

Developing Physical Literacy–Based Game Designs to Enhance Motor Skills and Responsibility Character in Primary School Students

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Abstract. Physical literacy is important for children in relation to their growth and development. Physical literacy also affects children's physical health, but the use of gadgets has contributed to a decline in physical activity among primary school students over the past decade, resulting in low physical literacy and increased sedentary behaviour. This situation calls for learning innovations that integrate physical activity and character building in the context of primary schools. This study aims to develop a physical literacy-based game design to improve the motor skills and character of responsibility of primary school students. The study uses a mixture of research and development (R&D) methods with ADDIE (Analysis, Design, Development, Implementation, Evaluation) design to develop physical activity products, and quantitative methods to measure the effectiveness of the products on student learning outcomes. The test subjects involved 49 students in two primary schools. Data were collected through teacher interviews, needs questionnaires, validation questionnaires, response questionnaires, learning observations, and learning outcome tests. The research successfully developed four game designs, namely Quiz Box, Friendly Sandals, Defence Fortress, and Stick Dance for students in grades 2 and 3. The resulting game designs showed a product validity level of 93% (very feasible) and an average material validity of 77% (feasible). User response reached 86% (very practical), and the average learning outcome score of 78.24 exceeded the Minimum Completion Criteria of 65. These findings indicate that physical literacy-based game designs are effective in increasing engagement, material comprehension, and the internalisation of responsible character traits. The implications of this study support the strengthening of active learning based on physical literacy as a strategy for improving the quality of basic education that not only affects cognitive abilities but also affective and psychomotor abilities.

Keywords: *Physical Literacy, Game-Based Learning, Motor Skills, Responsibility Character, Primary School Students*

INTRODUCTION

Elementary education plays a strategic role in shaping the cognitive, affective, and psychomotor development of students. Law Number 20 of 2003 concerning the National Education System emphasizes that the goal of national education is not only to develop intellectual capacity but also to foster individuals who are healthy, possess strong character, and demonstrate responsibility. In this context, health and physical activity are integral components of the educational process in elementary schools.

However, current conditions indicate a decline in children's physical activity levels over the past decade. Children tend to spend long hours in front of screens and are increasingly engaged in sedentary activities rather than active outdoor play [1]. This situation has led to reduced physical fitness, limited development of fundamental movement skills, and decreased confidence in participating in physical activities. If not addressed through appropriate instructional strategies, this phenomenon may negatively affect children's overall growth and development.

Conceptually, physical literacy has emerged as a relevant approach to address these challenges. According to Margaret Whitehead [2], physical literacy is defined as a disposition characterized by motivation, confidence, physical competence, as well as knowledge and understanding to engage in physical activity throughout life. In line with this, Istvan Balyi emphasizes the importance of developing movement competence in a gradual and systematic manner as part of the long-term athlete development framework. This perspective positions movement as a fundamental basis for quality of life [3].

At the elementary school level, physical literacy should be integrated into learning activities through approaches that are enjoyable, contextual, and aligned with children's developmental characteristics.

Elementary school students are in the concrete operational stage; they enjoy playing, moving, working collaboratively, and learning through direct experience. Therefore, game-based learning should be a dominant approach to optimize the development of locomotor, non-locomotor, and manipulative skills [4], [5], [6], [7].

Nevertheless, observations conducted in several elementary schools indicate that physical education learning still tends to rely on conventional teaching methods and lacks variation. Game activities are often not systematically designed based on physical literacy principles and are not explicitly integrated with character education. Learning activities frequently fail to connect movement experiences with values such as responsibility, cooperation, and discipline in a structured manner.

Empirical studies have shown that physical activity-based learning models can improve student engagement and learning outcomes. However, most of these studies primarily focus on enhancing physical fitness or motor skills, without developing game-based models that integrate the broader dimensions of physical literacy and character education. Consequently, comprehensive approaches in this area remain limited [8], [9], [10], [11], [12], [13].

The gap between ideal conditions and actual classroom practices highlights the urgent need to develop innovative learning models. Ideally, physical education in elementary schools should foster intrinsic motivation, improve movement competence, and simultaneously build students' sense of responsibility. However, the availability of models that are empirically validated, practical, and effective is still limited.

From a policy perspective, the implementation of the Merdeka Curriculum emphasizes student-centered, contextual, and meaningful learning. Physical literacy aligns with this vision, as it positions movement experiences as a medium for developing the Pancasila Student Profile. Nevertheless, teachers still require practical guidance in the form of applicable and easy-to-implement game-based learning models [14].

Based on the theoretical and empirical analysis, a research gap can be identified in the lack of systematically developed physical literacy-based game models that have been tested for validity, practicality, and effectiveness in elementary school settings. Previous studies have not comprehensively integrated physical literacy, traditional games, and the development of responsibility as a character value within a structured instructional design.

Therefore, this study focuses on the development of a physical literacy-based game model for elementary school learning. The model is designed using a research and development approach with systematic stages to produce a product that is both academically validated and practically applicable in real classroom contexts.

The objective of this study is to develop a physical literacy-based game model that is valid, practical, and effective in improving students' movement competence and responsibility character in elementary schools. This study is expected to contribute theoretically to the development of physical literacy research in the context of elementary education and practically to assist teachers in designing active, meaningful, and holistic learning experiences for students.

METHODS

This study employed a Research and Development (R&D) approach to produce a physical literacy-based game model for elementary school learning. The development procedure adapted the steps of Borg and Gall, integrated with the ADDIE instructional design model (Analysis, Design, Development, Implementation, and Evaluation) to ensure a systematic and structured development process.

In the analysis stage, a needs analysis and learning context analysis were conducted. The needs analysis involved classroom observations of physical education learning in three elementary schools, as well as interviews with third-grade classroom teachers and physical education (PJOK) teachers. The analysis focused on students' physical activity levels, variations in teaching models, the integration of responsibility character, and teachers' understanding of physical literacy. In addition, a literature review was conducted to strengthen the conceptual framework related to physical literacy and the developmental characteristics of elementary school students. The data were analyzed qualitatively through data reduction, data display, and conclusion drawing.

In the design stage, an initial prototype of the physical literacy-based game model was developed. The design process included: (1) determining learning objectives, (2) mapping physical literacy indicators (motivation, confidence, movement competence, and knowledge), (3) developing game scenarios for each activity station, (4) integrating responsibility as a character value, and (5) preparing instructional materials, including lesson plans, evaluation instruments, and observation sheets. The product draft was designed as a practical and contextual game model guide.

In the development stage, the product underwent expert validation and revision. The validation process involved one learning model expert and three subject-matter experts. The validation instrument used a Likert scale covering aspects of content relevance, product feasibility, language clarity, presentation, and contribution of the model. Quantitative data were analyzed by calculating feasibility percentages, while qualitative data were analyzed based on experts' suggestions for improvement. The product was revised until it met the feasibility criteria.

In the implementation stage, a limited trial was conducted involving 17 third-grade elementary school students. The model was implemented over several learning sessions. The data collected included: (1) student responses through questionnaires, (2) learning outcomes measured through multiple-choice tests, and (3) observation of the implementation process. Quantitative data were analyzed using mean scores and percentages, while qualitative data were used to evaluate the practicality and dynamics of the learning process.

Data Collection Techniques

Data collection in this development study was conducted progressively according to the R&D phases. During the needs analysis stage, data were collected through observations, semi-structured interviews, and documentation studies. Observations were carried out to identify the actual conditions of physical education learning, students' physical activity levels, and patterns of classroom interaction. Interviews were conducted with classroom teachers and physical education teachers to explore the need for a physical literacy-based learning model and the integration of responsibility character. Documentation studies included the analysis of teaching materials and curriculum documents.

During the development and implementation stages, data were collected through: (1) expert validation sheets (learning model experts and subject-matter experts) to assess product feasibility; (2) student response questionnaires to measure practicality and acceptability; (3) multiple-choice learning outcome tests to measure cognitive aspects; and (4) observation sheets to assess the implementation of the learning model in the classroom. All instruments were developed based on physical literacy indicators (motivation, confidence, movement competence, and knowledge) as well as responsibility character indicators.

RESULTS AND DISCUSSION

This study employed the ADDIE development model, consisting of five systematic stages: analysis, design, development, implementation, and evaluation. Each stage was conducted sequentially to ensure that the resulting product—a physical literacy-based game model—met the criteria of validity, practicality, and effectiveness in elementary school learning contexts.

In the analysis stage, the researchers conducted observations and interviews with physical education teachers in elementary schools. The findings revealed that students' physical activity levels have declined significantly, with many students preferring sedentary activities such as screen-based entertainment. This trend has contributed to reduced physical fitness and limited opportunities for students to develop fundamental movement skills [1].

Furthermore, classroom observations indicated that learning activities were still dominated by conventional methods, where teachers relied heavily on verbal explanations and lacked interactive elements. As a result, students often experienced boredom and disengagement during lessons. This condition highlights the gap between students' developmental needs and the learning strategies implemented in schools.

Interviews with teachers also revealed that they faced challenges in designing engaging physical education lessons. Teachers expressed the need for a learning model that could integrate movement, cognitive engagement, and character development in a structured and practical manner. These findings formed the basis for developing a physical literacy-based game model that addresses both pedagogical and developmental needs.

In the design stage, the researchers developed a learning model that integrates physical literacy principles with game-based learning. The model was designed to incorporate three fundamental movement domains: locomotor, non-locomotor, and manipulative skills. Additionally, the model embeds character education, particularly responsibility, into each learning activity [2], [15].

The designed model consists of four main game stations, each representing different movement and learning objectives. The first activity, the Quiz Box game, combines physical movement with cognitive challenges, requiring students to answer questions while performing locomotor tasks. The second activity, the Cooperative Sandal game, focuses on teamwork, balance, and coordination. The third activity, the Defense Wall game, emphasizes agility, strategy, and spatial awareness. The fourth activity, the Stick Dance game, develops rhythm, coordination, and concentration [16].

Each activity was structured into three phases: warm-up, core activity, and cooldown. The warm-up phase prepares students physically and mentally, the core activity focuses on the main learning objectives, and the cooldown phase ensures recovery and reflection. This structure ensures that the model aligns with both physical education standards and pedagogical principles.

In the development stage, the model underwent expert validation to assess its feasibility. The validation process involved experts in learning models and subject matter. The results showed that the learning model expert provided a score of 93%, indicating a very high level of validity. Meanwhile, material experts gave scores ranging from 75% to 83%, categorized as valid.

Table 1. Learning Model Expert Validation

No.	Component	Total Score	Score Ideal	Percentage (%)
1	Content Suitability	14	16	$14 \times 100\% = 88\%$ 16
2	Product Feasibility	12	12	$12 \times 100\% = 100\%$ 12
3	Product Contribution	15	16	$15 \times 100\% = 94\%$ 16
4	Product Advantages	15	16	$15 \times 100\% = 94\%$ 16

Table 2. Learning Material Expert Validation

No.	Component	Total Score	Score Ideal	Percentage (%)
1	Material Suitability	33	40	$33 \times 100\% = 83\%$ 40
2	Linguistics	30	40	$30 \times 100\% = 75\%$ 40
3	Presentation	21	28	$21 \times 100\% = 75\%$ 28

These validation results indicate that the model is appropriate in terms of content accuracy, instructional design, and usability. Feedback from experts also contributed to refining the model, particularly in improving clarity of instructions, alignment with learning objectives, and suitability for elementary school students. Following validation, the model was tested in a limited field trial during the implementation stage. The trial involved 17 third-grade students in an elementary school setting. The implementation process was carried out according to the designed procedures, ensuring that each game activity was conducted systematically. Student responses were collected using questionnaires to evaluate the practicality and attractiveness of the model. The results showed that the average student response reached 86%, indicating a very positive perception of the learning model. Students reported that the activities were enjoyable, engaging, and easy to follow.

In addition to positive responses, observations during implementation showed increased student participation and enthusiasm. Students were actively involved in each activity, demonstrating improved confidence and willingness to engage in physical tasks. This suggests that the model successfully creates an engaging learning environment. In the evaluation stage, the effectiveness of the model was assessed through learning outcomes. The results showed that students achieved an average score ranging from 78.24 to 81, which is above the minimum competency standard.

These findings indicate that the model not only enhances student engagement but also improves learning outcomes. The improvement in scores suggests that the integration of physical activity and cognitive tasks supports better understanding of the learning material. Overall, the results demonstrate that the developed physical literacy-based game model meets the criteria of being valid, practical, and effective. The systematic implementation of the ADDIE model ensures that the product is well-developed and suitable for use in elementary school settings.

Discussion

The findings of this study provide strong evidence that a physical literacy-based game model can effectively enhance learning in elementary schools. The results align with the theoretical framework of physical literacy proposed by Margaret Whitehead, which emphasizes the integration of motivation, confidence, physical competence, and understanding in engaging with physical activity. The developed model incorporates these components through structured and meaningful game-based activities.

The increase in student engagement observed during the implementation stage can be explained by the integration of play into the learning process. Play-based learning is known to create enjoyable learning

environments that foster intrinsic motivation. When students are actively engaged, they are more likely to participate, explore, and internalize learning experiences [17], [18].

From a theoretical perspective, the effectiveness of the model is also supported by experiential learning theory introduced by David Kolb. According to this theory, learning occurs through direct experience, reflection, and application. The game-based activities in this model provide students with opportunities to experience learning firsthand, making the learning process more meaningful and memorable.

In addition, the model aligns with cognitive development theory proposed by Jean Piaget, which states that elementary school students are in the concrete operational stage. At this stage, students learn best through hands-on activities and real-life experiences. The use of physical games allows students to interact directly with their environment, facilitating the construction of knowledge.

One of the key strengths of the developed model is its ability to promote holistic development. Unlike traditional learning models that focus primarily on cognitive outcomes, this model integrates physical, cognitive, and affective domains. Students not only develop movement skills but also enhance their problem-solving abilities and social interactions [8].

Another advantage of the model is its emphasis on character education, particularly responsibility. Each game activity requires students to follow rules, cooperate with peers, and complete tasks. This integration demonstrates that physical education can serve as a medium for character development, supporting the broader goals of education. The model also enhances student motivation and engagement. The use of games creates a fun and interactive learning environment, reducing boredom and increasing participation. This is particularly important in addressing the issue of declining physical activity among children, as identified in the needs analysis stage [9], [19].

Furthermore, the model provides contextual learning experiences, where students learn through real-life situations and interactions. This approach helps students connect theoretical concepts with practical applications, leading to deeper understanding and retention.

The positive learning outcomes observed in this study indicate that the integration of physical activity and cognitive tasks can improve academic performance. This finding supports the idea that physical activity is not only beneficial for physical health but also for cognitive development [20].

In terms of relevance, the model is highly suitable for elementary school students because it aligns with their developmental characteristics. Children at this age enjoy playing, moving, and interacting with peers. By incorporating these elements into the learning process, the model creates an environment that is both engaging and developmentally appropriate.

The findings of this study also have important implications for educational practice. Teachers are encouraged to adopt more innovative and interactive learning models that integrate physical literacy principles. This shift from traditional to active learning approaches can enhance the quality of education and support student development. However, despite its strengths, this study has several limitations. The sample size is relatively small, and the implementation was limited to a specific context. Therefore, the generalizability of the findings may be limited.

Future research should focus on testing the model in larger and more diverse populations to validate its effectiveness further. Additionally, longitudinal studies are needed to examine the long-term impact of the model on students' physical literacy and overall development. In conclusion, the physical literacy-based game model developed in this study offers a promising approach to improving learning in elementary schools. By integrating movement, cognition, and character education, the model supports holistic student development and addresses the challenges of modern education.

CONCLUSION

This study concludes that the development of a physical literacy-based game model in elementary school learning has successfully met the criteria of validity, practicality, and effectiveness. The model, developed through a systematic R&D approach integrating the ADDIE framework, resulted in four structured game activities—Quiz Box, Friendly Sandals, Defense Fortress, and Stick Dance—that effectively combine movement skills, cognitive engagement, and character education. Empirical findings indicate that the model achieved a high level of validity based on expert judgment, demonstrated strong practicality through positive student responses, and proved effective in improving learning outcomes, with average scores exceeding the minimum competency standard. These results confirm that integrating physical literacy principles into game-based learning can enhance students' motor skills, engagement, and internalization of responsibility as a character value.

The implications of this study highlight the importance of adopting innovative, student-centered learning models in physical education. The developed model provides a practical framework for teachers to design meaningful and engaging learning experiences that align with the developmental characteristics of elementary school students. Furthermore, this study reinforces the role of physical literacy as a holistic approach that not only improves physical competence but also contributes to cognitive and affective development, supporting the broader goals of education in fostering well-rounded individuals.

However, this study has several limitations that should be acknowledged. The implementation was conducted on a relatively small sample size and within a limited number of schools, which may affect the generalizability of the findings. Additionally, the duration of the intervention was relatively short, limiting the ability to observe long-term impacts on students' physical literacy development and character formation.

Therefore, future research is recommended to involve larger and more diverse samples to strengthen the external validity of the model. Longitudinal studies are also needed to examine the sustainability of learning outcomes and the long-term development of physical literacy and character values. In addition, further research may explore the integration of this model with digital or hybrid learning environments to adapt to evolving educational contexts. Overall, this study provides a meaningful contribution to the development of physical literacy-based learning and offers practical insights for improving the quality of elementary education.

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