



LITERATURE REVIEW: SMARTPHONE APPLICATIONS IN PHYSICAL EDUCATION

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Abstract

Currently, the progress of time is accompanied by the rapid advancement of technology in various fields. This phenomenon has also had an impact on the field of education and learning in recent times. The integration of technology into various aspects of education has revolutionized teaching and learning practices, including physical education (PE). Smartphone applications, commonly referred to as apps, have gained significant popularity as a tool for delivering educational content. This literature review aims to explore the use of smartphone applications in the context of physical education, their impact on teaching and learning, and the potential benefits and challenges associated with their implementation. In this article, a review was conducted on several articles sourced from databases Scopus. The aim of this article is to provide a clearer overview and serve as an additional source for research on the development or implementation of smartphone applications in physical education. The integration of smartphone applications in Physical Education has great potential to enhance learning outcomes.

Keywords:

Smartphone Applications, Physical Education, Mobile Applications.

Introduction

In recent years, the rapid advancement of technology has had a profound impact on various fields, transforming the way we live, work, and interact. From communication and transportation to healthcare and entertainment, technology has revolutionized nearly every aspect of our lives (Hamad and Jia 2022). One of the most notable areas where technological development has been significant is in communication (Subramanian 2018). The emergence of the internet and mobile devices has revolutionized how we connect and share information. Communication has become faster, more accessible, and more efficient, enabling instant global connectivity (Subramanian 2018). Social media platforms have connected people from different corners of the world, fostering new relationships and promoting cultural exchange (Subramanian 2018). Ultimately, technological developments have had an impact on various areas of life, including education.

The development of technology has had a profound impact on education and learning, revolutionizing the way knowledge is acquired, shared, and accessed (Rajendran and Kaur 2023). One of the key areas where technology has transformed education is in the availability and accessibility of learning resources (Rajendran and Kaur 2023; Vega-Ramírez, Notario, and Ávalos-Ramos 2020). Information and communication technology (ICT) has now become a very important



part of everyday life in various forms of educational integration (Vega-Ramírez et al. 2020). The existence of technology such as the internet has been proven to make it easy for teachers to find various learning resources which are then conveyed to students in planned learning. The internet has opened up a vast repository of information, enabling students and educators to access a wealth of knowledge from anywhere at any time. Online platforms, digital libraries, and educational websites provide a wide range of resources, including textbooks, articles, videos, and interactive tutorials. This accessibility to information has empowered learners to explore subjects beyond the limitations of traditional classroom settings. As one of the findings in research (Vega-Ramírez et al. 2020) that as many as 80% of Physical Education teachers stated they used the internet as part of their learning strategy.

The implementation of technology in physical education (PE) has revolutionized the way students engage and learn in this field. Technology has introduced innovative tools and resources that enhance the overall educational experience in PE.

One significant aspect of technology integration is the use of wearable devices and fitness trackers (Creaser et al. 2022; Vega-Ramírez et al. 2020). These devices enable students to monitor and track their physical activity levels, heart rate, and calories burned, providing valuable data for self-assessment and goal setting. They promote a personalized approach to fitness and allow students to take ownership of their health and well-being. Additionally, digital platforms and smartphone applications offer interactive and engaging content for PE lessons (Maňenová, Knajfl, and Wolf 2022).

The presence of smartphones in our daily lives is highly prevalent today. The majority of teenage students are already very familiar with smartphones, even though they are primarily used for various purposes such as communication, entertainment, and social media. The findings (Vega-Ramírez et al. 2020) indicate that high school students use smartphones for social networking and instant messaging applications (87.3% of women; 88.7% of men). Although the potential use of smartphones by students to support learning, especially through student initiatives, is not yet certain, it can be seen as an opportunity and a challenge for us to integrate smartphone applications in education, especially in Physical Education. Various research articles on the integration, utilization, and development of smartphone applications applied in the field of Physical Education, sports, and other physical activities indicate an increasing trend.

With the rapid development of smartphone applications supported by various adjustments, it appears evident that they can be applied in physical education. However, to our knowledge, there is limited literature available in the form of research findings that reveal the impact of implementing or integrating smartphone applications in physical education learning within schools. Based on this, we conducted a review to describe the research findings regarding the implementation or integration of smartphone applications in physical education learning within schools, as well as provide recommendations for future research opportunities, especially in Indonesia.



Methods

This article was written using the literature review method. As mentioned in the background, a systematic review is one of the choices that can be employed for research subjects based on educational science (Gazali et al. 2022; Otero-Saborido, Torreblanca-Martínez, and González-Jurado 2021). The literature search focused on the Scopus database. In the initial search stage, using the search keywords "Smartphone Applications Physical Education," 2 articles were found. Using the keywords "Mobile learning in physical education," 9 articles were found, and the search with the keywords "Mobile Applications Physical Education" yielded 18 articles. Therefore, a total of 29 articles were found based on these three search keywords. To narrow down the articles that align with the research objective, we applied the following exclusion criteria: (1) Articles published before 2020, (2) Articles in languages other than English, (3) Various forms of literature reviews, and (4) Articles that are not related to physical education at the school level (Application to college-level students is not considered as an option). The stages of the selection can be seen in Figure 1. Finally, there were 7 articles that were selected to become literature for analysis.

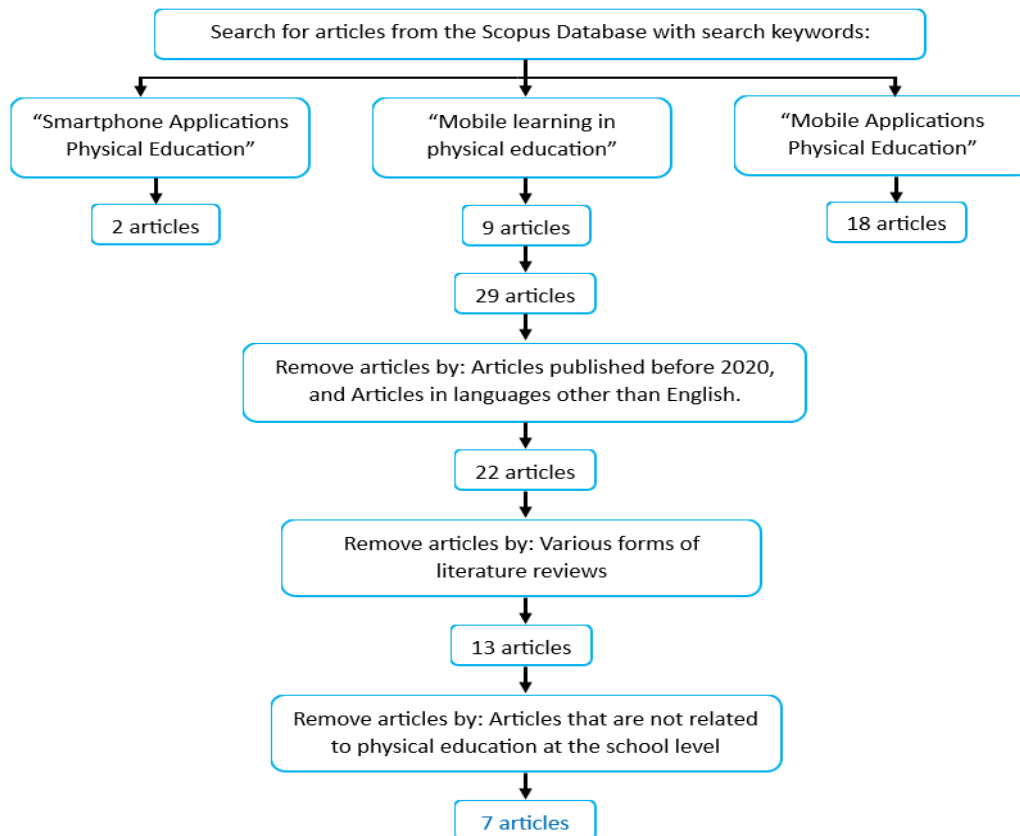


Fig 1. Searching steps.



Result

Based on the search and article selection process, here is the list of articles included in this literature review:

Table 1. List of the papers included in the present study

Author and Year	Title	Type Research	Purpose	Result	Sources and
(Lee and Gao 2020)	Effects of the iPad and mobile application-integrated physical education on children's physical activity and psychosocial beliefs	Quantitative approach, experimental.	The study examined the short-term (two-week) effects of mobile app-integrated PE classes on children's PA and their psychosocial beliefs.	The changes in children's PA were significantly different between the app-integrated and comparison groups in sedentary behavior. Children in both groups demonstrated a decrease in their MVPA; however, the decrease in the app-integrated group was significantly greater than that of the comparison group (-1.6%). There were no significant differences in changes of all beliefs between the two groups.	Physical Education and Sport Pedagogy, Scopus (Q1).
(Papastergiou et al. 2021)	Introducing tablets and a mobile fitness application into primary school physical education	Quantitative approach, experimental.	The aim of this study was to assess the impact of the integration of tablets and a mobile application for fitness development into a PE lesson in primary education, in schools that did not apply a 'one tablet per child' policy, on students' intrinsic motivation for the PE lesson.	In the experimental lesson, the students particularly appreciated the usefulness of the activity for their body, certain features of the app used and that they trained in subgroups, whereas the PE teachers were freed from the duty of repeatedly demonstrating exercises and had more time to provide individualized feedback to students.	Education and Information Technologies, Scopus (Q1).
(Vega-Ramírez et al. 2020)	The Relevance of Mobile Applications in the Learning of	Quantitative approach, descriptive	The objective of this research was to analyze the use of	The Polar Beat application in physical education classes has allowed them a better	Education sciences, Scopus



Author and Year	Title	Type Research	Purpose	Result	Sources and
	Physical Education	analysis.	smartphone by 40 Spanish teenagers and assess the degree of satisfaction of the Polar Beat application within the subject of physical education in high school.	understanding of the content developed; the students affirmed that their motivation towards PSA increased with the knowledge and use of the Polar Beat app and that smartphones are innovative and effective tools.	(Q2).
(Chaichitwanidchakol and Feungchan 2020)	Design and Implementation of Interactive Mobile Application for Autistic Children in Physical Education Class	Research and development	The aim of this research is to find video interaction in the form that encourage autistic children's exercise on a treadmill suitable for individual child.	The results showed that the AVI was the most suitable technique for autistic children with an average accuracy rate of 92.31%. The study shows that the application is able to reduce the caretaker's burden and motivate autistic children to focus while exercising.	International Journal of Interactive Mobile Technologies, Scopus (Q3).
(Man'enov et al. 2022)	Motivation and Performance of Students in School Physical Education in Which Mobile Applications Are Used	Quantitative approach, experimental.	The research objective was to identify typical groups of students on the basis of their physical performances and motivation.	The research results show that thanks to the implementation of mobile phones in the process of PE and thanks to a different approach taken by the teacher, increased internal motivation and an increase in identified regulation can be seen, as well as a decrease in amotivation and a rapid increase in motor performances, especially in the case of students whose performances are average or below average in usual PE classes.	Sustainability, Scopus (Q2).
(Copetti et al. 2022)	Pedagogical support for the Test of Gross Motor Development – 3 for children with	Quantitative approach, validity measurement.	This study aimed to develop and investigate the face, content, and criterion	The Motor Skills Sequential Pictures (MSSP), mainly ball skills, proved to be valid to illustrate the TGMD-3 motor	Physical Education and Sport Pedagogy, Scopus



Author and Year	Title	Type Research	Purpose	Result	Sources and
	neurotypical development and with Autism Spectrum Disorder: validity for an animated mobile application		validity of a Motor Skills Sequential Pictures (MSSP) for the Test of Gross Motor Development – 3 (TGMD-3) to be animated and used in a mobile application (App).	performance criteria and may be useful as a visual pedagogical support for children to facilitate skill understanding. Future directions will be to evaluate whether the MSSP animation, in an app- based program, will improve children’s motor skill performance.	(Q1).
(Saucedo-Araujo et al. 2022)	Testing the Mystic School Mobile Application to Promote Active Commuting to School in Spanish Adolescents: The PACO Study	Qualitative approach.	To analyze the adolescents’ opinion of the mobile application (app) Mystic School, which was designed to promote ACS in Spanish adolescents.	The Mystic School app can be a useful tool for the physical education teacher to integrate the content from this curriculum related to the promotion of physical activity, such as active commuting to school (ACS).	Children, Scopus (Q2).

Type Research

Based on the analyzed literature, researchers employed several types of research methodologies. Out of seven studies, five utilized a Quantitative approach, namely (Lee and Gao 2020) (Papastergiou et al. 2021) (Vega-Ramírez et al. 2020) (Man’enová et al. 2022) and (Copetti et al. 2022). One study used a Research and Development approach (Chaichitwanidchakol and Feungchan 2020), while another study (Saucedo-Araujo et al. 2022) employed a Qualitative approach. More specifically, (Lee and Gao 2020) (Papastergiou et al. 2021) (Man’enová et al. 2022) used a Qualitative approach through experimental designs, implementing various forms of smartphone applications in physical education to assess their impact on specific variables. On the other hand, the Quantitative approach employed by (Vega-Ramírez et al. 2020) involved descriptive analysis to measure the level of satisfaction with smartphone applications in physical education. Meanwhile, (Copetti et al. 2022) used the Quantitative approach to assess the validity of a Gross Motor Development Test instrument based on smartphone applications. (Chaichitwanidchakol and Feungchan 2020) utilized the Research and Development approach to produce a video interaction form that encourages autistic children to engage in treadmill exercises, tailored to individual children and presented through smartphone applications. On the other hand, (Saucedo-Araujo et al. 2022) employed a Qualitative approach to analyze teenagers' opinions regarding a specific smartphone application.

Smartphone applications in the context of physical education



1. The findings of the study indicate the use of various smartphone applications. Employing a pre-test post-test quasi-experimental design, (Lee and Gao 2020) implemented applications such as 'Garage Band' and 'Coach's Eye' with children aged 9-11 in fourth or fifth grade of elementary school. These smartphone applications allowed teachers to incorporate different music for transitions between activities and provided support for instructional delivery to students. Additionally, the 'Coach's Eye' app assisted teachers in providing feedback through video recording clips as students learned motor skills (Lee and Gao 2020).
2. In their research, (Papastergiou et al. 2021) utilized the smartphone application "SworKit Kids" (<http://kids.sworKit.com/>) developed by Neexercise Apps Inc., which was implemented in elementary school physical education classes for 5th and 6th-grade students aged between 10-12 years. "SworKit Kids" offers a range of 66 gymnastic exercises categorized into three groups: strengthening exercises, agility exercises, and flexibility and balance exercises (Papastergiou et al. 2021). The application is specifically designed for children and teenagers aged 7 to 14 and has received widespread recommendations due to its user-friendly interface and its suitability for meeting the fitness needs of children and adolescents (Papastergiou et al. 2021).
3. The study conducted by (Vega-Ramírez et al. 2020) analyzed the use of smartphones among 40 Spanish teenagers and evaluated the satisfaction level with the Polar Beat application in the context of physical education classes in high school. Polar Beat was utilized to execute and develop content related to Physical Fitness and Health, specifically focusing on physical endurance capacity (Vega-Ramírez et al. 2020). The selection of this application was based on its free availability, compatibility with both Android and iOS platforms, customization options, ease of use, and features such as distance and duration control, training history tracking, and speed graph development (Vega-Ramírez et al. 2020).
4. The study conducted by (Chaichitwanidchakol and Feungchan 2020) aimed to find a suitable video interaction format that encourages autistic children to engage in exercise on a treadmill. To support their research, (Chaichitwanidchakol and Feungchan 2020) employed six techniques of mobile camera interaction, namely: 1) Face Detection, 2) Upper Body Detection, 3) Color Detection, 4) QR Code Detection, 5) Motion Detection, and 6) Adaptive Video Interaction (AVI). The developed application by (Chaichitwanidchakol and Feungchan 2020) collected information on each autistic child, which could be customized to provide the most suitable monitoring for each individual. Additionally, the application allowed caregivers and experts to generate personal reports that could be used to revise activity plans (Chaichitwanidchakol and Feungchan 2020). The application was tested on iPhone 6 and iPad mini 4 devices.
5. The study conducted by (Maněnová et al. 2022) aimed to determine whether it is possible to identify groups of students based on their motor performance outcomes and level of motivation for Physical Education, with the use of smartphones in Physical Education lessons (Maněnová et al. 2022). Several applications were used, including Google Fit, Break Dance tutorial, Zumba Fitness, Gymnastic Training, Train Effective: Football, and others



- (Maňenová et al. 2022), which were implemented in Physical Education learning for elementary and secondary school students.
6. The study conducted by (Copetti et al. 2022) aimed to test the validity of the developed gross motor instrument called Motor Skills Sequential Pictures (MSSP). The MSSP consists of a sequential illustration (five to six pictures) of each TGMD-3 skill, including locomotor skills (run, gallop, hop, skip, jump, slide) and ball skills (strike with one and two hands, dribble, catch, kick, overhand and underhand throw), along with the skills' performance criteria (3-5 for each skill) (Copetti et al. 2022). The validation of the MSSP instrument involved several experts and undergraduate students, as well as 66 children (48 neurotypical and 18 with Autism Spectrum Disorder - ASD) (Copetti et al. 2022).
 7. In the study by (Saucedo-Araujo et al. 2022), a smartphone application with potential for implementation in Physical Education was tested. The application, called Mystic School, is a mobile-based active video game (AVG) aimed at promoting walking as a mode of transportation to increase the daily physical activity (PA) levels of adolescents (Saucedo-Araujo et al. 2022). Mystic School includes an accelerometer and GPS functionality to track the number of steps and distance covered. As the application is based on AVGs, the real-world steps taken by the adolescents are converted into virtual steps that contribute to progressing in the game (Saucedo-Araujo et al. 2022).

Result

Various uses, developments, and testing of smartphone applications based on the literature review have resulted in diverse findings. The study by (Lee and Gao 2020) implementing smartphone applications in physical education revealed that the integrated smartphone group showed a greater increase in sedentary time and a decrease in moderate-to-vigorous physical activity (MVPA) compared to the control group. However, it is worth noting that sedentary behavior and MVPA trends were similar in both groups. Additionally, light physical activity decreased for the integrated group and increased for the control group (Lee and Gao 2020). The research by (Papastergiou et al. 2021) using the "Sworkit Kids" app with students aged 10-12 found that the experimental group reported higher levels of interest and enjoyment, which proved to be motivating for both boys and girls, as well as for 5th and 6th-grade students (Papastergiou et al. 2021). On the other hand, the findings from (Vega-Ramírez et al. 2020) showed that the most downloaded mobile applications related to physical activity were Polar Beat, Runtastic, Nike training, and others. According to students, the main function of smartphones in physical education class was the use of video and photos for exercise analysis (Vega-Ramírez et al. 2020). The development by (Chaichitwanidchakol and Feungchan 2020) resulted in camera interaction techniques suitable for autistic children to support their exercises in physical education classes. The study by (Maňenová et al. 2022) indicated that mobile applications have great potential to enhance motivation in physical education, although cluster analysis revealed a group of high-performing students who were not engaged with technology and thus rejected it. The research by (Copetti et al. 2022) showed that the Motor Skills Sequential Pictures (MSSP) app tested on children with neurotypical development demonstrated their ability to recognize and perform most skills, understand movements, and perform them effortlessly (Copetti et



al. 2022). The study by (Saucedo-Araujo et al. 2022) testing the Mystic School app with high school students revealed that Mystic School could be a useful tool for physical education teachers to integrate curriculum content related to promoting physical activity, such as active commuting to and from school (ACS) (Saucedo-Araujo et al. 2022).

Discussion

The integration of smartphone applications in physical education is believed to have great potential in supporting learning (Gil-Espinosa et al. 2022; Lee and Gao 2020; Mančenová et al. 2022). Various studies have shown the benefits and possibilities of using smartphone applications in the context of physical education. For example, they can be used to enhance physical activity (PA) in physical education classes (Gil-Espinosa et al. 2022; Lee and Gao 2020; Saucedo-Araujo et al. 2022), improve student motivation (Mančenová et al. 2022), increase interest and enjoyment (Papastergiou et al. 2021), and even be developed and customized for students with Autism Spectrum Disorder (ASD) (Chaichitwanidchakol and Feungchan 2020; Copetti et al. 2022). These studies highlight the potential of smartphone applications to enhance the teaching and learning experience in physical education, catering to different needs and promoting engagement among students.

With the rapid development of technology, particularly smartphone applications, the opportunities for their utilization in physical education are growing. There are numerous smartphone applications available for use, as evidenced by a search conducted by (Gil-Espinosa et al. 2022) on the Google Play Store between January 2021 and March 2021, which identified a total of 4,650 apps. However, after evaluation, only 18 applications were found to focus on physical activity (PA) (Gil-Espinosa et al. 2022). Out of the 18 selected apps, eight were linked to the "Fitness, health, and life quality" content block, two to "Games and sport," four to "Body expression," and four to "Outdoor physical activities" (Gil-Espinosa et al. 2022). This indicates that while there is a wide accessibility of applications, it does not necessarily mean that most of these apps are suitable for supporting physical education learning.

The significant potential of integrating smartphone applications in Physical Education needs to be supported by various aspects. Physical Education teachers should be discerning in selecting smartphone applications that align with students' needs (Gil-Espinosa et al. 2022). The appropriate selection of smartphone applications can have a positive impact on increasing students' motivation in Physical Education learning (Mančenová et al. 2022). Furthermore, teachers should also consider the instructional methods to be employed, such as whether each student will use an individual smartphone device or not. For instance, (Papastergiou et al. 2021) implemented a small group approach in Physical Education learning with the assistance of smartphone applications, referred to as "Tablets Lesson Group (TLG)" (Papastergiou et al. 2021). Each small group was provided with a tablet device displaying various movement demonstrations, allowing teachers to have more time to observe students during the lesson as the role of movement demonstration is replaced by the smartphone application and device.

In the integration of smartphone applications in Physical Education, it is evident that the role of teachers is crucial. Apart from being able to select and determine the appropriate smartphone applications and instructional methods, a solid foundation in IT skills is fundamentally required. This



can be initiated by providing training that supports aspiring teachers (Mančenová et al. 2022) so that they become prepared and capable of integrating smartphone applications in Physical Education, albeit with the necessary support from the government, educational institutions, and relevant stakeholders. With comprehensive support from various aspects, the significant potential of smartphone applications can be realized, contributing significantly to advancing Physical Education learning. Based on these considerations, further research is still needed, such as the development of smartphone applications that align with students' needs and curriculum demands at various levels of education, especially in Indonesia.

Conclusion

Overall, the integration of smartphone applications in Physical Education has great potential to enhance learning outcomes. By leveraging technology that is already familiar to students, the learning process becomes more engaging and relevant to their daily lives. However, it is important to note that the implementation of smartphone applications in Physical Education should be accompanied by appropriate approaches and adequate supervision to ensure their effective and safe use.

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