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The Effect of Local Wisdom-Based Educational and Recreational Physical Activities Supported by Interactive Multimedia on Students' Physical Literacy in Physical Education

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Abstract

Physical literacy has become an essential concept in physical education as it integrates physical competence, motivation, and confidence, and knowledge and understanding necessary for lifelong physical activity. However, physical education learning in many schools still focuses primarily on motor skills, with limited integration of culturally relevant activities and digital learning media. This study aimed to examine the effects of educational and recreational physical activities, supported by interactive multimedia, on students' physical literacy. This research employed a quantitative approach using a quasi-experimental design with a pretest–posttest control group. The study was conducted in three junior high schools in Palembang, South Sumatra, Indonesia, involving 60 students. Data were collected through a physical literacy assessment instrument covering physical competence, motivation and confidence, and knowledge and understanding. The data were analyzed using descriptive statistics, normalized gain (N-Gain), and an independent samples t-test with a significance level of 0.05. The results showed a substantial improvement in students' physical literacy scores, with the mean pretest score increasing from 58.27 (SD = 7.02) to 92.90 (SD = 4.06) on the posttest. The N-Gain value of 0.83 indicated a high level of improvement, and the statistical test confirmed a significant difference between pretest and posttest scores ($p < 0.05$). These findings indicate that educational and recreational physical activities based on local wisdom supported by interactive multimedia effectively enhance students' physical literacy in physical education learning.

Keywords: Interactive Multimedia; Local Wisdom; Physical Education; Physical Literacy.

1. Introduction

Physical literacy (PL) has emerged as a central construct in contemporary physical education, emphasizing not only physical competence but also students' motivation, self-confidence, and understanding of physical activity as integral components of a healthy and active lifestyle [1]. It is widely

recognized at the international level as a foundational concept within physical education. However, how PL is conceptualized, assessed, and implemented within the Indonesian school context remains unclear, and a systematic synthesis of existing national research is still lacking. Current studies on physical literacy in Indonesia are fragmented and predominantly oriented toward skill-based approaches, with limited alignment to holistic principles of physical literacy [2].

Furthermore, physical literacy has been consistently associated with a range of positive outcomes for students, including enhanced physical competence, increased motivation, and improved overall well-being [3] [4] [5]. In recent years, the concept has attracted growing scholarly and international attention. Consequently, prior research has recommended that scholars adopt more innovative and integrative approaches that are philosophically aligned in the measurement and assessment of physical literacy [6].

However, in many school contexts, physical education instruction continues to prioritize motor skill acquisition and physical fitness outcomes, while the affective and cognitive dimensions of physical literacy receive limited and insufficient systematic attention [7] [8] [9] [2]. Consequently, students' engagement and meaningful participation in physical education activities often remain suboptimal, particularly at the junior high school level, where motivation to learn and self-confidence tend to decline as academic demands intensify. Nevertheless, physical education offers a valuable framework for examining movement in relation to physical activity (PA) and motor skill outcomes, as well as environmental contexts and broader social and affective learning processes [10].

Several international studies have indicated that students' physical literacy is positively influenced by learning environments that are meaningful, enjoyable, culturally relevant, and supported by appropriate instructional media [11] [12] [13] [14] [15] [16]. Structured learning programs that integrate physical competence, motivation, and knowledge have been shown to significantly contribute to the development of students' overall physical literacy [17] [18] [19] [20] [21] [22]. In addition, other studies have concluded that the learning environment plays a significant role in shaping student motivation and participation in physical education [20] [21] [22] [19]. Despite these findings, many existing teaching practices continue to rely on conventional teacher-centered approaches and repetitive drills, which may be insufficient to address students' diverse learning needs and interests.

In the Indonesian context, and particularly in junior high schools in Palembang, physical education teachers generally implement standard curriculum-based activities with limited integration of local cultural elements and digital learning media. Initial observations conducted in three junior high schools in Palembang indicate that learning activities generally focus on technique-based exercises, while the use of interactive multimedia and movement activities based on local wisdom is still minimal. As a result, students often demonstrate low enthusiasm and limited confidence when engaging in physical activity, and learning experiences tend to be perceived as routine rather than meaningful.

Previous studies have underscored the educational potential of local wisdom-based physical activities and traditional games in enhancing students' motivation, social interaction, and enjoyment within physical education contexts [23] [24] [25] [26] [27]. The integration of culturally relevant physical activities into physical education lessons has been shown to positively influence students' attitudes toward physical activity [28] [29] [30] [31]. Moreover, active participation affords students authentic opportunities to engage in and shape physical activity experiences, thereby fostering increased motivation to be physically active [32].

Conversely, research examining the use of digital and interactive multimedia in physical education has demonstrated that multimedia-based instruction can enhance students' understanding of movement concepts and increase learning motivation [33] [34] [35] [36] [37]. However, to date, no studies have empirically investigated the combined integration of culturally based physical activities and interactive multimedia within a unified instructional model aimed at developing physical literacy as a

multidimensional construct.

These findings suggest that both cultural relevance and technology-enhanced instruction can independently contribute to improving the quality of learning in physical education. Nevertheless, most prior studies have treated indigenous wisdom-based activities and digital learning media as separate instructional interventions. This gap is particularly evident in the context of Indonesian junior high schools, where integrated and contextually relevant physical education models remain limited.

Very limited empirical evidence is available on instructional models that systematically integrate local wisdom-based physical activities and interactive multimedia to support the development of students' physical literacy as an integrated learning outcome. This gap is particularly evident in the context of junior high schools in Indonesia, where empirical studies that explicitly adopt internationally recognized physical literacy frameworks remain scarce. Consequently, empirical guidance for teachers and curriculum developers on how culturally rooted and technology-enabled learning interventions can be designed to foster students' holistic physical literacy remains limited.

Based on these considerations, this study introduces a learning intervention that integrates locally-based educational and recreational physical activities supported by interactive multimedia in physical education lessons. The novelty of this study lies in the integration of culturally meaningful movement activities with interactive multimedia as pedagogical support, while explicitly targeting students' physical literacy as a multidimensional learning outcome in the Indonesian junior high school context.

The purpose of this study was to examine the effects of educational and recreational physical activities, supported by interactive multimedia, on students' physical literacy in three junior high schools in Palembang, South Sumatra, Indonesia. The findings of this study are expected to provide theoretical and practical significance. Theoretically, this study contributes to the development of physical literacy research by extending existing international frameworks to the culturally specific and technology-enabled learning contexts of Indonesia. Practically, the results of this study can serve as an empirical reference for physical education teachers in designing more meaningful, engaging, and culturally responsive learning activities supported by digital media.

2. Methods

This study employed a quantitative approach utilizing a quasi-experimental design with a pretest–posttest control group. The research was conducted in three junior high schools in Palembang, South Sumatra, Indonesia. The experimental group received physical education instruction through educational and recreational activities grounded in local wisdom and supported by interactive multimedia, whereas the control group participated in conventional physical education instruction. This design was selected to examine the causal effects of the proposed instructional intervention on students' physical literacy [38] [39]. The intervention was implemented over a period of eight weeks, comprising 16 class sessions conducted during regular physical education lessons.

Primary data consisted of students' physical literacy scores collected before and after the intervention. Data were obtained from students attending physical education classes. Secondary data were obtained from relevant school documents, including curriculum guidelines, lesson plans, and class profiles, to support the intervention's implementation. The data sources were students as the primary research subjects and physical education teachers as supporting informants regarding the learning implementation. Data were collected through 1) physical literacy assessment tests administered as pretests and posttests, 2) systematic observation of student participation during learning activities to ensure appropriateness of the treatment, and 3) documentation of learning activities and learning media used during the intervention.

The sample was selected based on theoretical considerations and the contextual characteristics of the research site. Junior high school students were chosen as participants because they are at a critical developmental stage during which motivation, self-confidence, and engagement in physical activity tend to decline. This condition provides an appropriate context for examining interventions aimed at enhancing physical literacy.

The sample comprised 60 junior high school students enrolled in Grades VII and VIII, aged approximately 12–14 years. It included both male and female students who were actively participating in regular physical education classes during the 2025/2026 academic year. In terms of educational background, all participants followed the same national curriculum, and none had prior structured exposure to physical literacy-based interventions or multimedia-supported physical education programs. This relatively homogeneous background contributed to ensuring comparability between groups.

Furthermore, the students were drawn from similar socio-educational environments within the same urban area, which helped to control for potential external variability. The selected schools were considered representative of a typical educational context in the region, where physical education instruction remains predominantly characterized by conventional approaches. A quasi-experimental design with cluster sampling was employed, in which intact classes were selected and assigned to experimental and control groups. This approach preserved natural classroom conditions while maintaining group comparability, as verified through pretest results.

The main research instrument was a physical literacy assessment instrument adapted from a standard physical literacy framework, covering the domains of physical competence, motivation and confidence, and knowledge and understanding [1] [13] [14], as presented in Table 1.

Table 1. Physical Literacy Framework

Domain	Indicator	Type of Test	Questionnaire / Test Indicators	Number of Items	Measurement Method	Instrument Form	Scale
Physical Competence	Locomotor skills (running, jumping, agility)	Performance test	Students demonstrate running, jumping, and agility movements correctly during physical activity tasks	3 tasks	Direct observation during skill performance	Skill performance rubric	Score 1–5
	Object control skills	Performance test	Students demonstrate throwing, catching, and kicking skills during learning activities	3 tasks	Observation checklist	Skill observation rubric	Score 1–5
	Balance and coordination	Motor skill test	Students maintain body balance during static and dynamic movement tasks	2 tasks	Balance performance test	Balance task rubric	Score 1–5
	Agility and movement control	Physical fitness test	Students perform agility movements during physical activity games	2 tasks	Motor skill assessment	Agility test rubric	Score 1–5

Motivation & Confidence	Interest in physical activity	Questionnaire	1. I enjoy participating in physical education activities. 2. Physical activity is interesting for me. 3. I like participating in traditional games during physical education lessons.	3 items	Self-report questionnaire	Likert-scale questionnaire	1–5
	Self-confidence in performing movement	Questionnaire	1. I feel confident performing movement skills in physical education class. 2. I believe I can perform physical activities well. 3. I am not afraid to try new movement skills.	3 items	Self-report questionnaire	Likert-scale questionnaire	1–5
	Enjoyment of learning activities	Questionnaire	1. Physical education activities make me feel happy. 2. Learning through traditional games is enjoyable. 3. I feel enthusiastic during physical activity lessons.	3 items	Self-report questionnaire	Likert-scale questionnaire	1–5
	Active participation	Questionnaire	1. I try to participate actively in physical education activities. 2. I complete all physical activity tasks given by the teacher. 3. I enjoy working with classmates during physical games.	3 items	Self-report questionnaire	Likert-scale questionnaire	1–5
Knowledge & Understanding	Knowledge of physical activity benefits	Cognitive test	Students identify the health and fitness benefits of regular physical activity	3 questions	Written test	Multiple choice test	Score (0–1)
	Knowledge of movement concepts	Cognitive test	Students understand basic movement concepts such as balance, coordination, and agility	3 questions	Written test	Short answer / multiple choice	Score (0–1)

Understanding of healthy lifestyle	Cognitive test	Students understand the importance of regular exercise, nutrition, and physical fitness	2 questions	Written test	Multiple choice test	Score (0–1)
Knowledge of traditional physical activities	Cognitive test	Students recognize rules and cultural values of traditional games used in the learning activities	2 questions	Written test	Multiple choice test	Score (0–1)

To ensure the quality of the research instrument, validity and reliability were systematically established before data collection. Content validation was conducted through assessments by three experts, including physical education and educational measurement experts, who assessed the relevance, clarity, and representativeness of each item based on the physical literacy framework. The expert assessments indicated that all items in the instrument were appropriate and valid. Construct validation using correlation analysis on 30 students concluded that the correlation coefficient exceeded the minimum threshold ($r > 0.30$), indicating acceptable validity. Meanwhile, the instrument’s reliability using Cronbach’s Alpha showed a coefficient of 0.86 for the overall scale, indicating high internal consistency. The reliability coefficients for each domain were also satisfactory, with values of 0.83 for physical competence, 0.88 for motivation and self-confidence, and 0.85 for knowledge and understanding. These results confirm that the instrument is valid and reliable for measuring students’ physical literacy.

The data obtained from the physical literacy assessments were analyzed using both descriptive and inferential statistical techniques. Descriptive statistics were initially employed to summarize the data, including the mean, standard deviation, minimum, and maximum scores of students’ physical literacy in both the experimental and control groups. Prior to hypothesis testing, the assumptions of normality and homogeneity were examined using the Kolmogorov–Smirnov test and Levene’s test to ensure that the data satisfied the requirements for parametric analysis.

Subsequently, an independent samples t-test was conducted to determine whether a statistically significant difference existed in physical literacy scores between students who participated in educational and recreational physical activities based on local wisdom supported by interactive multimedia and those who received conventional physical education instruction. In addition, the normalized gain (N-Gain) was calculated to assess the magnitude of improvement in students’ physical literacy before and after the intervention. To further evaluate the practical significance of the intervention, effect size was computed using Cohen’s *d*. All statistical analyses were performed at a significance level of 0.05 and were conducted using IBM SPSS Statistics (Version 25).

3. Results and Discussion

3.1 Results

The research results presented several findings related to a significant increase in physical literacy.

Table 2. Physical Literacy Index

Domain	Mean Score	Percentage Contribution	Category
Physical Competence (PC)	92.90	35%	Very High

Motivation	Confidence (MC)	94.83	36%
Very High Knowledge	Understanding (KU)	79.83	29%
High Physical Literacy Index	89.19	100%	Very High

Table 2. shows that the highest contribution to students' physical literacy came from motivation and confidence, followed by physical competence, while knowledge and understanding contributed slightly lower but remained within the high category.

Table 3. Descriptive Statistic

Variable	N	Mean	SD
Pretest Physical Literacy	60	58.27	7.02
Posttest Physical Literacy	60	92.90	4.06

Table 3 shows that the average post-test score increased substantially compared to the pre-test. Thus, it indicates there was a significant improvement after the intervention.

Table 4. Descriptive Statistic

Variable	Pretest Mean	Posttest Mean	N-Gain	Category
Physical Literacy	58.27	92.90	0.83	High

Table 4 shows that the N-Gain value of 0.83 falls within the high improvement category, demonstrating that the learning intervention was highly effective in improving students' physical literacy.

Table 5. Independent Sample t-Test

Variable	Mean Difference	t-value	Sig. (p)	Interpretation
Physical Literacy Score	34.63	18.74	0.000	Significant

Table 5 shows that the significance value $p < 0.05$ indicates that the difference between pretest and posttest scores is statistically significant.

Figure 1 presents a comparison of students' physical literacy scores before and after the intervention. The graph shows a significant increase in students' physical literacy scores after the treatment. This indicates that the learning approach used was quite effective. Students in the experimental group experienced a higher increase compared to the control group. Thus, it can be concluded that the integration of local wisdom-based physical education and recreation activities supported by interactive multimedia significantly contributed to improving students' physical literacy. Overall, Figure 1 demonstrates that the intervention had an impact on strengthening students' physical literacy.

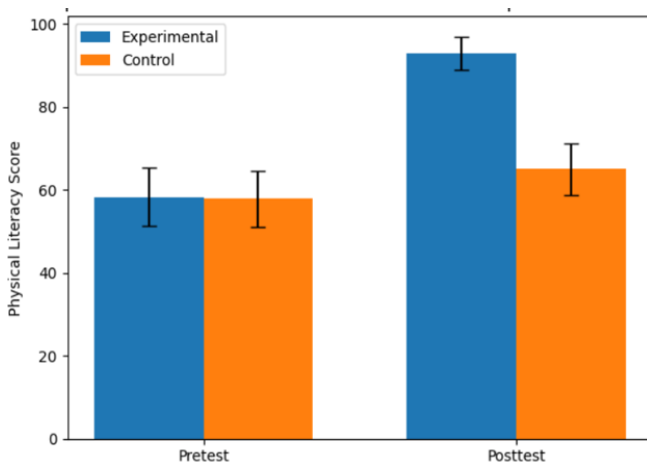


Figure 1. Improving Students' Physical Literacy Score Between Pre-test and Post-test

Table 6. Effect Size Analysis (Cohen's d)

Variable	Pretest Mean	Posttest Mean	SD Pooled	Cohen's d	Effect Size Category
Physical Literacy	58.27	92.90	5.74	6.03	Very Large

Table 6 shows the effect size value of Cohen's $d = 6.03$ indicates a very large effect, suggesting that the educational and recreational physical activities based on local wisdom supported by interactive multimedia had a substantial impact on students' physical literacy development.

The results of this study were derived from the analysis of students' physical literacy scores before and after the implementation of educational and recreational physical activities based on local wisdom supported by interactive multimedia. The descriptive statistics revealed that the mean pretest score of students' physical literacy was 58.27 ($SD = 7.02$), which increased substantially to 92.90 ($SD = 4.06$) in the posttest. This result indicates a significant improvement in students' physical literacy following the intervention.

Further analysis using the normalized gain (N-Gain) produced a value of 0.83, which falls into the significant improvement category, indicating that the learning intervention was highly effective in enhancing students' physical literacy. The physical literacy index analysis also showed that the domain of motivation and confidence contributed the largest proportion (36%), followed by physical competence (35%), while knowledge and understanding accounted for 29% of the overall physical literacy score. In addition, the statistical test demonstrated a significant difference between the pretest and posttest scores ($p < 0.05$). These findings confirm that educational and recreational physical activities based on local wisdom supported by interactive multimedia significantly improved students' physical literacy.

3.2 Discussion

The findings of this study indicate that students' physical literacy significantly improved through educational and recreational physical activities based on local wisdom implemented using interactive multimedia. This means that physical activities relevant to culture and local wisdom values, implemented using digital technology, provide students with meaningful learning experiences aligned

with real-life realities. Thus, there was an increase in students' physical competence, motivation, and understanding of movement activities during the learning process. [40] [41] These findings reinforce the notion that physical literacy is a multidimensional concept involving physical competence, motivation and self-confidence, as well as knowledge and understanding that support lifelong engagement in physical activity. [42] [43] The integration of local wisdom values provides insight into the formation of students' character. [44]

Another study even concluded that physical literacy in Indonesia is being studied, including measuring physical literacy and developing physical literacy instruments in elementary schools, using learning approaches to improve physical literacy, and incorporating the concept of physical literacy in Physical Education. This means that these findings also provide a new contribution to physical literacy among junior high school students. [45] Furthermore, this study examines the improvement of students' physical literacy, relevant to the theoretical concept that meaningful movement learning plays a role in developing students' motivation and competence during physical activity. According to Whitehead's concept of physical literacy, individuals who develop competence, confidence, and understanding in movement are more likely to participate in physical activity throughout their lives [46] [47]. It is supported by research showing that physical literacy significantly contributes to students' active participation in physical activity and promotes long-term healthy lifestyles. Therefore, learning environments that provide engaging and meaningful movement experiences can support the development of students' physical literacy in the school setting [48] [49].

A key component of this research is integrating local wisdom into physical education learning. Integrating cultural values into learning activities provides a learning concept that is contextual and relevant to students' lives. Another study concluded that culturally integrated physical education learning can improve students' motivation, participation levels, and sense of ownership in the learning concept [24] [50]. Therefore, learning materials based on local wisdom can offer an alternative, authentic material because they are relevant to students' real-life contexts. This suggests that culturally contextualized learning experiences help students connect movement activities to their social and cultural environments, thereby strengthening learning outcomes and cultural awareness [51] [52].

Furthermore, interactive multimedia provides visual, auditory, and interactive elements that make learning more engaging and accessible to students. Moreover, today's digital technology developments are easily accessible and usable, thus increasing student engagement, understanding, and retention of learning [53] [54] [55] [56]. These findings suggest that digital integration in physical education is a pedagogical innovation and effective in physical education teaching. The use of digital learning tools allows teachers to provide clearer movement demonstrations, interactive explanations, and direct feedback to students. Consequently, multimedia-based learning environments can help students better understand physical activity concepts and increase their confidence in performing movement skills. In this context, combining cultural learning approaches with digital media is an innovative strategy that aligns with current trends in educational innovation and digital pedagogy.

However, many physical literacy studies reveal gaps in the existing literature. Furthermore, other studies have focused more on assessing students' physical literacy levels and their participation in physical activity. Cultural values and learning media have also been examined separately. However, limited research has explored the combined integration of local wisdom-based physical activity and interactive multimedia as a comprehensive instructional approach to improving students' physical literacy [57] [58] [59].

Therefore, the novelty of this study lies in the integration of three essential components of physical education: educational and recreational physical activities, a cultural context grounded in local wis-

dom, and the use of interactive multimedia. By synthesizing these elements, this study proposes an innovative instructional model that not only enhances students' physical literacy but also reinforces cultural relevance and the integration of technology within physical education. This integrated approach contributes to the advancement of pedagogical strategies in physical education and offers new insights into how culturally responsive and technology-enhanced learning environments can support students' holistic development.

Overall, the findings of this study suggest that the integration of culturally contextualized physical activity and interactive multimedia can be an effective strategy for improving students' physical literacy. The approach supports meaningful learning experiences that simultaneously develop students' physical competencies, motivation, and understanding of physical activity while preserving cultural values and utilizing modern educational technology.

The findings of this study provide important implications for physical education practice. Physical education teachers are encouraged to integrate local wisdom into learning activities to make the learning process more contextual, meaningful, and culturally relevant for students. In addition, the use of interactive multimedia can support more innovative and engaging learning experiences, which may increase students' motivation and participation in physical education. Schools and curriculum developers may also consider incorporating local culture-based physical activities and digital learning media as part of strategies to improve students' physical literacy.

Future research is recommended to involve a larger and more diverse sample from different regions to examine the broader applicability of this learning approach. Further studies may also explore the long-term effects of educational and recreational physical activities based on local wisdom on students' physical literacy and physical activity behavior. In addition, future researchers are encouraged to develop more advanced interactive multimedia learning tools and investigate their effectiveness in different educational contexts and age groups.

This study has several limitations, including a relatively small sample size, a quasi-experimental design without randomization, and a short intervention duration, which may limit the generalizability of the results. Furthermore, the results of the unusually large effect size measurement must be considered to ensure sufficient validity without misinterpreting the low variability after the intervention. These limitations can serve as guidelines for future researchers to further develop this study and expand it to student achievement.

Although previous research has widely reported the positive effects of culturally relevant physical activity and multimedia integration on student engagement and learning outcomes, some studies have shown that the impact of interventions is influenced by contextual factors such as teacher readiness, technology access, and student characteristics. The results of this study indicate that digital media in physical education learning can have a significant impact on student achievement when supported by a well-structured pedagogical design. This suggests that the effectiveness of current interventions may also be influenced by the specific implementation context and the quality of instruction.

4. Conclusion

This study demonstrates that the implementation of educational and recreational physical activities based on local wisdom, supported by interactive multimedia, exerts a statistically significant positive effect on students' physical literacy. The findings indicate a marked improvement in students' physical literacy scores, as evidenced by the increase in the mean score from 58.27 in the pretest to 92.90 in the posttest, alongside a high N-Gain value of 0.83, indicating a high level of effectiveness. The intervention also produced a very large effect size (Cohen's $d = 6.03$), further confirming the

strong practical impact of the proposed learning model.

Moreover, the results reveal that the domains of motivation and confidence and physical competence contributed most significantly to the overall physical literacy development, while knowledge and understanding also improved within a high category. These findings suggest that the integrated instructional approach effectively supports the multidimensional nature of physical literacy, encompassing affective, physical, and cognitive domains. Overall, the study confirms that combining culturally relevant physical activities with interactive multimedia creates a more meaningful, engaging, and contextually relevant learning environment in physical education, thereby enhancing students' holistic development.

The findings of this study have important theoretical and practical implications. Theoretically, this study contributes to the advancement of physical literacy research by providing empirical evidence for an integrated instructional model that combines cultural relevance and technology-enhanced learning. It extends existing physical literacy frameworks into the Indonesian context, particularly at the junior high school level.

Practically, the results suggest that physical education teachers should incorporate local wisdom-based activities into their instructional practices to create more contextualized and meaningful learning experiences. The integration of interactive multimedia can further enhance student engagement, understanding, and motivation. For schools and curriculum developers, this study provides a viable model for designing culturally responsive and technology-supported physical education programs aimed at improving students' physical literacy outcomes.

Despite its contributions, this study has several limitations. First, the sample size was relatively small ($N = 60$) and limited to three junior high schools within a single urban area, which may restrict the generalizability of the findings. Second, the use of a quasi-experimental design without random assignment may introduce potential bias and limit causal inference. Third, the duration of the intervention (eight weeks) was relatively short, which may not fully capture the long-term impact of the instructional model on students' physical literacy development. Additionally, the exceptionally large effect size observed in this study should be interpreted with caution, as it may be influenced by limited variability in posttest scores or specific contextual factors related to the implementation setting.

Future research is recommended to involve larger and more diverse samples across different regions and educational contexts to enhance the generalizability of the findings. Longitudinal studies are also needed to examine the sustainability of the intervention's effects on students' physical literacy and their long-term physical activity behaviours. Furthermore, future studies should explore the effectiveness of this integrated model across different age groups and educational levels, as well as investigate the role of moderating variables such as teacher competence, access to technology, and school resources. Researchers are also encouraged to develop and test more advanced and adaptive interactive multimedia tools to further optimize learning outcomes in physical education.

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