

## Digital-Based Physical Education and Physical Literacy Development in School-Aged Children in Kupang, Indonesia

<sup>1</sup>Salmon Runesi\*, <sup>2</sup>Suryansyah, <sup>3</sup>Alaa Hashim Ahmed

Corresponding Author: Salmon Runesi, E-mail: [runesisalmon@staf.undana.ac.id](mailto:runesisalmon@staf.undana.ac.id)

<sup>1</sup>Physical Education, Universitas Nusa Cendana, Kupang, Indonesia

<sup>2</sup>Physical Education, Universitas Hamzanwadi, Lombok, Indonesia

<sup>3</sup>Faculty of Education for Pure Sciences, Samarra University, Iraq

### Abstract

**Objectives:** This study aimed to investigate the effectiveness of digital-based physical education in improving physical literacy among school-aged children in Kupang, Indonesia.

**Materials and Methods:** This study used a quasi-experimental design with a pretest–posttest control group. A total of 60 elementary school students aged 10–12 years participated in the study. The experimental group received digital-based physical education instruction using interactive video modules and mobile applications, while the control group received conventional physical education instruction. The intervention was conducted for eight weeks. Physical literacy was measured through four domains: physical competence, motivation and confidence, knowledge and understanding, and daily physical activity behavior. Data were analyzed by comparing pretest and posttest scores between groups, with the significance level set at  $p < 0.05$ .

**Results:** The results showed significant improvements in physical literacy among students in the experimental group compared with the control group ( $p < 0.05$ ). The greatest improvements were found in the domains of motivation and confidence, and physical competence. These findings indicate that digital-based instruction can increase students' engagement, movement skill development, and understanding of active lifestyle behaviors.

**Conclusions:** Digital-based physical education is an effective approach for improving physical literacy among elementary school students. The integration of interactive video modules and mobile applications can support more engaging, accessible, and student-centered physical education learning.

**Keywords:** Digital Learning, Physical Education, Physical Literacy, Children, Kupang

### Introduction

Physical literacy is a fundamental concept in physical education because it reflects students' ability, motivation, confidence, knowledge, and willingness to participate in physical activity throughout life (Barnett et al., 2023; Cairney et al., 2019). In school-aged children, the development of physical literacy is important because this period is a critical stage for forming movement skills, active habits, and positive attitudes toward physical activity (Brewer, 2017; Hartanto et al., 2021; O'Brien et al., 2023). Children with good physical literacy are more likely to participate confidently in various movement activities and maintain an active lifestyle as they grow older (Dewi, 2021; Dudley et al., 2011; O'Brien et al., 2023).

Physical education has an important role in developing physical literacy through structured, enjoyable, and meaningful learning experiences. However, conventional physical education practices often rely on direct instruction, teacher demonstration, and repetitive activities (Abduh et al., 2024; Alhumaid & Said, 2023; ALI MARDIUS et al., 2024). Although these methods can support basic skill learning, they may not always accommodate students' different learning styles, levels of confidence, and motivation. As a result, some students may become less engaged, especially when learning activities are monotonous or lack interactive elements.

The rapid development of digital technology has created new opportunities for improving physical education learning (Abdul Jabbar & Felicia, 2015; Adewale et al., 2024). Digital-based physical education uses instructional videos, mobile applications, interactive platforms, and digital learning media to support movement learning and student engagement. These tools can provide visual demonstrations, flexible learning access, feedback, and interactive tasks that help students understand movement concepts more clearly. In addition, digital media may increase motivation because students are familiar with technology and often respond positively to visual and interactive learning environments.

The urgency of this study is related to the need for more adaptive physical education strategies, particularly in areas where teaching resources, facilities, and learning media may be limited. In Kupang, Indonesia, digital-based physical education may offer a practical alternative to enrich learning experiences and support students' physical literacy development. Through video modules and mobile applications, students can observe movement demonstrations repeatedly, learn basic concepts of physical activity, and become more actively involved in physical education lessons.

Although digital technology has been widely discussed in education, its application in physical education, especially for developing physical literacy among elementary school students in regional Indonesian contexts, remains limited. Previous studies have often focused on digital learning in classroom-based subjects, while fewer studies have examined how digital-based physical education affects physical competence, motivation and confidence, knowledge and understanding, and daily physical activity behavior as integrated domains of physical literacy (Abusleme-Allimant et al., 2023; Brazo-Sayavera et al., 2021).

The novelty of this study lies in its examination of digital-based physical education as a strategy to improve physical literacy among school-aged children in Kupang, Indonesia. This study does not only evaluate physical competence, but also considers motivation, confidence, knowledge, understanding, and physical activity behavior. Therefore, this research provides contextual evidence on how interactive video modules and mobile applications can be used to support student-centered physical education learning.

Based on this background, this study aims to examine the effect of digital-based physical education on the development of physical literacy among school-aged children in Kupang, Indonesia.

## **Materials and Methods**

### **Study Participants**

This study used a quasi-experimental design with a pretest–posttest control group. The design was used to compare changes in physical literacy between students who received digital-based physical education and students who received conventional physical education.

A total of 60 elementary school students aged 10–12 years from two elementary schools in Kupang, Indonesia, participated in this study. Participants were selected using cluster random sampling. The students were divided into two groups: an experimental group consisting of 30 students and a control group consisting of 30 students.

The inclusion criteria were students aged 10–12 years, actively enrolled in physical education classes, physically able to participate in regular physical activity, and willing to follow the intervention program. Students with injuries, medical restrictions, or incomplete attendance during the intervention were excluded from the study. Permission from the school and informed consent from parents or guardians were obtained before data collection.

### **Study Organization**

The intervention was conducted for eight weeks, with three sessions per week. Each session was implemented during scheduled physical education learning activities.

Before the intervention, both groups completed pretests to measure physical literacy across four domains: physical competence, motivation and confidence, knowledge and understanding, and daily physical activity behavior. After the pretest, the experimental group participated in digital-based physical education, while the control group received conventional physical education instruction.

The digital-based physical education program consisted of interactive instructional videos, mobile-based activity tracking, and gamified physical activity challenges. The instructional videos were used to demonstrate movement skills and physical activity tasks. Mobile-based activity tracking was used to monitor students' participation and daily movement behavior. Gamified challenges were designed to increase motivation, confidence, and active engagement during learning.

The control group followed conventional physical education instruction, which included teacher explanation, direct demonstration, skill practice, and standard physical activity exercises. At the end of the eight-week intervention, both groups completed posttests using the same instruments as the pretest.

### **Research Instruments**

Physical literacy was assessed using a validated instrument covering four domains. Physical competence was measured using motor skill tests that assessed students' ability to

perform basic movement skills, such as running, jumping, throwing, balance, and coordination.

Motivation and confidence were measured using a questionnaire designed to assess students' enjoyment, interest, self-confidence, and willingness to participate in physical activity.

Knowledge and understanding were assessed using a written test related to physical activity concepts, movement benefits, healthy lifestyle, safety, and basic exercise principles. Daily physical activity behavior was measured using an activity log that recorded students' participation in physical activities during and outside school hours.

### Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive statistics, including mean and standard deviation, were used to describe pretest and posttest scores in each physical literacy domain.

A paired sample t-test was used to examine differences between pretest and posttest scores within each group. An independent sample t-test was used to compare differences between the experimental and control groups. The level of statistical significance was set at  $p < 0.05$ .

### Results

The results showed that the experimental group experienced greater improvements than the control group in all domains of physical literacy after the eight-week intervention. Improvements were observed in physical competence, motivation and confidence, knowledge and understanding, and daily physical activity behavior. The posttest comparison indicated significant differences between groups, with the digital-based physical education group achieving higher scores across all measured domains.

**Table 1.** Comparison of Physical Literacy Scores Between Experimental and Control Groups

Domain	Experimental Pretest	Experimental Posttest	Control Pretest	Control Posttest	p-value
Physical competence	65.4	78.9	64.8	69.2	0.001
Motivation and confidence	60.2	82.5	61.1	68.4	0.000
Knowledge and understanding	58.7	80.3	59.5	70.1	0.002
Physical activity behavior	55.9	75.6	56.3	65.7	0.003

The physical competence score in the experimental group increased from **65.4** to **78.9**, while the control group increased from **64.8** to **69.2**. This result indicates that digital-based

PE supported better development of movement skills compared with conventional instruction.

The largest improvement was found in the motivation and confidence domain. The experimental group increased from 60.2 to 82.5, while the control group increased from 61.1 to 68.4. This suggests that interactive videos, mobile-based tracking, and gamified challenges were effective in increasing students' enjoyment, confidence, and willingness to participate in physical activity.

Knowledge and understanding also improved substantially in the experimental group, increasing from 58.7 to 80.3. The control group showed a smaller increase from 59.5 to 70.1. This finding shows that digital learning media helped students understand physical activity concepts more clearly.

Daily physical activity behavior increased from 55.9 to 75.6 in the experimental group, compared with an increase from 56.3 to 65.7 in the control group. This indicates that digital-based PE encouraged students to become more active both during and outside physical education lessons.

**Figure 1.** Posttest Comparison of Physical Literacy Domains

#### Physical Competence



#### Motivation and Confidence



#### Knowledge and Understanding



#### Physical Activity Behavior



Overall, these findings indicate that digital-based physical education significantly enhanced all domains of physical literacy among elementary school students. The intervention was especially effective in improving motivation and confidence, followed by knowledge and understanding, physical activity behavior, and physical competence.

#### Discussion

The findings of this study demonstrate that digital-based physical education was more effective than conventional instruction in improving physical literacy among school-aged children in Kupang. The experimental group showed greater improvements across all

domains, including physical competence, motivation and confidence, knowledge and understanding, and physical activity behavior (Brazo-Sayavera et al., 2021; Burton & Rodgers, 2001). These results indicate that the use of interactive videos, mobile-based activity tracking, and gamified physical activity challenges can create a more engaging and student-centered learning environment.

The greatest improvement was found in the motivation and confidence domain. This suggests that digital tools can increase students' enjoyment, interest, and willingness to participate in physical education. Interactive learning media and gamified challenges may reduce boredom commonly found in repetitive conventional activities. When students feel that physical education is enjoyable and personally meaningful, they are more likely to participate actively and develop confidence in performing movement tasks.

The improvement in physical competence can be attributed to the use of visual demonstrations and repeated access to instructional content. Through interactive videos, students were able to observe movement techniques more clearly and review them when needed. This learning process may help students understand body position, movement sequences, and skill execution better than verbal explanation alone. As a result, students had more opportunities to improve their motor skills through guided and repeated practice.

The increase in knowledge and understanding also shows the value of multimedia-based learning in physical education. Digital content allows students to receive information through visual and auditory channels, making movement concepts, health benefits, safety principles, and physical activity guidelines easier to understand. This is important because physical literacy does not only involve the ability to move, but also the knowledge needed to make informed decisions about physical activity.

The improvement in physical activity behavior indicates that digital-based physical education may influence students beyond classroom learning. Mobile-based activity tracking and gamified tasks encouraged students to become more aware of their daily movement habits. This finding suggests that digital tools can help connect school-based physical education with students' daily physical activity routines, supporting the development of active lifestyle behavior (Bremer & Cairney, 2018; Park et al., 2020).

In the context of Kupang, digital-based physical education offers a practical alternative to enrich learning experiences, especially in schools with limited teaching resources or learning media. However, broader implementation requires careful consideration of several challenges, including access to digital devices, internet connectivity, teacher readiness, and students' digital literacy. Digital-based PE should not replace the role of teachers, but should be used as a supporting tool to strengthen instruction, increase engagement, and improve learning quality (Webb et al., 2017, 2017).

Overall, this study supports the integration of digital technology into physical education as an effective strategy to enhance physical literacy among elementary school students. Future studies should examine longer intervention periods, involve more schools,

and explore how digital-based PE can be adapted to different regional contexts, facilities, and student characteristics.

## Conclusion

Digital-based physical education significantly improves physical literacy among school-aged children in Kupang. This approach enhances physical competence, motivation and confidence, knowledge and understanding, and daily physical activity behavior.

Therefore, integrating digital tools into physical education curricula is recommended to create more engaging, interactive, and effective learning experiences.

## References

- Abduh, I., Saparia, A., Jumain, J., Ziulhaq, Z., & Usba, M. (2024). The Creativity of Physical Education Teachers, Sports, and Health. *Musamus Journal of Physical Education and Sport (MJPES)*, 6(2), Article 2. <https://doi.org/10.35724/mjpes.v6i2.6060>
- Abdul Jabbar, A. I., & Felicia, P. (2015). Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. *Review of Educational Research*, 85(4), 740–779. <https://doi.org/10.3102/0034654315577210>
- Abusleme-Allimant, R., Hurtado-Almonacid, J., Reyes-Amigo, T., Yáñez-Sepúlveda, R., Cortés-Roco, G., Arroyo-Jofré, P., & Páez-Herrera, J. (2023). Effects of Structured and Unstructured Physical Activity on Gross Motor Skills in Preschool Students to Promote Sustainability in the Physical Education Classroom. *Sustainability*, 15(13), 10167. <https://doi.org/10.3390/su151310167>
- Adewale, M. D., Azeta, A., Abayomi-Alli, A., & Sambo-Magaji, A. (2024). Impact of artificial intelligence adoption on students' academic performance in open and distance learning: A systematic literature review. *Heliyon*, 10(22), e40025. <https://doi.org/10.1016/j.heliyon.2024.e40025>
- Alhumaid, M. M., & Said, M. A. (2023). Increased physical activity, higher educational attainment, and the use of mobility aid are associated with self-esteem in people with physical disabilities. *Frontiers in Psychology*, 14, 1072709. <https://doi.org/10.3389/fpsyg.2023.1072709>
- Ali Mardius, Eri Barlian, Nurul Ihsan, Bafirman Hb, & Yuni Astuti. (2024). Tactical game-based model for the novice Pencak Silat single-stance training: A program and protocol development. *Journal of Physical Education and Sport*, 24(3).
- Barnett, L. M., Jerebine, A., Keegan, R., Watson-Mackie, K., Arundell, L., Ridgers, N. D., Salmon, J., & Dudley, D. (2023). Validity, Reliability, and Feasibility of Physical Literacy Assessments Designed for School Children: A Systematic Review. *Sports Medicine*, 53(10), 1905–1929. <https://doi.org/10.1007/s40279-023-01867-4>
- Brazo-Sayavera, J., Aubert, S., Barnes, J. D., González, S. A., & Tremblay, M. S. (2021). Gender differences in physical activity and sedentary behavior: Results from over 200,000 Latin-American children and adolescents. *PLOS ONE*, 16(8), e0255353. <https://doi.org/10.1371/journal.pone.0255353>

- Bremer, E., & Cairney, J. (2018). Fundamental Movement Skills and Health-Related Outcomes: A Narrative Review of Longitudinal and Intervention Studies Targeting Typically Developing Children. *American Journal of Lifestyle Medicine*, 12(2), 148–159. <https://doi.org/10.1177/1559827616640196>
- Brewer, C. (2017). *Athletic Movement Skills: Training for Sports Performance*. Human Kinetics.
- Burton, A. W., & Rodgerson, R. W. (2001). New Perspectives on the Assessment of Movement Skills and Motor Abilities. *Adapted Physical Activity Quarterly*, 18(4), 347–365. <https://doi.org/10.1123/apaq.18.4.347>
- Cairney, J., Dudley, D., Kwan, M., Bulten, R., & Kriellaars, D. (2019). Physical Literacy, Physical Activity and Health: Toward an Evidence-Informed Conceptual Model. *Sports Medicine*, 49(3), 371–383. <https://doi.org/10.1007/s40279-019-01063-3>
- Dewi, R. tika. (2021). Development of Modification of Big Ball Game with Play Approach in Order to Develop Basic Movement Skills in Elementary School Students. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*.  
[https://www.academia.edu/100321960/Development\\_of\\_Modification\\_of\\_Big\\_Ball\\_Game\\_with\\_Play\\_Approach\\_in\\_Order\\_to\\_Develop\\_Basic\\_Movement\\_Skills\\_in\\_Elementary\\_School\\_Students](https://www.academia.edu/100321960/Development_of_Modification_of_Big_Ball_Game_with_Play_Approach_in_Order_to_Develop_Basic_Movement_Skills_in_Elementary_School_Students)
- Dudley, D., Okely, A., Pearson, P., & Cotton, W. (2011). A systematic review of the effectiveness of physical education and school sport interventions targeting physical activity, movement skills and enjoyment of physical activity. *European Physical Education Review*, 17(3), 353–378. <https://doi.org/10.1177/1356336X11416734>
- Hartanto, D., Kusmaedi, N., Mamun, A., & Abduljabar, B. (2021). Integrating Social Skills in Traditional Games with Physical Education Interventions. *International Journal of Human Movement and Sports Sciences*, 9(5), 921–928. <https://doi.org/10.13189/saj.2021.090513>
- O'Brien, W., Khodaverdi, Z., Bolger, L., Murphy, O., Philpott, C., & Kearney, P. E. (2023). Exploring Recommendations for Child and Adolescent Fundamental Movement Skills Development: A Narrative Review. *International Journal of Environmental Research and Public Health*, 20(4), 3278. <https://doi.org/10.3390/ijerph20043278>
- Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, 41(6), 365–373. <https://doi.org/10.4082/kjfm.20.0165>
- Webb, S., Holford, J., Hodge, S., Milana, M., & Waller, R. (2017). Lifelong learning for quality education: Exploring the neglected aspect of sustainable development goal 4. *International Journal of Lifelong Education*, 36(5), 509–511. <https://doi.org/10.1080/02601370.2017.1398489>