effective when using traditional teaching methods. This has led to a gap in students' understanding and engagement, resulting in low motivation and learning outcomes. Therefore, there is an urgent need to present health materials in more interactive, appealing ways that align with students' digital habits.

In today's digital age, where mobile devices have become part of teenagers' daily lives, education needs to adapt to their learning styles. Delivering health education through interactive, technology-based digital media can increase student motivation and be more accessible and in line with their digital habits. Therefore, a more contextual and relevant learning approach is needed to address the challenges in adolescent health education.

The role of technology in supporting learning is becoming more significant (Han & Geng, 2023; Sutiasih & Saputri, 2019). In this digital era, technology and optimizing digital literacy are becoming increasingly important for all levels of society (Lestari et al., 2023). Social media has become an integral part of modern society, becoming the primary means of obtaining and disseminating information (Zonyfar et al., 2022). This aligns with the increasing use of smartphones as educational media and learning resources. Using smartphones as learning tools offers high flexibility and accessibility, allowing students to learn anytime and anywhere, especially in today's dynamic learning context (Danial & Muyasaroh, 2023; Joshi et al., 2025).

Learning conditions at State Junior High School 29 Semarang illustrate the need for innovation in instructional media. Android-based platforms offer a potential solution to improve the delivery and accessibility of healthy lifestyle materials (Delungahawatta et al., 2022; Sutiasih & Saputri, 2019). These technologies provide opportunities to create interactive, engaging learning experiences that address the limitations of conventional methods. A study by Fauziyah & Suryobroto (2024) showed that Android-based media significantly improved student learning outcomes, with average test scores rising from 53.83 to 67.50—a 25% increase in understanding physical fitness concepts.

This growing need for technology-based learning media reflects the challenge of delivering health information in a compelling and easy-to-understand manner (Dunleavy et al., 2019; Lestari et al., 2023). Learning can become more relevant and personalized by integrating mobile devices—tools already deeply embedded in students' daily routines. The development of Android-based learning media is expected to overcome conventional limitations and foster greater motivation among students. Developing such media requires an in-depth understanding of user interface

(UI) and user experience (UX) design principles, as well as technical programming skills (Chandran et al., 2022; Putra et al., 2020). Android-based educational apps offer flexibility, allowing students to access learning materials whenever needed, thus encouraging independent study and review (Pangalo, 2020).

Previous studies have developed Android-based learning media in Physical Education, such as sports skill learning (Wicaksono et al., 2018) and healthy lifestyle education (Sudrajat et al., 2024). Wicaksono et al. (2018) developed an Android-based multimedia learning application for basketball learning aimed at junior high school students. This study focused on improving students' understanding and skills in basketball through digital media. The results showed that the product was feasible and practical, receiving positive feedback from teachers and students. However, this study was limited to sports skills (basketball). It did not cover health education materials or assess learning outcomes regarding cognitive, affective, and psychomotor domains related to healthy lifestyles. Sudrajat et al. (2024) created an Android-based learning media for promoting healthy lifestyle behaviors in Physical Education. Their research involved small and large group trials, with results showing significant improvement in students' pre- and post-test scores. However, this study mainly focused on students' knowledge improvement only and lacked detailed validation from media experts or evaluations from teachers' perspectives. Furthermore, it did not analyze the quality of the application's interactive design or user interface in depth.

However, these studies have been limited to knowledge-based aspects, lacking comprehensive validation from media experts and teachers, and have not holistically measured effectiveness from the perspectives of cognitive, affective, and psychomotor domains. This indicates a research gap that has not been extensively explored, particularly in developing holistic, curriculum-based digital educational media.

At State Junior High School 29 Semarang, existing teaching methods for healthy lifestyle education—relying on textbooks, worksheets, and PowerPoint slides—have become overly repetitive and uninspiring. This has diminished students' enthusiasm for learning. Incorporating Android-based media on basic healthy living techniques can offer teachers alternative instructional strategies while enabling students to reinforce learning at home. Books and videos can remain core classroom tools, while mobile apps are supplementary materials for independent study.

Based on the researcher's observations, these issues highlight the need for a more effective learning approach. To address this, the researcher developed an Android-based application named Healthy Habits. This application aims to enhance learning in Physical Education, particularly on healthy lifestyle topics, by offering an engaging and accessible platform that addresses the existing shortcomings in instructional delivery.

Therefore, to assist teachers in delivering material on healthy living habits more effectively, this study is titled "Development of Android-based Healthy Lifestyle Learning Media." The study aims to design and develop an Android-based learning media application that teachers and students can use during the learning process.

This study offers something new by developing an interactive Android-based learning app that contains healthy lifestyle material and features practice questions, a user-friendly interface, and multi-party validation (subject matter experts, media experts, teachers, and students). The app, called Healthy Habits, is specifically designed to support the learning objectives of Physical Education at the junior high

school level with an approach that suits the characteristics of digital natives at the adolescent age.

Healthy Habits is a healthy lifestyle learning application explicitly designed for Android devices. It focuses on key components of healthy living, such as diet and sleep hygiene. While similar applications exist, Healthy Habits offers more innovative and creative features tailored for educational use, including built-in practice questions. This functionality distinguishes it from other health-related apps that lack a pedagogical focus.

The main contribution of this study is to provide empirical evidence that Android-based digital learning media can effectively improve students' understanding of healthy lifestyles while increasing their motivation and engagement in learning. These findings show that developing applications such as Healthy Habits can be a practical and applicable solution to help teachers deliver health material more interestingly and effectively, and can be adapted to the learning context in other schools with similar characteristics.

METHODS

Study Design and Participants

This study employed research and development (R&D) methods (Sugiyono, 2019) to produce and test the feasibility and effectiveness of an Android-based learning media product for healthy lifestyle material in Physical Education, Sports, and Health at State Junior High School 29 Semarang. The development procedure following the modified Borg and Gall model is presented in Figure 1.

Figure 1. Development Procedure

The purpose of these stages was to ensure that the learning media developed met the required quality standards and was suitable for use in junior high school education. The research subjects included Physical Education teachers and seventh-grade students at State Junior High School 29 Semarang.

Ethical approval statement

This study has received ethical approval from the Ethics Committee of the Faculty of Social Sciences and Physical Education (FPIPSKR), Universitas PGRI Semarang, with approval number No. 125/EC/FPIPSKR-UPGRIS/II/2025. All procedures involving human participants were conducted by the ethical standards of the institutional and/or national research committee, as well as with the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants prior to their involvement in the study.

Research Instruments

Instruments used to collect the data included questionnaires and structured interview guides, which were distributed during expert validation and product trials. Data collected from these instruments served as the foundation for evaluating:

- Media appearance (design, layout, interface)
- Content/material quality (relevance, accuracy, completeness)

- Instructional effectiveness (support for learning, student engagement)

The development process emphasized content validity and user-centered design, ensuring that the final product could effectively bridge the gap between learning objectives and student needs.

The validation process in this study involved two experts with different areas of specialization to ensure the quality and feasibility of the developed product. The first was a media expert, who focused on evaluating the technical aspects of the application, including interface design, interactivity, usability, and overall user experience in line with educational multimedia standards. The second was a material expert, who specialized in healthy lifestyle education and was responsible for validating the accuracy, relevance, and appropriateness of the content presented in the application based on current curriculum standards. Both experts provided qualitative feedback through suggestions for improvement and quantitative assessments that informed the product revisions. The Healthy Habits application was developed and trialed to support the development and testing phases using an Android smartphone, specifically the Redmi Note 10S. This device was selected to represent the technology commonly available to students, ensuring that the application's performance, functionality, and user interface were optimized for practical classroom use and accessible across similar Android platforms.

Data Analysis

The analysis technique for testing the effectiveness of Android-based healthy lifestyle learning media development products is a percentage to analyze and assess the level of effectiveness of development products with the formula:

$$P = \frac{f}{N} \text{ x } 100\%$$

Description:
f = Frequency of subjects
N = Total number

To make decisions using the criteria set as follows:

Table 1. Criteria for Effectiveness Testing

Score	Scale	Qualifications
1	0 – 55%	Very Poor
2	56 – 65 %	Poor
3	66 – 80 %	Good
4	81 – 100%	Very Good

RESULTS

Based on the systematically conducted research stages, the final product was successfully developed as an Android-based multimedia learning application designed to support the learning process of healthy lifestyle material. This application has been proven effective in enhancing the teacher's role as a facilitator and providing students with an alternative for independent learning at the Junior High School level, particularly in Physical Education, Sports, and Health (Physical Education) subjects. The developed product, Healthy Habits, is presented as an interactive application with an easily accessible menu structure.

The application contains several main menus, namely:

- Healthy Eating Patterns
- Food Nutrients

- Balanced Nutrition
- Practice Questions

In the Healthy Eating Patterns section, users are provided with information on the principles of consuming balanced, nutritious food tailored to the body's needs, emphasizing a variety of natural ingredients and avoiding processed food and excessive sugar intake. This section also displays examples of healthy food groups such as vegetables, fruits, animal products, fish, eggs, legumes, seeds, and dairy products. The Food Nutrients menu describes the essential components in food that the body needs to support physiological processes and growth. These components are summarized in the Table 2.

Table 2. Data Normality Test Results

Components	Function
Carbohydrates	as a primary energy source
Fats	that functions as a high energy source and vitamin solvent
Proteins	for tissue regeneration and development
Minerals	that is important for muscle and bone function
Vitamins	as a supporter of metabolism and immunity
Water	that plays a vital role in metabolic processes, circulation, and body temperature regulation

Source: Muhajir (2021)

The Balanced Nutrition menu explains the importance of consuming all nutrients in proper proportions. It also outlines the basic principles such as portion accuracy, food variety, nutrient balance, and quality food selection. Applying these principles aims to enable the body to function optimally, maintain the immune system, and reduce health risks.

The Practice Questions menu (Figure 3 and Figure 4) is designed to test students' understanding through interactive questions. The evaluation results are displayed immediately after the student completes the exercise, allowing instant feedback. Welcome Page, Login Page, and Menu Page are shown in Figure 2.

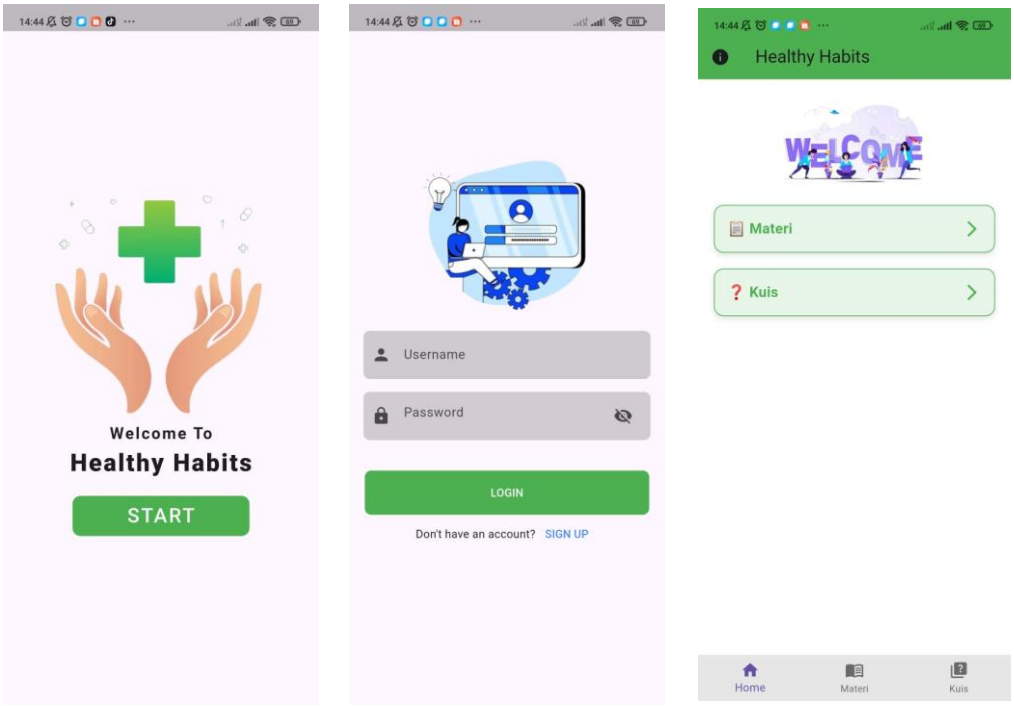

Figure 2. Welcome Page, Login Page, and Menu Page

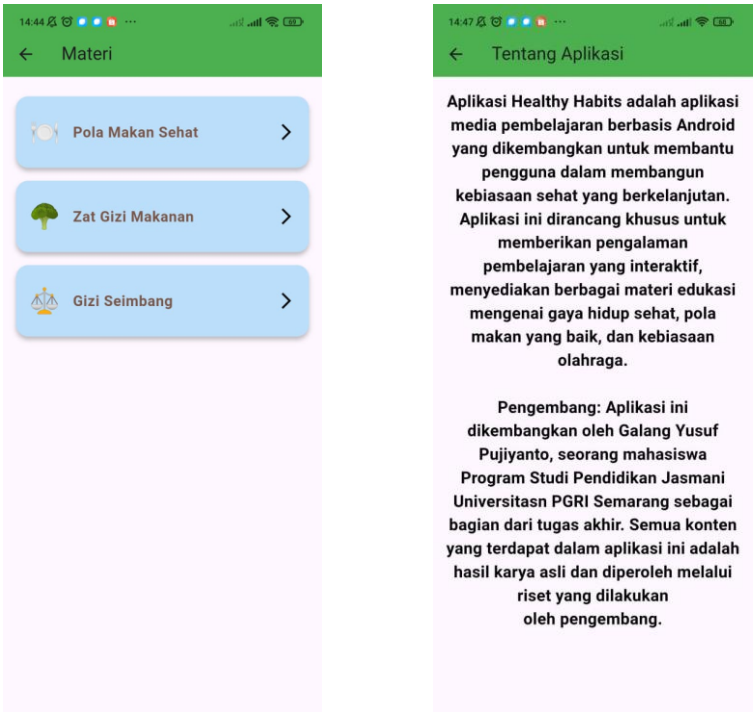

Figure 3. Sub Menu and Information

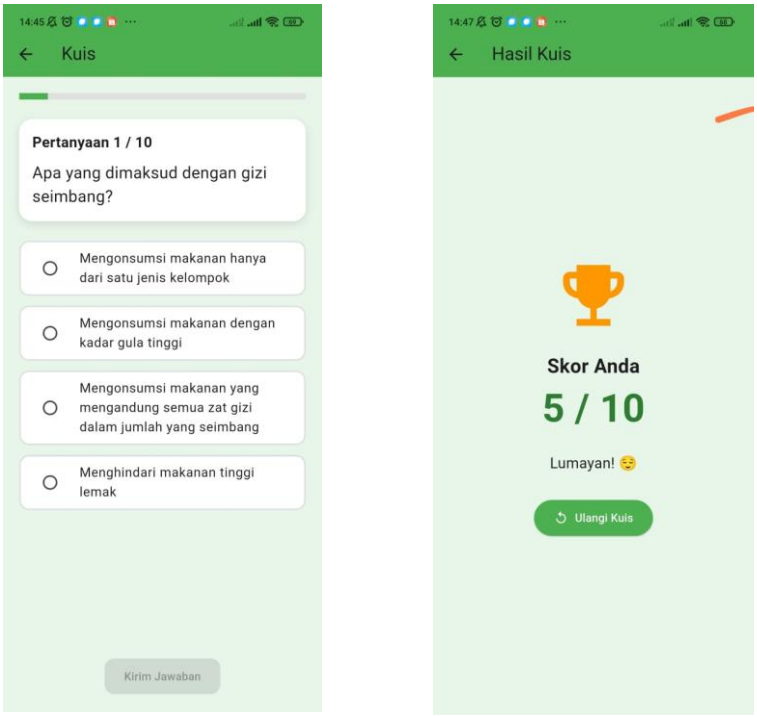

Figure 4. Practice Questions and Result

One of the main advantages of the Android-based Healthy Habits application lies in its ease of access and usability. Along with technological advancement, smartphones have become integral to students' everyday lives. This application is designed to be downloaded and run directly on Android devices without additional hardware. It enables learners to flexibly access the learning material anytime and anywhere, thus supporting an independent and continuous learning process.

Table 3 presents the quality assessment results of the Android-based learning media for healthy lifestyles conducted by PE teachers at State Junior High School 29 Semarang. The assessment includes Appearance, Content/Material, and Learning. The total scores for each aspect are 40.6, 39.7, and 33.3, respectively. The average scores for these aspects are 4.07, 3.97, and 4.17, all categorized as "Good." The overall average score is 4.07, which falls under the "Good" category, indicating that the learning media is considered good in appearance, content, and learning quality.

Table 3. Quality of Learning Media Products by PE Teacher of State Junior High School 29 Semarang

Assessment aspects	Total Score	Average	Category
Appearance	40,6	4,07	Good
Content/material	39,7	3,97	Good
Learning	33,3	4,17	Good
Average		4,07	Good

Table 4 shows the analysis of the effectiveness of the Android-based healthy lifestyle multimedia product based on three assessment aspects: Affective, Cognitive, and Psychomotor. The affective aspect achieved 92.0%, the cognitive aspect 81.0%, and the psychomotor aspect 83.7%. All aspects are categorized as "Very Good." The overall average effectiveness score is 85.6%, which is also categorized as "Very Good." This indicates that the multimedia product improves students' affective, cognitive, and psychomotor aspects related to healthy lifestyles.

Table 4. Analysis of Data on the Effectiveness of Android-Based Healthy Lifestyle Multimedia Products

Assessment aspects	Percentage	Criteria
Affective Aspects	92,0%	Very Good
Cognitive Aspects	81,0%	Very Good
Psychomotor Aspects	83,7%	Very Good
Overall Average	85,6%	Very Good

DISCUSSION

Based on the validation process, the Healthy Habits application was rated "Good" by material experts (average score: 4.05) and "Very Good" by media experts (average score: 4.24), indicating its content accuracy and strong technical design. Physical Education teachers also gave a "Good" overall rating (4.07), highlighting its relevance, layout, and support for learning. Student trials showed positive outcomes, with small-scale testing scoring between "Fairly Good" and "Very Good," and large-scale testing resulting in a "Very Good" average score of 4.23. Additionally, effectiveness tests across cognitive, affective, and psychomotor domains produced an average score of 85.6%, confirming the app's success in supporting learning objectives in health education.

The findings of this study are consistent with the results of a school-based health promotion intervention study conducted by KOICA and Yonsei Global Health Center in Peru, which showed that a multi-component approach can significantly impact adolescent health behavior (Sharma et al., 2018). In that study, interventions such as health education, screening, psychological counseling, teacher training, and parental involvement increased vegetable consumption and reduced depressive symptoms among secondary school students. Additionally, although there was no direct reduction, the intervention also successfully prevented an increase in risky behaviors such as suicide attempts, sedentary habits, unhealthy food consumption,

and fights. This supports findings from the Healthy Habits app development study, which demonstrated effectiveness in students' cognitive, affective, and psychomotor aspects. The involvement of an Android-based app as part of interactive learning media is one form of digital intervention that promotes a healthy lifestyle in the school environment (Sudrajat et al., 2024). Therefore, developing media like Healthy Habits can be viewed as a strategic step in strengthening school-based health education through a more contextual and accessible technological approach for students.

Findings from a systematic literature review conducted by Triantafyllou et al. (2025) indicate that gamification has excellent potential to increase student engagement and motivation and encourage behavioral changes that support the learning process. Although various gamification models, theories, and elements have been applied in educational and training contexts, their effectiveness still requires further testing through in-depth research. The study emphasizes that gamification will be most effective if designed with appropriate learning principles to align with learners' needs and expectations. This is relevant to developing the Healthy Habits application, which has incorporated interactive elements and practice question features as a form of simple gamification to enhance the appeal of healthy lifestyle learning. Thus, the integration of gamification in Android-based educational media like Healthy Habits not only supports the achievement of students' cognitive, affective, and psychomotor aspects but also opens opportunities to enhance overall learning motivation (García-Peña & Rodriguez-Ayala, 2023; Yadav & Dixit, 2024). These findings underscore the importance of a structured instructional design approach in developing digital educational media to achieve more optimal learning outcomes.

Findings from a study by Liu (2020) indicate that mobile learning positively impacts reading self-efficacy in English, particularly for non-English major students. The results of the t-test indicate that students who use mobile learning applications have significantly higher reading self-efficacy compared to those who do not use such applications, both overall and across the four dimensions of reading skills: basic reading skills, applied reading skills, task-based reading skills, and advanced reading skills. However, for students with lower reading abilities, the increase in self-efficacy is only significant in basic and applied reading skills. These findings reinforce the relevance of digital media in learning, including in the context of the Healthy Habits app, which is also designed to boost students' confidence and learning abilities through a technology-based approach. By leveraging devices that students are already familiar with in their daily lives, mobile learning not only improves accessibility but also supports increased motivation and self-confidence in understanding the material, including healthy lifestyle content in Physical Education.

Findings from research conducted at Elementary School Panca Budi Medan show that developing an Android-based interactive learning application about healthy lifestyles has proven effective in improving elementary school students' understanding and interest in learning (Hariyanto et al., 2024). This application was developed using the Multimedia Development Life Cycle (MDLC) method, which includes the stages of conception, design, material collection, assembly, testing, and distribution. Through black box testing, all features such as navigation, quizzes, and content materials functioned well, indicating the application's technical quality is suitable for use. The final results show that digital media can convey health and hygiene-related content in an engaging and easily understandable manner for

children. This aligns with developing the Healthy Habits application in this study, which is to provide an alternative learning medium that is engaging, easy to use, and suitable for the characteristics of school-age students. Using a simple interface and interactive features can enhance student engagement in learning, particularly in topics related to healthy lifestyles, which are often perceived as monotonous in conventional methods.

This research recognizes the existence of potential external variables that influenced the results, such as students' prior familiarity with technology, individual learning motivation, and access to supporting devices outside of school. These factors could have affected students' engagement and learning outcomes when interacting with the application.

Future research is encouraged to expand the implementation of the Healthy Habits application to different schools across various regions to validate its effectiveness in diverse educational settings. Further development of the application should focus on enhancing content depth, adding adaptive learning features, and potentially integrating it with other subjects, such as Science or Home Economics, to strengthen interdisciplinary learning related to health education. Longitudinal studies could also be conducted to examine the sustained impact of the application on students' behavior and lifestyle over time.

Limitations of the study

The research also had several limitations. First, the study was conducted within the scope of a single school environment (State Junior High School 29 Semarang), which may limit the generalizability of the findings to other schools with different characteristics. Second, the sample size for the small-scale trial (10 students) and even the large-scale trial (60 students) remains relatively limited for drawing broader conclusions across diverse student populations. Additionally, this study only focused on one subject area, namely Physical Education, Sports, and Health, and specifically on healthy lifestyle material, without exploring integration with other disciplines.

CONCLUSIONS

This study successfully developed an Android-based learning application, "Healthy Habits," to enhance students' understanding of healthy lifestyles in Physical Education at State Junior High School 29 Semarang 29 Semarang. The application proved effective and well-received, with teachers rating it "Good" and students rating it "Very Good."

To optimize its use, developers are encouraged to add more interactive features—quizzes, animations, and gamification—and ensure broad device compatibility. Teachers are advised to integrate the app into lesson plans, use it as a complementary learning tool, and assign in-app tasks to reinforce learning.

The positive outcomes highlight the app's potential as a model for integrating digital media into health education, promoting greater student engagement, motivation, and learning outcomes.

ACKNOWLEDGMENTS

The author expresses his deepest appreciation to all parties who have helped in completing this research.

DATA AVAILABILITY

All data supporting the findings of this study are included in the article and its supplementary materials. Additional datasets are available from the corresponding author upon a reasonable request.

FUNDING

This research did not receive external funding.

CONFLICT OF INTEREST

The author states that this study was carried out independently, with full integrity, and without any conflicts of interest involving any organization, institution, or individual. There were no financial, professional, or personal affiliations that could have influenced the design, data collection, analysis, or interpretation of the research.

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