

Developing Thematic-Based Physical Activity Models to Enhance Physical Literacy in Early Childhood

Asep Suherman^{✉1}, Adang Suherman², Tife Juliantine³ & Agus Mahendra⁴

¹ Department of Physical Education, Health, and Recreation, Universitas Singaperbangsa Karawang, Karawang, Indonesia

^{2,3,4} Sports Education Postgraduate School, Universitas Pendidikan Indonesia, Bandung, Indonesia

✉ asep.suherman@fkip.unsika.ac.id

Abstract. This study aims to develop a thematic-based physical activity model to improve physical literacy in early childhood and to test its effectiveness. The method used is research and development (R&D) following the ADDIE procedure, which includes analysis, design, development, implementation, and evaluation stages. The research sample consisted of 41 children aged 4-5 years. Instruments used were a needs analysis questionnaire, validation questionnaires from experts on the physical activity model and physical literacy, a learning module validation questionnaire, and a physical literacy observation sheet. The findings show that the developed model is very good. The effectiveness test using a pre-experimental design showed a significant improvement in children's physical literacy, with an average pretest score of 68.2 and posttest score of 89, and an N-gain score of 0.52 (moderate category). Interview results indicated a positive impact of the model on children's holistic development, including increased confidence, cooperation, and motivation for physical activity, despite challenges such as limited facilities, classroom management, and children's egocentric attitudes. In conclusion, the thematic-based physical activity model is feasible for use in learning and effective in improving physical literacy in early childhood. According to these findings, early childhood educators can improve children's physical, psychological, social, and cognitive development by incorporating thematic physical activities. They can also promote its inclusion in national literacy policies.

Keywords: Early Childhood; Physical Activity Model; Physical Literacy; Thematic

1. Introduction

Early childhood is a critical period in human development due to rapid growth, especially in physical and motor aspects (Wujiati & Mutohir, 2019). Physical activity in early childhood not only enhances physical health but also plays a crucial role in developing fundamental motor skills, which form the foundation for more complex motor skills later. Additionally, adequate physical activity improves cognitive functions such as concentration and problem-solving, vital for learning (Cairney et al., 2019; Crumbley et al., 2020; Dobell et al., 2020; Haugland et al., 2023). Therefore, stimulating physical activity from an early age is essential to support optimal child development.

However, many young children currently lack adequate physical activity stimulation. Environmental factors, parenting styles, and limited facilities are major causes of low physical activity (Sujarwo et al., 2024). Rapid technological development and easy access to electronic devices cause children to spend more time in sedentary activities like watching TV or playing gadgets (Capio et al., 2021). This negatively impacts motor development and overall health, increasing risks of obesity and motor development disorders (Knaier et al., 2023).

Parents and educators play a crucial role in addressing low physical activity in early childhood by modeling active behavior, providing time and space for active play, and motivating children (Ruedl et al., 2021; Telford et al., 2021). However, many parents and educators still do not fully understand the importance of physical activity or how to effectively integrate it into daily activities (Lei et al., 2023). Data show only a small portion of children aged 2-6 meet the

recommended minimum of 60 minutes of moderate to vigorous physical activity daily (Guthold et al., 2020; Leppänen et al., 2019).

In early childhood education, physical literacy is gaining global attention as a vital foundation for lifelong healthy and active living (Barratt et al., 2024; Fortnum et al., 2025). Physical literacy includes motor skills, motivation, knowledge, and confidence in physical activity (Barratt et al., 2024; Fortnum et al., 2025; Rutkauskaite et al., 2024). Early childhood education is critical for preparing children to be physically literate, as good motor and physical literacy development helps children perform better academically, have good social skills, and reduce obesity risk (Higgs et al., 2019). Hence, developing physical literacy early should be an integral part of early childhood curriculum and practice.

Although the importance of physical literacy is widely recognised, existing interventions are often still not comprehensive or do not holistically cover the four domains of physical literacy (physical, psychological, social, and cognitive), and frequently face significant implementation challenges, including teacher competency gaps and resource limitations (Surya et al., 2025; (Martins et al., 2023; Weir et al., 2024). These limitations are further exacerbated by traditional or non-thematic teaching approaches in physical education, which may be less integrated, not always relevant to the developmental context of young children, and often fail to inspire lifelong active participation, especially when taught by non-specialist teachers who may have limited training (Mainsbridge et al., 2024, Nioda & Tagare, 2024, Syed Yahya et al., 2024).

The thematic approach offers an innovative solution for developing more meaningful and integrated physical activity models. This approach enables holistic learning by integrating various aspects of development and subjects into a context relevant to children's world, thereby enhancing motor, cognitive, and socio-emotional skills synergistically (Cherni, 2021, Andriadi & Saputra, 2021, Adi et al., 2022).

1.1. Problem Statement

Given the importance of physical literacy for holistic human development in early education, policymakers should emphasize and support physical literacy through early childhood education programs that encourage daily active play such as running, jumping, climbing, dancing, and skipping rope. Promotion of physical literacy must be a key feature of all physical education curricula in early childhood education (UNESCO, 2015). However, unlike other literacy policies in Indonesia, physical literacy has not been integrated into national literacy policy through physical education learning in schools. The National Literacy Movement focuses on six literacies: (1) language, (2) numeracy, (3) science, (4) digital, (5) financial, and (6) cultural and citizenship. The movement implements three activities: habituation (reading exercises, daily journals, text-rich environment), development (enrichment activities to improve reading skills), and learning (strengthening literacy through education) (Friskawati et al., 2023).

The Sport Development Index (SDI) reported an increase in physical literacy scores from 2021 to 2022 (Mutohir et al., 2021), but data do not yet show improvements in physical literacy for early childhood. Other reports indicate Indonesian preschool children have low motor competence, requiring appropriate programs to improve motor skills and support physical literacy development (Bakhtiar et al., 2020). Measurement data on physical literacy is essential to support early childhood development and help educators and practitioners identify when and where to intervene to develop specific domains and elements of physical literacy. Current reports do not strongly reflect early childhood physical literacy conditions to form a basis for intervention in active movement habits in early childhood education (Friskawati et al., 2023). Many young children lack adequate physical activity stimulation due to facility limitations, parenting, and technology promoting sedentary behavior. Physical literacy, a crucial foundation for active and healthy lifestyles, is not yet optimally integrated into early childhood education. Therefore, developing thematic-based physical activity models suited to early childhood characteristics is needed to improve physical literacy.

Unfortunately, in Indonesia, physical literacy is not yet part of the national literacy policy, which focuses more on language, numeracy, science, digital, financial, and cultural literacy

(Friskawati et al., 2023). This gap highlights the need for appropriate interventions to improve physical literacy in early childhood through holistic and integrated learning approaches.

1.2. Related Research

Several studies have focused on developing physical literacy and interventions within the context of early childhood education. For instance, Weir et al. (2024) explored the knowledge and beliefs about physical literacy (PL) and physical activity (PA) among children aged 3-5, investigating key questions regarding its importance, current practices, and implementation barriers. Their findings highlight the need for a holistic approach to interventions and evidence-based practices to promote PL in young children.

Another study by Fang et al. (2025) focused on parental physical literacy, revealing how it positively influences children's physical literacy and fitness levels. Furthermore, Leung et al. (2023) found that early childhood educators' perceived PL correlated moderately with their self-efficacy and professional competence in conducting physical activities.

In addition, several studies have explored the integration of thematic approaches in early childhood education. Kristina et al. (2025) investigated the role of play in early childhood education using a holistic approach, finding that play significantly enhances critical thinking, social skills, and physical health. Adi et al. (2022) developed a thematic game using an R&D method, demonstrating that this type of game is viable, practical, and effective for use in first-grade physical education classes with the theme "My Hobbies." It was also shown to be effective in improving student learning outcomes.

A study by Li & Cheong (2023) utilized the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) instructional design model to guide the development of a functional training program. After its development, the program was implemented and evaluated. The results showed that the program successfully engaged students and significantly improved their physical fitness. The study concluded that functional exercises are useful for enhancing physical fitness in elementary school students and provides a reference for integrating them into the physical education curriculum.

Based on these studies, there is a clear urgency for developing a holistic physical literacy in early childhood, one that encompasses physical, psychological, social, and cognitive domains. However, existing research consistently identifies significant gaps in comprehensive interventions. These interventions are often limited to the physical aspects and are not sufficiently responsive to cultural contexts or the practical needs of educators. Challenges in teacher competency and the lack of structured pedagogical models are also major obstacles to effective implementation.

Overall, the unique contribution of this research lies in its systematic effort to create and validate a holistic, integrated, and theme-based physical literacy intervention. This is supported by a robust R&D methodology specifically tailored for the context of early childhood education in Indonesia.

1.3. Research Objectives

Many early childhoods have not received adequate physical activity stimulation due to limited facilities, parenting styles, and technological developments that trigger sedentary activity. Physical literacy, as an important foundation for an active and healthy lifestyle, has not been optimally integrated into early childhood education. Therefore, it is necessary to develop a learning model that suits the characteristics of early-age children, allowing their overall development to progress. Based on this background, this study formulates five main questions:

1. How are the learning needs of early childhood related to the development of a thematic-based physical activity model to improve physical literacy in early childhood?
2. How is the design of a thematic-based physical activity model to improve physical literacy in early childhood?

3. How is the process of developing a thematic-based physical activity model to improve physical literacy in early childhood?
4. How is the implementation of a thematic-based physical activity model to improve physical literacy in early childhood?
5. How is the effectiveness of a thematic-based physical activity model to improve physical literacy in early childhood?

2. Theoretical Framework

2.1. Physical Activity

Physical activity is any bodily movement involving skeletal muscles that expends energy (Fynmore, 1902). It is fundamental for improving physical and mental health (Kumar et al., 2015). Physical activity includes exercise, household chores, leisure sports, and dancing (Corbin et al., 2000). The Indonesian Ministry of Health defines physical activity as bodily movement that increases energy expenditure (Depkes RI, 2012). Physical activity contributes to children's physical, social, emotional, linguistic and cognitive development (Naghipourgivi et al., 2024). physical activity can be defined as any limb movement that can increase energy production hhat involves all body movements such as sitting, getting up, walking, and jumping whether for exercise, recreation, or competition purpose and to improve an individual's health status, a person must be physically active, requiring that individual fitness can be improved overall (Zain et al., 2021).

2.2. Physical Literacy

The concept of physical literacy, as popularized by Margaret Whitehead in (Durden-Myers, 2024), defines a physically literate individual as someone who possesses motivation, self-confidence, physical competence, knowledge, and understanding that together support physical activity throughout their life. This framework of physical literacy is multidimensional and holistic, encompassing the integration of four main domains (Naghipourgivi et al., 2024): (1) Physical Domain (Motor Competence): Involves the coordination and application of physical skills necessary to execute movements in various situations and environments, including the development of fundamental movement skills, balance, agility, and overall physical competence. (2) Psychological Domain (Mental-Emotional): Includes the development of self-esteem, self-confidence, and motivation, as well as understanding emotional responses related to movement and physical activity. It emphasizes the importance of fostering a positive attitude and resilience. (3) Social Domain (Behavioral-Social): Encompasses the development of social skills such as collaboration, fair play, leadership, and communication. (4) Cognitive Domain: Focuses on the development of an individual's understanding of how, when, and why to move in certain ways, as well as knowledge and awareness of the benefits of movement and physical activity, and the ability to make informed decisions regarding health and fitness. The model of physical literacy as a pedagogical framework in physical education aims to foster motor competence safely, efficiently, and meaningfully, while promoting comprehensive benefits for students at the physical, cognitive, affective, and social levels (Valle-Muñoz & Mendoza-Muñoz, 2025). This idea supports the notion that physical literacy is a dynamic lifelong process that should be nurtured from an early age.

2.3. Thematic Learning

Thematic learning is an integrated learning approach that uses "themes" as the basis for developing learning content and materials to achieve basic competencies. Themes are not the goals or materials to be learned by children. Themes are a means of integrating the attitudes, knowledge, and skills that children need to develop. The theme also serves as an umbrella that frames the entire learning material through play-based activities (Ministry of Education and Culture, 2019). The thematic approach is based on the idea that children learn best through holistic and real experiences. By highlighting a theme across various disciplines, learning becomes more cohesive, helping children make better connections with the concepts being explored. This supports a deeper understanding of a topic, fosters a love of learning, and develops social skills (Cherni, 2021). Thematic learning is a learning strategy that

involves multiple areas of development to provide meaningful experiences for children. The integration in this learning can be seen from the aspects of process or time, curriculum aspects, and teaching-learning aspects. Thematic learning is taught to children because they generally still see everything as a whole (holistic); their physical development cannot be separated from mental, social, and emotional development (Nurani, 2019). The thematic approach is rooted in the view that children learn most effectively when information is presented in a relevant and interconnected context, rather than in separate subject units. This allows for integrated learning because one theme can bring together various skills and concepts from different disciplines, helping children make connections between ideas. Thematic learning encourages critical thinking, brainstorming, and different teaching strategies, as well as helping teachers and students to focus and concentrate better.

3. Method

3.1. Research Design

The research design used is Research and Development (R&D) to develop and validate the product. The procedures or stages of research to develop a thematic-based physical activity model used by the author are the ADDIE model (Branch, 2009), which is carried out through five stages, namely: analysis, design, development, implementation, and evaluation. ADDIE was chosen because its structured and systematic stages enable more comprehensive model development. A needs analysis provides a foundation for developing the learning model to be developed based on the various real needs and challenges faced by teachers in implementing physical activity learning in early childhood education. Based on these needs, a relevant model is developed and designed. Furthermore, this stage facilitates improvements to the learning model based on input from experts and teachers, as well as classroom implementation. Therefore, the final design of this physical activity learning model is relevant to early childhood learning principles and contributes to more holistic stimulation for child development.

3.2. Participant

The participants involved in this study were quite diverse, ranging from experts to teachers and children. In the needs analysis phase, 70 early childhood education teachers, primarily from West Java, participated. The needs identification results provide an overview of the challenges faced in teaching physical activity in early childhood education. In the model development stage, the participants involved were 3 experts, consisting of one doctorate in the field of early childhood education with 11 years of research experience, one doctorate in education with 11 years of research experience in developing learning models, and one doctorate in physical education who focused on research on early childhood physical literacy and had 8 years of experience. These experts participated in validating the model design, which was then improved as an initial model. In the implementation stage, the participants involved were 6 teachers who all had bachelor's degrees in early childhood education with teaching experience of 1-6 years and 41 children aged 4-5 years with diverse development. The involvement of participants in this implementation stage was to provide an overview of the effectiveness of the learning model so that a better final learning model design could be obtained.

3.3. Data Collection

The data collection procedure in this research follows the stages of the ADDIE model. In the needs analysis stage, a preliminary study was conducted to identify problems and analyze the sports learning needs faced in early childhood education. The instrument used at this stage is a mixed questionnaire that combines closed and open-ended questions. Questions and statements in the questionnaire are designed to explore the knowledge, experiences, and challenges faced by teachers in implementing physical activity learning for early childhood.

The design phase is carried out based on previous analysis results (Peterson, 2003), with the product design arranged to align with the learning needs in early childhood education. This

aims to ensure that the developed physical activity model truly provides benefits in the context of physical education for early childhood. The physical activities developed in this research are designed based on several themes. Theme is understood as the main idea that serves as the framework for the content or learning materials while children are engaged in activities (Ministry of Education and Culture, 2019). The determination of the theme refers to five principles, namely: (1) proximity, (2) simplicity, (3) interest, (4) support, and (5) incidental (Ministry of Education and Culture, 2019). The themes chosen in this research include Animals, Transportation, and Plants. The model design at this stage includes several components, namely syntax, social system, reaction, support system, instructional impact, and accompanying impact (Joyce & Weil, 2003). Meanwhile, the observed aspects of physical literacy include physical, psychological, social, and cognitive dimensions (Barnett, 2021). At the development stage, the main goal is to produce and validate the designed learning resources (Branch, 2009). The design of the model and module was then analyzed for feasibility by three experts, consisting of one early childhood education expert and two experts in the field of physical activity learning models and physical literacy. The instrument used at this stage was an expert validation questionnaire, which was used to assess the relevance of the initial model design with the principles of learning in early childhood education, physical education, and physical literacy.

At the implementation stage, the model and modules that have been revised based on expert validation results are then applied in the classroom. This implementation aims to determine the effectiveness of the thematic-based physical activity model in improving physical literacy in early childhood. The assessment of effectiveness is conducted through a pre-experimental research approach with a one-group pretest-posttest design. The research instrument used at this stage is an observation sheet, which is used by teachers to observe children's physical literacy activities during the learning process.

Next, at the evaluation stage, an analysis of the children's physical literacy development data obtained from pretest and posttest results is conducted. This analysis aims to assess the extent to which the developed model can holistically enhance early childhood physical literacy through a thematic and meaningful physical activity approach.

3.4. Data Analysis

Data to identify the effectiveness of the learning model was obtained from observations of physical literacy development before and after the implementation of the thematic-based physical activity learning model. This data was analyzed using descriptive statistics by calculating the average value and n-gain test as well as inferential statistics, which included normality, homogeneity, and difference tests. The descriptions of each analysis technique are as follows.

- a. Calculate the average pretest and posttest scores, then calculate the N-gain test using the following equation:

$$N\text{-Gain} = \frac{(\text{Maximum Score} - \text{Pre-test Score})}{(\text{Posttest Score} - \text{Pretest Score})}$$

The N-gain values obtained were then interpreted according to the criteria specified by Hake (1998), as shown in Table 1 below:

Tabel 1. N-gain Criteria

N-gain Score	Criteria
$\geq 0,7$	High
$0,3 \leq N\text{-gain} < 0,7$	Moderate
$\leq 0,3$	Low

- b. Normality Test

The normality test provides information on whether the distribution of subject data is

normal or not. The normality test will have an impact on the use of statistical tools in testing the effectiveness of the model, whether to use parametric or non-parametric statistics. The normality calculation using Shapiro-Wilk is based on the number of samples tested < 50 people with processing using the SPSS version 21 program (Dahlan, 2010). The criteria applied to determine whether a distribution is normal are as follows: if the sig. (2-tailed) value is > 0.05, the data is normally distributed; conversely, if the sig. (2-tailed) value is < 0.05, the distribution is considered not normally distributed.

c. Homogeneity Test

The homogeneity test provides information on whether the data obtained from a group of subjects comes from the same population or not. If the data distribution based on the results of the normality test is normally distributed, then a parametric statistical model is used for the test. However, if the data distribution based on the results of the normality test is not normally distributed, then a non-parametric statistical model is used for the analysis. The homogeneity criterion is that if the sig. (2-tailed) value is > 0.05, the test is declared homogeneous, and if the sig. (2-tailed) value is < 0.05, the test is declared non-homogeneous. In the homogeneity test, the Test of Homogeneity of Variances is used with the SPSS 21 application (Gozali, 2013).

d. Effectiveness Test

In testing the effectiveness of the model, the author used an independent samples t-test. The following are the hypotheses with the independent samples test:

H_0 : There was no significant difference in children's physical literacy before and after using the thematic-based physical activity model.

H_1 : There was a significant difference in physical literacy between before and after using the thematic-based physical activity model.

The condition applied to determine the difference is when the Sig. (2-tailed) value is > 0.05, then H_0 is accepted. Based on these criteria, there is no significant difference in children's physical literacy between before and after using the thematic-based physical activity model. However, if Sig. (2-tailed) < 0.05, then H_0 is rejected and H_1 is accepted, indicating a significant difference in physical literacy between before and after using the thematic-based physical activity model (Ghozali, 2013).

3.5. Validity and Reliability

Validity and reliability tests in this study were conducted on the questionnaire used in the needs analysis stage. To identify the validity of the questions/statements in the questionnaire, a product-moment correlation test was used using SPSS version 21.

Table 2. Recapitulation of Needs Analysis Questionnaire Validation Data

Item Number	$r_{\text{calculated}}$	r_{table}	Inference
1.	0,100793	0,2319	Invalid
2.	0,613283	0,2319	Valid
3.	0,66139	0,2319	Valid
4.	0,743718	0,2319	Valid
5.	0,430062	0,2319	Valid
6.	0,742261	0,2319	Valid
7.	0,699846	0,2319	Valid
8.	0,739147	0,2319	Valid
9.	0,345291	0,2319	Valid
10.	0,409191	0,2319	Valid
11.	0,343061	0,2319	Valid

Based on Table 2, the results of the validity test indicated that one question item was declared invalid, and therefore this item was excluded from the final instrument used during the needs analysis stage. In addition to the validity test, a reliability test was also conducted using the Cronbach's Alpha formula through the SPSS version 21 application. According to this formula,

a variable is considered reliable if it yields a value greater than 0.7 (Gozali, 2013). The results of the reliability test are presented in the following table 3.

Table 3. Results of the Reliability Test of Needs Analysis Questionnaire Data

Standard Value	Cronbach's Alpha Value	Inference
0,7	0,78	Reliable

The reliability test in Table 3 shows that the Alpha value = 0.78 ≥ 0.70, so the data is considered reliable, meaning that each item in the questionnaire has adequate internal consistency and can be used to measure physical literacy in early childhood consistently.

4. Findings

This chapter explains the process and results of developing a thematic-based physical activity model to improve physical literacy in early childhood using the ADDIE research model, which consists of five stages: (1) Need Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The results obtained at each stage of development are described below.

4.1. Need Analysis Results

The analysis stage is important to ensure that the model developed meets user needs. The model development needs analysis stage is carried out to obtain accurate data and information. During this phase, researchers distribute questionnaires and documentation. The questionnaire includes several questions regarding 1) teachers' level of understanding, 2) methods used, 3) sources of information/references used, and 4) challenges in improving physical literacy through learning. The results of this questionnaire are used as the basis for developing thematic-based physical activities to enhance physical literacy in young children. The data from the questionnaire analysis can be viewed in the table 4 below.

Table 4. Need Analysis Result

No	Question	Answer Percentage	Description
1		Availability of special teachers for sports activities	
	Available	36 %	Only 36% of schools have specialised physical education teachers for sports activities, while 64% of schools do not have specialised teachers for sports activities.
	Not available	64 %	
2		Those who accompany children during sports activities	
	Classroom Teacher	74 %	74% of sports activities at school are supervised by class teachers. Sports activities at school Specialised supervisory teachers are usually available at schools, including coaches for specific sports such as swimming, horse riding, archery, and outdoor activities. Some schools provide specialised supervisory teachers for children with special needs.
	Special Assistant Teacher	4 %	
	Practical student majoring in sports	1 %	
	Early Childhood Education Internship Students	19 %	
	Other	2 %	

No	Question	Answer Percentage	Description
3	Sources of information used to obtain information about sports activities for early childhood education (respondents may choose more than 1 answer)		
	Social media (WA, tiktok, IG, dll)	68%	In general, teachers' responses indicated that they sought information independently from various media and forums. They also found that they obtained information through sharing activities with fellow teachers or with the school's psychology team. Seminars and workshops on sports education for early childhood were rare, as most seminars and workshops related to learning administration, curriculum, child development, or parenting.
	Youtube	17%	
	Universities	7%	
	Seminar/workshop	6%	
	Book	1%	
	Others	1%	
4	Types of activities carried out at school		
	Gymnastic	83%	Of the sports activities carried out at school, 83% were gymnastics, 11% were ball throwing and catching, and the rest were unstructured physical activities.
	Throw and catch ball game	11%	
	Others	6%	
5	Teachers make special lesson plans for sports activities		
	Yes	43%	Lesson plans are created specifically for a predetermined schedule or specific activities (e.g., swimming and outings). Time allocation for sports activities is usually limited to one stage (opening/main/final activity) and is not designed to be continuous from the beginning to the end of the lesson.
	Never	57%	
6	Aspects of development that are stimulated in sports activities for children (respondents can choose more than 1 answer)		
	Physic Motoric	40%	The teacher's mindset regarding sports learning for Early Childhood Education is still focused on the physical
	Social Emotional	39%	
	Cognitive	4%	
	Language	4%	
	Art	3%	
	Religion	6%	

The results of the needs analysis above indicate that the majority of sports activities in Early Childhood Education are still handled by regular class teachers who do not have professional knowledge in the field of children's sports. Moreover, access to formal training on early childhood sports is still very limited, so most teachers seek information independently through social media. In addition, most teachers who have not created a specific lesson plan for physical activity or sports activities cause learning to be less systematic, and in general,

teachers are still oriented towards physical motor stimulation in sports learning for children; they have not stimulated children in other aspects of development holistically.

Based on this identification, it is necessary to develop a systematic and comprehensive sports learning model that stimulates children's physical literacy, encompassing physical, cognitive, social, and psychological aspects, through theme-based learning activities and a playful approach. The development of this learning model can provide teachers with insights into the implementation of physical activity learning that is easily accessible and practical for early childhood educators who do not have professional experience in sports.

4.2. Design

The design stage involved creating a thematic physical activity model to improve the physical literacy of early childhood. The physical activities developed in this study were created for several learning themes in early childhood education, including Animals, Transportation, and Plants. The aspects formulated in the learning model design refer to Joyce & Well (2003) and include learning syntax, facilities and infrastructure, learning media, a social system oriented toward physical literacy elements, reactions to student responses, direct learning impacts, and accompanying learning impacts. Meanwhile, the physical literacy elements observed include physical, psychological, social, and cognitive aspects (Barnett, 2021). The design of the learning model can be seen in the following table 5.

Table 5. Themed Physical Activity Models

Component	Description
Instructional Syntax	The syntax of the physical activity learning model consists of the following stages: 1) apperception (prayer, greeting, attendance, warm-up, and initial discussion of the theme); 2) observation, which is the stage where children make observations through the concept of the chosen theme through storytelling activities, singing, observing pictures or watching videos about the chosen theme, namely Animals, Plants and Means of Transportation; 3) exploration, which is the stage where children dig up information about the characteristics, properties, and benefits of the determined theme; 4) Formation of groups and rules of play, which is the stage where children are formed into small groups to then be given direction by the teacher regarding the rules of the physical activity game that will later be involved in the physical activity game; 5) Playing physical activity, which contains children's play activities by optimizing physical activities that are relevant for early childhood while stimulating the development of physical literacy that includes physical, psychological, social, and cognitive aspects; 6) Reflection, which is the final stage where children are invited to discuss their learning experiences when participating in physical activity games.
Learning facilities, infrastructure, and media	Space for playing, tools, and game materials (hula hoops, cones, baskets, plastic balls, and other tools) as well as learning media in the form of pictures, miniatures, and learning videos that are relevant to the theme.
Social system (Physical Literacy Based)	Physical: Children perform fundamental movements such as moving, using tools, balancing, and manipulating objects. Psychological: Children are self-confident, develop a strong motivation to learn through fun play activities, are brave and enthusiastic, patiently wait their turn, and can express their feelings. Social: They collaborate with their group members while playing, exchange ideas and respect each other's opinions, agree on strategies for completing the game, and demonstrate empathy.

Component	Description
	Cognitive: They understand the rules of the game, the importance of physical activity, and the concepts of the chosen theme.
Reaction to student responses	<ol style="list-style-type: none"> 1. Provide follow-up support for children in developing motor skills. 2. The teacher listens attentively if a child asks a question. 3. Provide positive affirmations: "Great, good," "I see," "Keep it up," "Come on, you can do it," "You're great," "You can try again next time," "You can stay a little faster," etc.
Direct impact of learning	<ol style="list-style-type: none"> 1. Students can perform locomotor, non-locomotor, and manipulative movements. 2. Learning can stimulate the growth of physical literacy in children.
Impact of learning accompaniment	Children's needs are met in terms of movement needs, opportunities for children to play, stimulation of behavior that respects each other, cares for others, cooperation and increased physical literacy.

4.3. Development

The model development stage consists of validating the learning model design created in the design stage. Validation is carried out by three experts, consisting of experts in physical activity and physical literacy learning models (2 people) and an expert in early childhood education (1 person) with the following results:

Table 6. Results of the Validation of the Physical Activity and Physical Literacy Learning Model

No	Aspect	Average score	Percentage	Description
1	Syntax for learning	4	100	Very Good
2	Supporting systems: infrastructure and learning media	4	100	Very Good
3	Development of social systems oriented towards elements of physical literacy	3.5	87,5	Very Good
4	Design regarding teacher reactions	3.5	87,5	Very Good
5	Direct impact of learning	3.5	87,5	Very Good
6	Impact of learning support	4	100	Very Good

Table 7. Results of the Validation of Thematic-Based Physical Activity Teaching Modules for Physical Literacy

No	Aspect	Average score	Percentage	Description
1	Compliance of the format with the provisions of the curriculum	4	100	Very Good
2	Alignment of content with learning characteristics for early childhood	4	100	Very Good
3	Grammar	4	100	Very Good

Based on the expert assessment results in Table 6 and Table 7, it can be seen quantitatively that the model design falls into the very good category. This indicates that the initial design of

the thematic-based physical activity learning model to enhance children's physical literacy is considered feasible and appropriate. Therefore, the model can proceed to the implementation stage to further examine its effectiveness in real classroom settings and determine its impact on children's physical literacy development.

4.4. Implementation

A thematic-based physical activity learning model to stimulate children's physical literacy was implemented in a preschool involving six teachers and 41 children across three different classes. The program focused on children aged 4-5 years, identifying a wide range of physical literacy developmental milestones. This learning model was implemented in three learning sessions on the theme of Animals, Plants, and Transportation. Table 8 below shows the stages of each session.

Table 8. Physical Activities Learning Model

Syntax	Activities	Physical Literacy aspect
Apperception	identifying children's prior knowledge about the topic. The learning methods used at this stage included telling stories about their experiences visiting the zoo, singing the song "Look at My Garden," discussing modes of transportation they have used, and other relevant activities.	<p>Psychological</p> <ul style="list-style-type: none"> • Confident in expressing opinions • Shows interest and enthusiasm during the learning process • Manages emotions, such as resisting the urge to speak first, interrupt others, or express excessive curiosity <p>Social</p> <ul style="list-style-type: none"> • Listens attentively when others are speaking • Waits for their turn to share • Respects differences in stories or answers shared by peers <p>Cognitive</p> <ul style="list-style-type: none"> • Recalls and retells their own experiences • Identifies various types of animals, plants, and modes of transportation • Connects stories or songs with real-life situations
Observation	Children were asked to observe objects related to the theme of Animals, Plants, and Transportation using various learning media, including pictures, miniature objects, and instructional videos.	<p>Psychological</p> <ul style="list-style-type: none"> • Shows enthusiasm when viewing learning media • Focuses during the observation of pictures, miniatures, and instructional videos • Expresses emotions, such as smiling, laughing, and others <p>Social</p> <ul style="list-style-type: none"> • Interacts with peers during the activity • Helps friends who have difficulty recognizing objects <p>Cognitive</p> <ul style="list-style-type: none"> • Identifies characteristics, names, and explains the features, properties, and benefits of animals, plants, and means of transportation

Syntax	Activities	Physical Literacy aspect
Exploration	Question-and-answer sessions and guided discussions were conducted with the teacher's assistance to help children gain information about the characteristics, properties, and benefits of animals, plants, and means of transportation. These activities were further enriched by inviting children to imitate animal movements, modes of transportation, or fundamental movement patterns while carrying plant-related objects, allowing them to explore the themes through physical expression and embodied learning	<p>Physical</p> <ul style="list-style-type: none"> Imitates animal movements, transportation modes, or performs fundamental movements while carrying plant-related objects <p>Psychological</p> <ul style="list-style-type: none"> Shows confidence when imitating movements Demonstrates enthusiasm and interest Follows the teacher's instructions and directions <p>Social</p> <ul style="list-style-type: none"> Engages in positive interactions with peers while imitating movements or discussing the characteristics of animals, plants, and transportation Takes turns when asked to imitate movements Gives praise to peers who successfully imitate movements or answer correctly Respects differences of opinion <p>Cognitive</p> <ul style="list-style-type: none"> Identifies characteristics, names, and explains the features, properties, and benefits of animals, plants, and means of transportation
Group formation and play rules	Children are divided into small groups. The teacher can assist in forming these groups to ensure that the characteristics of the children within the group are diverse. Once the groups are formed, the teacher will explain the rules of the game and agree on several points with the children.	<p>Social</p> <ul style="list-style-type: none"> Willing to work in a group with anyone Shares roles and responsibilities within the group <p>Cognitive</p> <ul style="list-style-type: none"> Understands instructions and game rules Remembers and applies the rules during the game Adapts to the game and the group's strategy
Play	The stage is where children participate in physical activity games designed by the teacher. These games are competitive, group-based, and conceptually based. In these games, children are asked to perform various physical activities such as running, tiptoeing,	<p>Physical</p> <ul style="list-style-type: none"> Performs fundamental movements Imitates the movements of objects Combines movements with the use of objects Demonstrates body coordination, balance, and agility <p>Psychological</p> <ul style="list-style-type: none"> Shows courage and confidence in competition Manages emotions when facing challenges or losses Demonstrates perseverance and a never-give-up attitude

Syntax	Activities	Physical Literacy aspect
	jumping, zigzagging, and others. These movements imitate the movements of certain animals or means of transportation or carry objects or plants.	<p>Social</p> <ul style="list-style-type: none"> • Cooperates with team members • Displays sportsmanship • Encourages and supports peers <p>Cognitive</p> <ul style="list-style-type: none"> • Connects game themes with learning concepts • Understands and follows game instructions • Develops simple strategies
Reflection	Children are asked to share their experiences during the learning process.	<p>Psychological</p> <ul style="list-style-type: none"> • Expresses emotions related to their past experiences • Shows enthusiasm and a sense of pride <p>Social</p> <ul style="list-style-type: none"> • Listens actively • Demonstrates empathy and respects peers' experiences • Speaks and responds politely <p>Cognitive</p> <ul style="list-style-type: none"> • Recalls and retells the sequence of activities • Connects personal experiences with the learning material

4.5 Evaluation

The evaluation as the final stage of ADDIE aims to identify the effectiveness of implementing a thematic-based physical activity learning model to improve the physical literacy of early childhood. The data used at this stage is data on the development of children's physical literacy obtained from observations before and after the model was implemented and data from interviews with teachers involved in the implementation.

4.5.1. Results of Physical Literacy Data Analysis Based on Descriptive Statistical Tests

Table 9. Average Scores and N-gain Test for Children's Physical Literacy

Variabel	Average value		Maximum value	n-gain Score	Description
	Pretes	Postes			
Physical Literacy	68,2	89	108	0,52	Medium

Based on the data in Table 9, there was an increase in the average physical literacy score of children from 68.2 in the pretest to 89 in the posttest after the intervention. This increase indicates that the intervention was effective in improving children's physical literacy skills. Additionally, the N-gain score obtained was 0.52 and falls into the moderate category. This indicates that the improvement in children's physical literacy skills after the intervention falls into the moderate effectiveness category. Therefore, it can be concluded that the program or intervention implemented is sufficiently effective in improving children's physical literacy, although there is still room for improvement to achieve the high effectiveness category.

4.5.2. Results of Physical Literacy Data Analysis Based on Inferential Statistical Tests

Data analysis in this study was also supplemented with inferential statistics, including normality tests, homogeneity tests, and difference tests. Normality tests were used to determine whether

the data obtained was normally distributed, while homogeneity tests were used to ensure that the variance between data groups was uniform. Furthermore, difference tests are applied to determine whether there are significant differences between pretest and posttest data.

Table 10. Results of Shapiro Wilk Normality Test of Children's Physical Literacy Data

Types of Physical Literacy Data	df	p-value	α	Hipotesis	Description
Pretest	41	0,02	0,05	Rejected	Not Normal
Posttest	41	0,22	0,05	Accepted	Normal

Based on the results of the Shapiro-Wilk normality test on children's physical literacy data, it was found that the pretest data had a significance value (p-value) of 0.02, which was smaller than $\alpha = 0.05$. Thus, the null hypothesis was rejected and it was concluded that the pretest data was not normally distributed. Conversely, the posttest data showed a p-value of 0.22, which is greater than $\alpha = 0.05$, so the null hypothesis is accepted and the posttest data can be considered normally distributed. These results indicate that only some of the data meet the normality assumption, so the difference test performed is the non-parametric Wilcoxon test.

Table 11. Results of Physical Literacy Data Homogeneity Test

Data Types	df	p-value	α	Hipotesis	Description
Physical Literacy	80	0,00	0,05	Rejected	Not homogeneous

Since the preliminary test results showed that the data was not normally distributed and was not homogeneous, the next statistical test performed was the Wilcoxon nonparametric test. This test is relevant for two types of data (pre-test and post-test) from the same subjects. The results of the Wilcoxon test are shown in the following table 12:

Table 12. Results of Wilcoxon Test of Children's Physical Literacy Data

Data Types	N	p-value	α	Description
Physical Literacy	41	0,00	0,05	Significant

Based on the results of the Wilcoxon Signed-Rank test, a significance value (p-value) of 0.000 was obtained. This value is smaller than the specified significance level ($\alpha = 0.05$), so it can be concluded that there is a significant difference between the children's physical literacy scores at the pretest and posttest. This means that there was a noticeable change after the children participated in thematic-based physical activity learning. This difference indicates that the implemented learning model has an impact on improving children's physical literacy, both in physical, psychological, social, and cognitive aspects.

5. Discussion

Based on the processing and analysis of data from the effectiveness test, it is stated that the intervention provided was able to enhance children's physical literacy skills. Additionally, the N-gain score obtained was 0.52, which falls within the moderate category. This indicates that the improvement in children's physical literacy skills after the intervention is categorized as moderate effectiveness. Therefore, it can be concluded that the program or intervention implemented is quite effective in enhancing children's physical literacy, although there is still room for improvement to achieve a high effectiveness category. This result is consistent with the findings of several other studies that show that physical literacy interventions often reach a moderate level of effectiveness in improving children's skills and confidence (Bloch et al., 2025; Carl et al., 2022). Thus, it can be concluded that the program or intervention implemented is quite effective in enhancing children's physical literacy. Nevertheless, there remains room for improvement to achieve a high effectiveness category, which can be attained through adjustments in intervention strategies, such as increasing intensity, duration,

or integrating more comprehensive program elements (Johannes et al., 2024). The development of a structured thematic-based physical activity model designed to enhance physical literacy in early childhood is expected to have a significant impact, as it is intentionally programmed. The structured and deliberately programmed thematic-based physical activity model is highly effective in improving physical literacy in early childhood up to elementary school (Satyawati & Dartini, 2021; Suherman et al., 2021; Weir et al., 2024).

Physical literacy is a component of early literacy that focuses on a child's ability to use their body in a coordinated and meaningful way within the context of communication and environmental exploration (Barratt et al., 2024; Rudd et al., 2020). This literacy encompasses spatial understanding, body orientation, movement coordination, as well as social skills such as following rules and collaborating (Higgs et al., 2019). The findings of this study indicate that thematic physical activity directly supports the development of physical literacy. For example, when children mimic animal movements while naming the animals and their habitats, they not only practice gross motor skills but also reinforce vocabulary, listening skills, and conceptual logic. The research also shows that when activities are performed repeatedly and in meaningful contexts, there is an improvement in holistic physical literacy skills. Support for this idea comes from various sources. Kristina et al. (2025) emphasize how play, which often involves thematic physical activity, significantly enhances critical thinking, problem-solving, and creativity, in addition to strengthening motor skills. This concept is reinforced by Liu et al. (2025), who highlight that game-based interventions, which are natural and engaging, are highly effective in improving physical literacy among preschool children. Furthermore, Buckler et al. (2023) demonstrate that physical exercise correlates with improved cognitive function that supports conceptual logic and child development across various domains, including emotional and social intelligence. In fact, a study by Gil-Moreno & Rico-González (2023) posits that physical education is highly beneficial for the emotional and social development of toddlers, creating a conducive environment for broader literacy development. Specifically, Zhang et al. (2024), through their systematic review, continue to support this relationship, indicating that linguistic stimulation through activities can enhance phonological awareness in early childhood. Thus, our research findings, supported by established academic literature, affirm that integrating repeated and meaningful thematic physical activities is a highly effective strategy for facilitating comprehensive literacy development in children.

The success of this learning is also attributed to the strength of the thematic approach, which naturally connects various developmental domains through a context familiar to children. The use of themes such as "Animals," "Plants," and "Transportation" allows for the simultaneous integration of movement, language, numeracy, and social-emotional skills. Recent research continues to confirm that thematic approaches facilitate balanced development across various domains. For instance, a study conducted by Khairunnisa & Ain (2022) emphasizes how thematic learning in early childhood education can significantly enhance children's cognitive, language, and social-emotional abilities simultaneously. The context of familiar themes enables children to explore concepts from various perspectives, supporting the development of comprehensive skills. Through relevant themes that are close to children's worlds, children not only engage in physical movement but also connect their motor experiences with specific vocabulary, concepts, and language structures, impacting their communication abilities. A child's communication development is closely related to their social skills. Children who can effectively express their ideas, feelings, and desires find it easier to interact, collaborate, and build social relationships (Jabborovna, 2019; Jurkic et al., 2023; Mulvey & Jenkins, 2021). Conversely, communication limitations can hinder socialization abilities. Therefore, early communication stimulation also supports the development of children's social skills, as evidenced by research showing that children's social abilities, as an aspect of physical literacy, improved at a moderate level.

The enhancement of children's social skills can also influence their psychological aspects. Positive social interactions, such as being accepted by peers, collaborating, and understanding others' feelings, can help children build self-confidence, self-esteem, and healthy emotional regulation (Panula et al., 2020; Sun et al., 2023). On the other hand, obstacles in social development, such as difficulties in socializing or social conflicts, can affect

a child's psychological condition, potentially leading to feelings of anxiety, inferiority, or anger. Thus, good social development serves as an important foundation for children's psychological well-being. Stangl et al. (2023) state that interpersonal conflicts can affect self-esteem and disordered eating behaviors in individuals. These findings support the notion that social conflicts contribute to psychological issues such as anxiety and low self-esteem. Furthermore, Zanella & Lee (2024) found that social anxiety and shame negatively impact individuals' social and psychological development. This indicates that problems in social interaction can lead to significant psychological consequences.

The thematic learning approach is multisensory, engaging movement, auditory, visual, and tactile senses in an integrated manner, thereby strengthening children's memory of the concepts and vocabulary learned (Pagliano, 2017). This rich sensory experience is crucial for developing early literacy as it helps the brain connect symbols, sounds, and meanings with real-life experiences, which also influences children's cognitive aspects.

This model aligns with the principles of early childhood education (ECE) according to the Merdeka Curriculum, where the learning approach must be child-centered, enjoyable, contextual, and active. Physical activity in this model serves not only as a means of entertainment but also has a strategic function as a medium for exploration and literacy reinforcement. In the context of the Merdeka Curriculum, early childhood education must be child-centered, enjoyable, contextual, and active. Elyana et al. (2023) emphasize the importance of managing initial assessments according to children's needs, supporting a fun and interactive learning process. Additionally, Raval (2023) states that physical activities in the form of play contribute to literacy reinforcement, which aligns with the principles of active and contextual learning.

Moreover, Masykuroh et al. (2024) assert that teaching environmental literacy through play activities can enhance children's engagement and their social-emotional development. This indicates that a supportive and enjoyable environment is essential for children's psychological well-being. Meanwhile, Nangia (2023) reveals that family conflicts can negatively impact children's development, making it crucial to create a positive and enjoyable learning environment. Finally, Stangl et al. (2023) highlight the impact of social anxiety on children's development, further reinforcing the importance of positive social interactions through physical activities in early childhood education.

This research has significant implications that affirm the importance of an integrated approach in early childhood development. The results indicate that physical literacy is much broader than mere motor skills; it serves as a foundation for cognitive, language, and social-emotional development. By integrating structured and meaningful thematic physical activities, we not only train children's physical abilities but also enrich their vocabulary, sharpen their logical thinking skills, and build crucial social skills. This means that learning that separates developmental aspects tends to be less effective compared to a holistic approach that integrates everything.

Furthermore, these findings validate the importance of incorporating programmed physical activities into the ECE curriculum. This is not merely free play time but an opportunity to design active, contextual, and child-centered learning, in line with the principles of the Merdeka Curriculum. This provides practical guidance for educators and curriculum developers on how to organize enjoyable activities while maintaining clear educational objectives. For parents, this research also raises awareness that active play with specific themes has significant educational benefits, encouraging stronger collaboration between home and school.

Although this study demonstrates moderate effectiveness, it opens up significant opportunities for improvement and innovation. There is room to refine physical literacy interventions to maximize their impact, possibly by increasing the intensity or duration of programs. This encourages further research to explore the best ways to optimize children's physical literacy development. Overall, this research not only enriches our understanding of early literacy but also provides a solid framework for future teaching practices and policies.

6. Conclusion

This study aims to develop and evaluate a thematic-based physical activity model to enhance physical literacy in early childhood, driven by the urgent need for adequate physical activity stimulation and the integration of physical literacy in early childhood education. The model, developed through the ADDIE approach and focusing on familiar themes such as Animals, Transportation, and Plants, successfully improved early childhood physical literacy, as evidenced by the increase in average pretest-posttest scores and an N-gain value of 0.52, which falls within the moderate category. Although its effectiveness is categorized as moderate, Wilcoxon test results indicate a significant difference between pretest and posttest scores, affirming that this model is effective in enhancing the four aspects of physical literacy: physical, psychological, social, and cognitive. The implications of this research are highly significant. First, this study reinforces the understanding that physical literacy encompasses more than just motor skills; it serves as a foundation for holistic cognitive, language, and social-emotional development in children. The integration of structured and meaningful thematic physical activities not only trains children's physical abilities but also enriches their vocabulary, sharpens logical thinking, and builds crucial social skills. Second, these findings validate the importance of incorporating programmed physical activities into the ECE curriculum, in line with the principles of the Merdeka Curriculum that emphasize active, contextual, and child-centered learning. This provides practical guidance for educators and curriculum developers in designing enjoyable activities with clear educational objectives. Finally, this research opens up significant opportunities for improvement and innovation, encouraging further studies to optimize physical literacy interventions to maximize their impact, possibly by increasing the intensity or duration of programs.

Limitation

This study has several limitations. First, the discussion of thematic-based physical activity models is limited. Second, this study only focbalyiuses on one school, one class, and three learning themes: Animals, Transportation, and Plants. Third, time constraints pose a challenge, as the allocation of time is insufficient for physical activities, and the material presented by educators continues to follow the learning schedule.

Recommendation

After developing a thematic-based physical activity model to enhance physical literacy in early childhood, the researchers provide the following recommendations to support further research.

For Early Childhood Educators: Educators should actively integrate physical activities into theme-based learning.

For Policymakers: Consider including physical literacy as part of the national literacy policy, given that the current focus is primarily on language literacy, numeracy, and other areas.

For Future Researchers: Future research could explore increasing the intensity and/or duration of intervention programs to determine whether this can yield higher effectiveness in improving children's physical literacy.

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Conflict of Interest

The authors have no conflict of interest in conducting research and article publication

Declaration of Generative AI-assisted Technologies

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