14 (3) (2025) 889 - 900
Journal of Physical Education, Sport, Health and Recreations
https://journal.unnes.ac.id/journals/peshr

Identification of Positive Trends in Physical Literacy Among Primary School Students: A Longitudinal Study for 2024–2025

Ahmad Winoto[1]✉, Adi S[2]

Physical Education for Elementary Schools, Faculty of Sports Science, Semarang State University, Semarang City, Indonesia[1]
Physical Education, Health, and Recreation, Faculty of Sports Science, Semarang State University, Semarang Citya, Indonesia[2]

Article History

Received September 2025
Accepted October 2025
Published Vol.14 No.(3) 2025

Keywords:
Physical Literacy; Longitudinal; Primary School Pupils; Physical Education

Abstract

Physical literacy is a holistic ability that encompasses physical, cognitive, and affective dimensions, playing an important role in encouraging lifelong participation in physical activities. This study aims to analyze changes in the physical literacy of elementary school students in Gunungpati District, Semarang City, over a period of two academic years. The research design used was a pure longitudinal study involving public elementary school students (n = 99) who were selected purposively. Physical literacy was measured using a combination of objective tests (TIAMSA, PACER, 30-second sit-ups) for the physical dimension and perception questionnaires for the cognitive and affective dimensions. The analysis was conducted using a paired sample t-test for inter-year comparisons and a Linear Mixed Model (LMM) to control for individual and school variations. The results showed a significant increase in total physical literacy scores (Mean Difference = $p < 0.05$), with the most consistent upward trend in the physical dimension ($p < 0.01$), while the cognitive and affective dimensions showed fluctuations and were not always significant ($p > 0.05$). LMM analysis confirmed the effect of time on physical literacy, but there was a lack of parallel development across dimensions. In conclusion, students' physical literacy improved, especially in physical abilities, while non-physical dimensions required special attention. This study is novel because it combines objective and subjective assessments in a longitudinal design in Indonesia and provides important empirical insights for holistic physical education policy.

How to Cite

Winoto, A., & S, A. (2025). Identification of Positive Trends in Physical Literacy Among Primary School Students: A Longitudinal Study for 2024–2025. Journal of Physical Education, Sport, Health and Recreation, 14 (3), 889-900.

✉ Correspondence address :
E-mail: ahmadwinotoltmpt@students.unnes.ac.id

p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

The digital age has significantly changed children's lifestyles, especially during primary school, which is an important phase for forming healthy habits. Increased exposure to gadgets and digital media encourages a sedentary lifestyle, reduces active play time, and lowers physical fitness levels (Ginanjar et al., 2024; Jiménez-Loaisa et al., 2023). These impacts are not only physical but also have the potential to hinder cognitive, social, and emotional development, even affecting long-term quality of life and academic performance. Limited exposure to natural light and outdoor activities due to excessive use of digital media can also trigger changes in serotonin and dopamine pathways, which are important for mood regulation and brain function (Dresp-Langley, 2020). However, technology also offers positive opportunities if used appropriately. Fitness applications, digital sports games, and wearable devices have been shown to increase motivation to move, provide feedback, and monitor children's physical development (Firmansyah et al., 2024; Navarra et al., 2021)The integration of technology in physical education, with the support of families and teachers, can promote cognitive skills, social interaction, and sustainable physical activity habits. Therefore, the main challenge is not the technology itself, but rather how to balance its use with outdoor physical activity. An approach that combines the strategic use of technology with active movement stimulation is believed to minimise the risk of sedentary lifestyles while optimising the benefits of digital media for children's development (Adi S, Tommy Soenyoto, et al., 2025; Navarra et al., 2021; Rahayu et al., 2024).

Physical literacy (PL) is an important foundation for children's active participation in physical activities throughout their lives, encompassing motor skills, motivation, self-confidence, knowledge, and understanding (Permana et al., 2024). Research shows that affective components such as motivation and self-confidence have the strongest influence on children's involvement in physical activity, which in turn improves physical fitness and shapes positive attitudes (Adi et al., 2025; Britton et al., 2022; Soenyoto et al., 2025). Physical competence is also directly related to fitness levels, while knowledge and understanding, although important, have a relatively smaller direct impact (Tang et al., 2023). The relationship between PL and physical fitness is mediated by moderate-to-vigorous physical activity (MVPA), which has been shown to improve fitness while reinforcing positive attitudes towards physical activity (Caldwell et al., 2020; Tang et al., 2023). In addition, PA contributes to children's well-being and can predict positive attitudes towards physical activity (Britton et al., 2022). However, this relationship is influenced by factors such as socioeconomic status and individual differences, requiring tailored approaches to promote PA. In Indonesia, research on PA is still limited, especially longitudinal studies. The majority of studies use a cross-sectional design, which does not capture the dynamics of PA development over time. Longitudinal studies are needed to understand PA growth patterns in specific educational and social contexts, as well as to provide a strong empirical basis for physical education policies and the promotion of physical activity in schools (Britton et al., 2023).

Physical literacy (PL) was chosen as the focus of this study because of its multidimensional and multifunctional nature. Not only does it assess physical aspects such as physical fitness, but PL also encompasses motivation, self-confidence, knowledge, and understanding that shape children's readiness to lead an active lifestyle throughout their lives (Adi S, Soenyoto, et al., 2025; Priadana et al., 2021). This approach provides a holistic picture of children's physical, mental, and social readiness to participate in physical activities, making it relevant as a comprehensive indicator of physical fitness (Adi et al., 2024). Longitudinal data-based PA research is crucial because it can track the development of PA components such as motivation, self-confidence, and physical competence from childhood to adolescence, as well as identify critical periods for intervention (Ramer & Bustamante, 2022; St. John et al., 2021). Unlike cross-sectional studies, which only offer a snapshot, longitudinal approaches can reveal the influence of school enrolment age and socioeconomic status on PA development (Teich et al., 2023), identify important predictors such as the influence of body composition on physical function and academic achievement (Ortiz-Sanchez et al., 2023), and assess the impact of early physical activity experiences on social skills and mental health (Ramer & Bustamante, 2022). Unfortunately, in Indonesia, research physical activity (PA), especially longitudinal studies, is still very limited. The majority of studies use a cross-sectional design, so they have not been able to capture the dynamics of PA development in a unique cultural, educational, and socioeconomic context. Existing evidence supports this limitation: (Andriyani et al., 2020), conducted a scoping review on physical activity and sedentary

behavior among indonesian youth and found that most studies used cross-section approaches whith limited follow-up data. Similarly, (Yulia et al., 2018) examined physical activity and nutritional status among indonesian school children using a one-time measurement design, which restricted the understanding of long-term behavior change. This research gap highlights the urgency of conducting longitudinal studies that can provide a stronger empirical basis for the development of physical education policies and physical activity interventions in primary schools.

The Gunungpati sub-district, Semarang City, has geographical characteristics in the form of hilly areas and distinctive socio-cultural diversity. These conditions significantly influence the facilities, infrastructure, and culture of physical activity in public primary schools, which ultimately have an impact on students' physical literacy. The hilly environment provides natural opportunities for outdoor activities, such as hiking or traditional movement-based games, which have been proven effective in developing basic motor skills while strengthening children's physical literacy (Aliriad, S, et al., 2024; Terrón-Pérez et al., 2021). However, such terrain also presents challenges in the development of formal sports infrastructure, requiring schools to innovate by utilising the potential of the natural landscape as part of their physical education programmes (Septian & Adi, 2025). In addition to geographical factors, socio-cultural diversity also shapes children's involvement in physical activities. Studies show that differences in social contexts, such as urbanity and school type, do not significantly change the culture of sports at the primary school level. This confirms that a uniform approach to physical education can still be applied in various social settings (Sari et al., 2023). However, the integration of traditional games and local culture-based activities has been proven to increase motivation and enrich students' physical literacy experiences (Aliriad, Adi, et al., 2024; Bereziuk, 2023). Physical literacy itself is seen as an important foundation for children's holistic development, in terms of health, motor skills, and optimal growth at the age of 7–12 years (Ardiana, 2024).

The post-pandemic context further emphasises the urgency of physical literacy in schools. The decline in children's physical activity levels after the ‘new normal’ era highlights the need for adaptive strategies to maintain an active lifestyle, regardless of geographical conditions or cultural backgrounds (Jimenez-Loaisa, 2023). Thus, the study in Gunungpati Subdistrict is not only relevant for describing local dynamics but can also serve as a strategic reference for other regions in Indonesia with similar geographical and socio-cultural characteristics. Measuring physical literacy in primary school children has become a major concern in physical education and health studies, as physical literacy is seen as an important foundation for children's physical, cognitive, and affective development. International studies consistently show that physical literacy is closely related to physical health, fitness, cognitive function, and well-being kesejahteraan (Caldwell et al., 2020; Melby et al., 2022; Nilsen et al., 2020; Tang et al., 2023).

In the physical dimension, physical literacy has been shown to be related to body composition, aerobic fitness, and systolic blood pressure, with moderate-to-vigorous physical activity (MVPA) playing an important mediating role (Caldwell et al., 2020). Internationally, MVPA has also been found to contribute to the improvement of basic motor skills, such as locomotion and balance (Nilsen et al., 2020). In the cognitive dimension, physical literacy encompasses the understanding and application of movement knowledge, which is related to children's cognitive functions. Several studies report that physical activity, particularly MVPA, provides benefits for cognitive development, although the mechanisms underlying this relationship are still being explored (Melby et al., 2022; Rudd et al., 2020).. Meanwhile, in the affective dimension, physical literacy, which includes motivation and self-confidence, is associated with children's mental well-being (Aliriad, Adi S, et al., 2023; Endrawan et al., 2023). Research shows that physical literacy can reduce the risk of internalisation problems and improve psychosocial well-being, with MVPA as one of the supporting factors (Tang et al., 2023; Yli-Piipari et al., 2022).

However, most of these studies are still dominated by research in Western countries, so there is a need to explore physical literacy in local contexts, including in Indonesia. Cultural, environmental, and educational system factors can influence how physical literacy develops and how interventions should be designed to be more adaptive to the needs of primary school students

The novelty of this research lies in its attempt to contextualise physical literacy within the unique socio-cultural and geographical characteristics of indonesian primary schools, particularly in the hilly area of Gunungpati District, Semarang City. Unike previous studies, which mostly adopted a western famework, this study emphasises the integration of local culture, the utilisation of the natural environment, and post-

pandemic behavioural adaptation as important factors in the formation of children's physical literacy. This approach is expected to not only broaden the theoretical understanding of physical literacy but also provide an empirical basis for the development of a physical education model relevant to the indonesian socio-cultural context.

This novelty is in line with the objectives of this study, which are to analyse the level and dimensions of physical literacy among primary school students in Gunungpati District, Semarang City, and to identify the influence of geographical and socio-cultural factors on its development.

METHODS

This study utilised a true longitudinal design with a quantitative approach. Measurements were taken on the same subjects at two different points in time, namely in 2024 and 2025, without any special treatment (non-experimental). This design was chosen to accurately identify changes in the physical literacy levels of primary school students over the course of one academic year.

The subjects in this study were Year 5 students in 2024 and Year 6 students in 2025 from five primary schools in the Gunungpati area, Semarang City. Participants were selected purposively based on their involvement in the school's physical literacy development programme. The sampling technique used purposive sampling with the following inclusion criteria:

1. Students who took the entire series of physical literacy tests in 2024 and 2025.
2. Students were in good physical condition at the time of the test.

Based on these criteria, 99 students from the same five public elementary schools were obtained in both years of measurement. Details of the participant distribution are presented in **Table 1.**

Table 1. Research Sample

School	Students		
	Female	Male	Total
Nongkosawit 01 State Primary School	12	14	26
Sukorejo 01 State Primary School	4	15	19
Ngijo 02 State Primary School	12	3	15
Cepoko State Primary School	9	6	15
Sadeng 01 State Primary School	12	12	24

Data collection in this study was conducted using various standard instruments that evaluated three main domains of physical literacy, namely: physical competence, motivation and self-confidence, and knowledge and understanding. The instruments used refer to the Physical Literacy Test for Primary Schools – Physical Competence Domain (TLJSD-DKF) developed by Fathiyati (2022) in accordance with the official guidebook without modification, as well as the physical literacy assessment by Permana et al. (2024). The instruments used in this study were:

TIAMSA Test

This test was used to assess students' motor skills. TIAMSA adapts elements of traditional games into a test format, enabling it to measure basic motor aspects such as balance, coordination, agility, accuracy, speed, strength, and endurance in a fun way.

PACER Test (Progressive Aerobic Cardiovascular Endurance Run)

This test was used to measure students' cardiorespiratory endurance. It was conducted in the form of a back-and-forth run with a beeping sound that increased in speed at each level. The number of laps completed became an indicator of students' cardiorespiratory fitness level.

Sit-Up Test

This test is used to assess the strength and endurance of the abdominal muscles. Students perform sit-ups with their knees bent and hands beside their ears within a specified time. The number of repetitions successfully completed becomes the final assessment score.

The questionnaire instrument is used to assess non-physical domains, including motivation, self-confidence, and students' knowledge and understanding of physical literacy. This instrument has undergone content and construct validity testing and uses a 1–4 Likert scale with answer choices ranging from 'strongly disagree' to 'strongly agree.' The questionnaire was conducted online via Google Forms with the assistance of teachers and researchers. Each question item was scored according to the answer choices, and the final result was obtained by adding up the total scores. These scores were then calculated as percentages to determine the students' level of motivation, confidence, and understanding. The following is the formula used to calculate the questionnaire results: $ResultsofNumberofStudent\ (1-40)x\ 100 : HighestScore\ (40) = \text{RESULT}\ (0-100)\ (1)$

The final score can be matched with the interpreted score as **Tabel 2.**

Tabel 2. Questionnaire Categorisation

Beginning	Progressing	Achieving	Excelling
0-25	26-50	51-75	76-100

In addition to assessment through questionnaires, physical literacy is also measured through tests in the physical competency domain, consisting of TIAMSA, PACER, and Sit-Ups. The scores from each test are added together to obtain a final score, which is then compared to the norms set in the Physical Literacy Test for Primary Schools – Physical Competency Domain (TLJSD-DKF). Achievement categories are divided into four levels, namely:

- Beginner: indicates limitations in completing the test, requiring further guidance.
- Developing: indicates an improvement in basic physical abilities appropriate for the student's age.
- Achiever: indicates that the student has good physical literacy and can utilise it optimally.
- Excellent: the highest level, where students are able to manage their physical fitness independently with excellent results.

The following is the formula used to calculate students' physical literacy results:

$$\text{T}IAMSA\ (10) Point + Pacer\ (10) Point + Sit\ Up\ (10)\ Point = Physical\ CompetencyA$$
$$\text{SSEM (Rang 0– 100) POINT } (2)$$

After finding the total points obtained by adding up all the points on the test items. Thus, the final points can be matched with the final points that have been classified as **Tabel 3.**

Tabel 3. Interpretation of Physical Literacy Assessment Categorisation

Year	Beginning	Progressing	Achieving	Excelling
		Female		
8	<13.2	13.2-18.0	18.1-20.3	>20.3
9	<13.7	13.7-18.6	18.7-20.9	>20.9
10	<14.1	14.1-19.1	19.2-21.6	>21.6
11	<14.5	14.5-19.8	19.9-22.3	>22.3
12	<15.2	15.2-20.7	20.7-23.3	>23.3
		Male		
8	<13.4	13.4-19.4	19.5-22.0	>22.0
9	<13.7	13.7-19.9	20.0-22.5	>22.5
10	<14.0	14.0-20.3	20.3-23.0	>23.0
11	<14.3	14.3-20.8	20.9-23.6	>23.6
12	<14.9	14.9-21.6	21.7-24.5	>24.5

This study used a quantitative approach, in which numerical data was collected from a series of physical literacy tests administered to students over two consecutive years. The data was processed using Microsoft Excel to group the scores and initial classifications. Data analysis was then performed using SPSS version 27 through the following stages:

The Kolmogorov–Smirnov test was used because the sample size was > 50 (n=99) to determine the distribution of data for each variable.

The Paired Samples t-Test was used if the data was normally distributed to compare the results for 2024 and 2025.

The Wilcoxon Signed-Rank Test was used if the data was not normally distributed.

This was used to analyse the effect of the measurement year (fixed effect) on physical literacy, motivation, and knowledge scores, taking into account the variability between students as a random effect.

LMM is chosen because the data are repeated measures on the same individuals, thus taking into account intra-subject correlations and providing more accurate estimates.

The LMM output provides the mean difference, standard error, confidence interval (95%), and p-value to test the significance of the difference between years.

All tests were conducted at a significance level of $\alpha = 0.05$, which was the threshold for determining statistically significant differences between two measurement times for the same student.

RESULTS AND DISCUSSION

Based on the results of physical literacy measurements of students in five elementary schools in the Gunungpati region in 2024 and 2025, **Table 4** presents the average scores and classifications differentiated by gender and year of measurement. The result categories refer to the Physical Literacy Test for Elementary Schools – Physical Competence Domain (TLJSD-DKF) guidelines.

Based on physical literacy measurements in five elementary schools in the Gunungpati region in 2024–2025, there were variations between schools and genders. In general, there was an upward trend in several schools, particularly:

- Nongkosawit 01 State Primary School (boys): scores increased from 21.4 to 23.5 (remaining in the Excelling category).
- Ngijo 02 State Primary School (boys): increased from 18.0 (Progressing) to 19.5 (Achieving).

- Ngijo 02 State Primary School (girls): increased from 13.7 (Beginning) to 15.0 (Progressing).

Conversely, Sukorejo 01 State Primary School (boys) actually decreased from 18.5 to 17.3, although it remained in the Progressing category. Changes in other schools were relatively small and did not change their achievement classifications.

Table 4. Physical Literacy Assessment Results

School	Year	Gender	Average Score	Classification
Nongkosawit 01 State Primary School	2024	Male	21.4	Excelling
	2024	Female	16.2	Progressing
	2025	Male	23.5	Excelling
	2025	Female	16.8	Progressing
Sukorejo 01 State Primary School	2024	Male	18.5	Progressing
	2024	Female	16.9	Progressing
	2025	Male	17.3	Progressing
	2025	Female	16.7	Progressing
Ngijo 02 State Primary School	2024	Male	18	Progressing
	2024	Female	13.7	Beginning
	2025	Male	19.5	Achieving
	2025	Female	15	Progressing
Cepoko State Primary School	2024	Male	16	Progressing
	2024	Female	14.8	Progressing
	2025	Male	16	Progressing
	2025	Female	14.8	Progressing
Sadeng 01 State Primary School	2024	Male	17.1	Progressing
	2024	Female	15.3	Progressing
	2025	Male	18.8	Progressing
	2025	Female	16.1	Progressing

Physical Literacy Questionnaire Results: Student Motivation and Self-Confidence & Knowledge and Experience Questionnaire

Based on the results of the questionnaire completed by students, **Table 5** shows the average scores and classifications for motivation and self-confidence, as well as knowledge and understanding. The data is presented per school and measurement year, with categories according to physical literacy guidelines. The results of the questionnaire above show that:

Motivation–self-confidence: the majority of students were in the Initial category in both years of measurement. Only Cepoko State Primary School increased from 23.5 (Initial) to 26.0 (Developing), while other schools tended to stagnate or decline (e.g. Sukorejo 01 State Primary School: 23.9 → 20.2).

Knowledge–understanding: all schools were in the Developing category. However, there was a slight decrease in scores at several schools, such as Nongkosawit 01 State Primary School (27.2 → 26.0)

Table 5. Results of the Student Motivation and Self-Confidence & Knowledge and Understanding Questionnaire

School	Year	Item	Average Score	Classification
Nongkosawit 01 State Primary School	2024	Motivation and Self-Confidence	24,5	Beginning
	2024	Knowledge and Understanding	27,2	Progressing
	2025	Motivation and Self-Confidence	24,2	Beginning
	2025	Knowledge and Understanding	26,0	Progressing
Sukorejo 01 State Primary School	2024	Motivation and Self-Confidence	23,9	Beginning
	2024	Knowledge and Understanding	27,3	Progressing
	2025	Motivation and Self-Confidence	20,2	Beginning
	2025	Knowledge and Understanding	27,0	Progressing
Ngijo 02 State Primary School	2024	Motivation and Self-Confidence	25,2	Beginning
	2024	Knowledge and Understanding	30,7	Progressing
	2025	Motivation and Self-Confidence	24,3	Beginning
	2025	Knowledge and Understanding	29,5	Progressing
Cepoko State Primary School	2024	Motivation and Self-Confidence	23,5	Beginning
	2024	Knowledge and Understanding	28,2	Progressing
	2025	Motivation and Self-Confidence	26,0	Progressing
	2025	Knowledge and Understanding	26,3	Progressing
Sadeng 01 State Primary School	2024	Motivation and Self-Confidence	25,0	Beginning
	2024	Knowledge and Understanding	28,8	Progressing
	2025	Motivation and Self-Confidence	24,9	Beginning
	2025	Knowledge and Understanding	27,2	Progressing

Based on the Kolmogorov–Smirnov and Shapiro–Wilk normality tests, present the results of examining the distribution of data on physical literacy, motivation and self-confidence, as well as knowledge and understanding. This information is used to determine the appropriate type of statistical test at the next stage of analysis.

Smirnov test, all variables show a p-value > 0.05, which means that the data is normally distributed. In detail:

- Physical literacy: p-value = 0.071 (> 0.05) → normal.
- Motivation and self-confidence: p-value = 0.064 (> 0.05) → normal.

Knowledge and understanding: p-value = 0.137 (> 0.05) → normal.

Although the Shapiro–Wilk test on physical literacy produced p = 0.007, this is considered reasonable because of the sensitivity of the test on large samples (n = 99). Therefore, the analysis was continued with a Paired Samples t-Test.

Based on the results of the analysis using the Paired Samples t-Test, presents a comparison of the 2024 and 2025 scores for the variables of physical literacy, motivation and self-confidence, as well as knowledge and understanding.

- Physical literacy: The average difference between 2024 and 2025 is -0.788 with a p-value = 0.007, indicating a significant increase.
- Motivation and self-confidence: The difference is -0.212 with a p-value = 0.618, indicating no significant difference.
- Knowledge and understanding: The difference is -1.313 with a p-value = 0.004, which is significant but indicates a decline in scores.

With these results, we can see a real increase in physical literacy, stability in the motivation and self-confidence questionnaire, and a significant m decline in the knowledge and understanding questionnaire for students.

The results of this study show that the pattern of physical literacy development is not entirely balanced, but rather forms an asymmetrical trend. Statistical analysis shows that physical competence has increased significantly with a small effect size (d = 0.28). This means that although the changes that have occurred are not significant, the contribution of physical education in schools remains evident in developing students' motor skills amid the challenges of a sedentary lifestyle that is increasingly ingrained in primary school children. This upward trend is in line with a meta-analysis (Carl et al., 2022) which confirms that the physical domain of physical literacy is the aspect most responsive to regular physical activity. This finding is further strengthened by the consistency of the Linear Mixed Model (LMM) analysis results, which show that the increase is stable and not just a temporary fluctuation. The results of this study are also in line with a study (Bloch et al., 2025), which found that adding one hour of structured physical activity per week at school had a long-term effect on children's motor skills and fitness for up to one year after the intervention. This approach confirms that schools remain a strategic arena for the development of physical. Literacy, particularly in the dimension of motor skills. Additionally, findings from (Al Mukharom et al., 2024; Kojić et al., 2024) support and sharpen the findings that structural physical interventions over a longer period (6 months) significantly improve agility, coordination, and motor speed in preschool children, emphasising. The importance of planned and repeated PE activities (Adi et al., 2023).

However, when these findings are analysed in more detail based on each dimension of physical literacy, an uneven pattern of development emerges. Physical competence does show significant improvement, but students' motivation and self-confidence remain relatively stagnant, while knowledge and understanding of physical activity experience a significant decline. This asymmetrical pattern confirms that physical literacy does not develop linearly but multidimensionally, with each domain influenced by different factors. In the physical domain, the significant improvement three main aspects. First, biological factors in the form of the natural motor maturation of school-age children. (Yapici et al., 2022) emphasise that biological maturation is a fundamental factor in the development of physical literacy, particularly in terms of motor competence. Adolescents with a higher level of maturation tend to exhibit greater muscle strength and power, which in turn contributes significantly to the quality of motor performance. These findings underscore that biological development is not merely a natural process, but also serves as a major determinant that influences the motor performance of school- age children (Aliriad, Da'i, et al., 2023). Findings from (Costa et al., 2024) through the 'Super Quinas' project show that adding 60 minutes of extracurricular physical activity sessions per week for 12 weeks can improve the motor skills of primary school children by up to 27%. In addition, this intervention has also been proven effective in increasing the duration of moderate to vigorous physical

activity (MVPA) while reducing sedentary time. . (Fang & Ho, 2020) found that providing an introductory session before conducting motor skills tests can improve the reliability of measurement results by minimising anxiety and the 'shock test' effect often experienced by students. This means that improvements in motor skills scores not only reflect physiological and environmental development but are also influenced by technical readiness in facing evaluation situations.

On the other hand, stagnation in the dimension of motivation-self-confidence reveals more complex pedagogical challenges. Self-Determination Theory (Ryan & Deci, 2000), explains that intrinsic motivation can only grow when learning experiences provide space for autonomy, competence, and social connectedness. In other words, improvements in motor skills do not automatically correlate with increases in motivation. This condition is in line with the findings (Liu & Chen, 2022) which confirm that without explicit pedagogical interventions targeting the affective domain, student motivation tends to stagnate even though physical skills improve. This means that success in the physical domain is not always followed by an increase in motivational aspects, so that PE learning design needs to balance physical aspects with strategies to strengthen student motivation. The results of this study also need to be considered in terms of the decline in the knowledge-understanding dimension. These results indicate structural weaknesses in PE learning practices in primary schools. First, the PE curriculum formally requires the development of knowledge, skills, and attitudes, but evidence of implementation shows that at the primary school level, learning practices tend to prioritise motor skills training, so that the portion of conceptual teaching (knowledge and understanding) is often limited (Faridha Isnaini, 2017; Nurjanah et al., 2024; Setyawan, 2021). Second, assessment administration procedures can affect results; in this study, the knowledge questionnaire was given after the physical test, so physical fatigue may have reduced the students' concentration. Third, a digital lifestyle characterised by high screen time has been shown to be associated with an increase in sedentary behaviour and a decrease in physical activity, making it easier for children to focus their attention on digital media rather than conceptual learning of physical activities (Engberg et al., 2022; Priftis & Panagiotakos, 2023). This trend is consistent with reports (Longmuir et al., 2018) finding that the cognitive domain of physical literacy tends to stagnate or even decline when not supported by concept-based learning. Thus, although PE is effective in building motor skills, it is not yet strong enough to foster students' conceptual understanding of the importance of physical activity for long-term health (Yuwono et al., 2024).

When all of these research results are reviewed as a whole, it can be seen that the development of students' physical literacy is asymmetrical: the physical domain has increased, the motivational domain has stagnated, while the cognitive domain has actually declined. This asymmetrical pattern confirms that physical literacy in primary schools has not developed multidimensionally as ideally, but rather partially with a dominance in the physical aspect. The common thread in these findings is the imbalance between the ideal goals of physical literacy, which encompass the physical, affective, and cognitive domains, and the practice of physical education, which is still predominantly oriented towards the motor domain. However, when compared with international literature, the results of this study reveal two important implications. First, the positive trend in physical competence is consistent with the findings of (Carl et al., 2022), but differs from (Robinson et al., 2015) and (Caldwell et al., 2020), who found a positive correlation between the dimensions of physical literacy, where an increase in the physical domain is usually followed by an increase in motivation and knowledge. Second, this difference in patterns highlights contextual factors in Indonesia, particularly in the PE curriculum structure, which emphasises motor skills over conceptual literacy. From this perspective, this study enriches the global literature by showing that the development of physical literacy can be asymmetrical, depending on the educational context.

Upon closer examination, these findings have practical implications. Physical Education (PE) teachers need to design learning strategies that not only emphasize motor skills age children (Aliriad, Da'i, et al., 2023). Findings from (Costa et al., 2024) through the 'Super Quinas' project show that adding 60 minutes of extracurricular physical activity sessions per week for 12 weeks can improve the motor skills of primary school children by up to 27%. In addition, this intervention has also been proven effective in increasing the duration of moderate to vigorous physical activity (MVPA) while reducing sedentary time. . (Fang & Ho, 2020) found that providing an introductory session before conducting motor skills tests can improve the reliability of measurement results by minimising anxiety and the 'shock test' effect often experienced by students. This means

that improvements in motor skills scores not only reflect physiological and environmental development but are also influenced by technical readiness in facing evaluation situations.

On the other hand, stagnation in the dimension of motivation-self-confidence reveals more complex pedagogical challenges. Self-Determination Theory (Ryan & Deci, 2000), explains that intrinsic motivation can only grow when learning experiences provide space for autonomy, competence, and social connectedness. In other words, improvements in motor skills do not automatically correlate with increases in motivation. This condition is in line with the findings (Liu & Chen, 2022) which confirm that without explicit pedagogical interventions targeting the affective domain, student motivation tends to stagnate even though physical skills improve. This means that success in the physical domain is not always followed by an increase in motivational aspects, so that PE learning design needs to balance physical aspects with strategies to strengthen student motivation. The results of this study also need to be considered in terms of the decline in the knowledge-understanding dimension. These results indicate structural weaknesses in PE learning practices in primary schools. First, the PE curriculum formally requires the development of knowledge, skills, and attitudes, but evidence of implementation shows that at the primary school level, learning practices tend to prioritise motor skills training, so that the portion of conceptual teaching (knowledge and understanding) is often limited (Faridha Isnaini, 2017; Nurjanah et al., 2024; Setyawan, 2021). Second, assessment administration procedures can affect results; in this study, the knowledge questionnaire was given after the physical test, so physical fatigue may have reduced the students' concentration. Third, a digital lifestyle characterised by high screen time has been but also provide space for increasing students' intrinsic motivation and strengthening knowledge aspects (Aliriad, Adi, et al., 2024; Nadea et al., 2024). For example, integrating project-based learning models, reflective approaches, or utilizing educational digital media can help balance the multidimensional development of physical literacy. The curriculum also needs to place the cognitive and affective domains alongside the physical domain so that physical literacy develops holistically. In other words, although the physical literacy trend in the competency domain shows a positive direction, the non-physical dimension actually signals future pedagogical challenges that must be addressed immediately. Thus, although the physical literacy trend of elementary school students in Gunungpati District shows a positive direction in the physical dimension, the results of this study also signal future pedagogical challenges. If not anticipated, the development of physical literacy will only produce students who are skilled at moving but lack motivation and have minimal conceptual understanding. This research emphasizes the importance of a holistic, sustainable, and contextual approach to physical literacy as a foundation for strengthening physical education in Indonesia.

CONCLUSION

Study shows that the physical literacy of elementary school students in Gunungpati District developed asymmetrically in 2024–2025: increasing in physical competence, stagnating in motivation–self-confidence, and declining in knowledge–understanding. This pattern confirms that physical literacy does not grow linearly, but is multidimensional with different dynamics across domains. These findings have important implications for physical education practices. While structured physical activity effectively promotes physical development, more innovative pedagogical strategies are needed to stimulate students' motivation and conceptual understanding. Therefore, schools need to balance the physical education curriculum so that it emphasizes not only motor skills but also builds awareness, understanding, and positive attitudes toward physical activity.

REFERENCES

Adi, S., Aliriad, H., Arbanisa, W., Winoto, A., Ramadhan, I., & Rizqanada, A. (2023). High intensity interval training on physical fitness. Jurnal Maenpo: Jurnal Pendidikan Jasmani Kesehatan Dan Rekreasi, 13(2), zz.

Adi, S., Nurharsono, T., Soenyoto, T., & Yuwono, C. (2024). Mapping the Landscape of Physical Literacy Research: A Bibliometric Analysis. Proceedings of International Conference on Physical Education, Health, and Sports, 4, zz.

Adi, S., Soenyoto, T., Aliriad, H., & Utama, M. B. R. (2025). MANAJEMEN AKTIVITAS FISIK SISWA. Cahya Ghani Recovery.

Adi S, Soenyoto, T., Yuwono, C., & Nurharsono, T. (2025). Exploring physical literacy, physical activity, motivation, and learning outcomes in elementary school PE . Edu Sportivo: Indonesian Journal of Physical Education, 6(1 SE-RESEARCH ARTICLES), 67–77. https://doi.org/10.25299/esijope.2025.vol6(1).17879

Adi S, Tommy Soenyoto, & Agus Darmawan. (2025).

Expansion of SLR Competencies and AI-Based Class Action Research Methods of Physical Education Teachers in Gunungpati District. GANDRUNG: Jurnal Pengabdian Kepada Masyarakat, 6(1 SE-Articles), 1954–1964. https://doi.org/10.36526/gandrung.v6i1.4230

Al Mukharom, F. A., Setiawan, I., & Pujianto, A. (2024). Model Pembelajaran Kebugaran Jasmani Melalui Permainan (3L Healthy) Siswa SLB di Tegal. Indonesian Journal for Physical Education and Sport, 5(2), 774–783.

Aliriad, H., Adi, S., Manullang, J. G., Endrawan, I. B., & Satria, M. H. (2024). Improvement of Motor Skills and Motivation to Learn Physical Education Through the Use of Traditional Games. Physical Education Theory and Methodology, 24(1 SE-Original Scientific Articles), zz. https://doi.org/10.17309/tmfv.2024.1.04

Aliriad, H., Adi S, Fahrudi, A., Apriyanto, R., & Da'i, M. (2023). Exploring the relationship between body mass index and physical fitness: Implications from a comprehensive study in a secondary school setting. Edu Sportivo: Indonesian Journal of Physical Education, 4(2 SE-RESEARCH ARTICLES), zz. https://doi.org/10.25299/es:ijope.2023.vol4(2).12775

Aliriad, H., Da'i, M., Adi, S., & Apriyanto, R. (2023). Strategi Peningkatan Motorik untuk Menstimulus Motorik Anak Usia Dini melalui Pendekatan Aktivitas Luar Ruangan. Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, 7(4), zz.

Aliriad, H., S, A., Saputro, D. P., Fahmi, D. A., & Waskito, S. Y. (2024). Memperkuat keterampilan motorik anak usia dini melalui pengalaman eksplorasi aktivitas di luar ruangan. Jurnal Olahraga Pendidikan Indonesia (JOPI), 3(2 SE-Articles), 126–141. https://doi.org/10.54284/jopi.v3i2.363

Andriyani, F. D., Biddle, S. J. H., Arovah, N. I., & Cocker, K. De. (2020). Physical Activity and Sedentary Behavior Research in Indonesian Youth: A Scoping Review. International Journal of Environmental Research and Public Health, 17(20). https://doi.org/10.3390/ijerph17207665

Ardiana, P. A. (2024). Analysis of physical activity to improve students basic movement skills physical literacy based primary school. Gladi: Jurnal Ilmu Keolahragaan, 15(01), 10–23.

Bereziuk, D. (2023). Content, Forms and Methods of Work on the of Physical Education of Primary School Students in the Socio-Cultural Environment. B U L L E T I N of Oleksandr Dovzhenko Hlukhiv National Pedagogical University, 52(2), 248–254. https://doi.org/10.31376/2410-0897-2023-2-52-248-254

Bloch, M., Cordovil, R., Rodrigues, L. P., Martins, C., Braga, M. L., Vale, S., Proença, R., Brito, J., Guilherme, J., Neto, C., Seabra, A., & Costa, J. A. (2025). The impact of a school-based physical activity program on children's movement behaviors, aerobic fitness and motor competence: a follow up study. Frontiers in Sports and Active Living, 7, 1541862. https://doi.org/10.3389/fspor.2025.1541862

Britton, Ú., Belton, S., Peers, C., Issartel, J., Goss, H., Roantree, M., & Behan, S. (2022). Physical literacy in children: Exploring the construct validity of a multidimensional physical literacy construct. European Physical Education Review, 29(2), zz. https://doi.org/10.1177/1356336X221131272

Britton, Ú., Onibonoje, O., Belton, S., Behan, S., Peers, C., Issartel, J., & Roantree, M. (2023). Moving well-being well: Using machine learning to explore the relationship between physical literacy and well-being in children. Applied Psychology: Health and Well-Being, 15(3), zz. https://doi.org/10.1111/aphw.12429

Caldwell, H. A. T., Di Cristofaro, N. A., Cairney, J., Bray, S. R., MacDonald, M. J., & Timmons, B. W. (2020). Physical literacy, physical activity, and health indicators in school-age children. International Journal of Environmental Research and Public Health, 17(15), zz.

Carl, J., Barratt, J., Wanner, P., Töpfer, C., Cairney, J., & Pfeifer, K. (2022). The Effectiveness of Physical Literacy Interventions: A Systematic Review with Meta-Analysis. Sports Medicine, 52(12), 2965–2999. https://doi.org/10.1007/s40279-022-01738-4

Costa, J. A., Vale, S., Cordovil, R., Rodrigues, L. P., Cardoso, V., Proença, R., Costa, M., Neto, C., Brito, J., Guilherme, J., & Seabra, A. (2024). 104 Impact of a School-Based Physical Activity Intervention program on Physical Activity Levels, Sleep Patterns, Aerobic Fitness, and Motor Competence. European Journal of Public Health, 34(Supplement_2), ckae114.078. https://doi.org/10.1093/eurpub/ckae114.078

Dresp-Langley, B. (2020). Children's Health in the Digital Age. In International Journal of Environmental Research and Public Health (Vol. 17, Issue 9). https://doi.org/10.3390/ijerph17093240

Endrawan, I. B., Aliriad, H., Apriyanto, R., Da'i, M., Adi, S., Cahyani, O. D., Santoso, S., & Muryadi, A. D. (2023). The Relationship between Sports and Mental Health: Mdrsjrns, 11(2), zz. https://doi.org/10.58209/hehp.11.2.215

Engberg, E., Hietajärvi, L., Maksniemi, E., Lahti, J., Lonka, K., Salmela-Aro, K., & Viljakainen, H. (2022). The longitudinal associations between mental health indicators and digital media use and physical activity during adolescence: A latent class approach. Mental Health and Physical Activity, 22, 100448. https://doi.org/https://doi.org/10.1016/j.mhpa.2022.100448

Fang, H., & Ho, I. M. K. (2020). Intraday reliability, sensitivity, and minimum detectable change of National Physical Fitness Measurement for preschool children in China. PLoS ONE, 15(11 November), 1–13. https://doi.org/10.1371/journal.pone.0242369

Faridha Isnaini. (2017). buku Pendidikan Jasmani dan Kesehatan. In Pusat Kurikulum dan Perbukuan, Balitbang, Kemendikbud.

Firmansyah, G., S, A., & Nova, A. (2024). Motivasi belajar peserta didik tingkat sekolah menengah atas pada mata pelajaran PJOK: sebuah analisis pada konteks Kurikulum Merdeka Belajar. Jurnal Olahraga Pendidikan Indonesia (JOPI), 4(1 SE-Articles), zz. https://doi.org/10.54284/jopi.v4i1.465

Ginanjar, S., Faridah, E., Kusmiyati, Nur, Halim, A., Andi, Adi, N., Andarias, S., Manalu, N., Anas, M., Mohammad, S., Fadhilah, E., Al, Tajuddin, I., Pungki, Lucky, I., Hardiyanto, P., Murtadho, A., Kurniawati, A., & adi, wijayanto. (2024). Sehat dan Bugar Melalui Pendidikan Jasmani dan Olahraga (p. zz). https://doi.org/10.5281/zenodo.11387822

Jimenez-Loaisa, A. . D. los R.-C. M. . M.-M. J. . & V. V. J. (2023). Q3 tb. 2041(2021), 444–451.

Jiménez-Loaisa, A., de los Reyes-Corcuera, M., Martínez-Martínez, J., & Valenciano Valcárcel, J. (2023). Niveles de actividad y condición física en escolares de Educación Primaria en la "nueva normalidad" (Levels of activity and physical condition in primary school students in the "new normality"). Retos, 47(SE-Artículos de carácter científico: investigaciones básicas y/o aplicadas), 442–451. https://doi.org/10.47197/retos.v47.94903

Kojić, F., Arsenijević, R., Grujić, G., Toskić, L., & Šimenko, J. (2024). Effects of Structured Physical Activity on Motor Fitness in Preschool Children. Children (Basel, Switzerland), 11(4). https://doi.org/10.3390/children11040433

Liu, Y., & Chen, S. (2022). Characterizing Middle School Students' Physical Literacy Development: A Self-Determination Theory-Based Pilot Intervention in Physical Education. Frontiers in Sports and Active Living, 3(January), 1–12. https://doi.org/10.3389/fspor.2021.809447

Melby, P. S., Nielsen, G., Brønd, J. C., Tremblay, M. S., Bentsen, P., & Elsborg, P. (2022). Associations between children's physical literacy and well-being: is physical activity a mediator? BMC Public Health, 22(1), 1267. https://doi.org/10.1186/s12889-022-13517-x

Nadea, M., Raharjo, A., Adi, S., & Putri, D. T. (2024). Survei Minat Siswa Dalam Mengikuti Kegiatan Ektrakurikuler Sepaktakraw Di Ma Ma'arif Borobudur Magelang Tahun Ajaran 2023/2024. Indonesian Journal for Physical Education and Sport, 5(1), zz.

Navarra, G. A., Thomas, E., Scardina, A., Izadi, M., Zangla, D., De Dominicis, S., Cataldo, P., Proia, P., & Bellafiore, M. (2021). Effective Strategies for Promoting Physical Activity through the Use of Digital Media among School-Age Children: A Systematic Review. In Sustainability (Vol. 13, Issue 20). https://doi.org/10.3390/su132011270

Nilsen, A. K. O., Anderssen, S. A., Johannessen, K., Aadland, K. N., Ylvisaaker, E., Loftesnes, J. M., & Aadland, E. (2020). Bi-directional prospective associations between objectively measured physical activity and fundamental motor skills in children: a two-year follow-up. International Journal of Behavioral Nutrition and Physical Activity, 17(1), 1. https://doi.org/10.1186/s12966-019-0902-6

Nurjanah, P. C., Adi, S., & Billiandri, B. (2024). Perbandingan Faktor Penunjang Dan Penghambat Pembelajaran Renang Pada Siswa SMP Reguler Dan Kelas Khusus Olahraga Grobogan. Indonesian Journal for Physical Education and Sport, 5(2), 688–698.

Ortiz-Sanchez, J. A., del Pozo-Cruz, J., Álvarez Barbosa, F., & Alfonso-Rosa, R. M. (2023). Análisis longitudinal de composición corporal, función física y rendimiento académico en niños/as (Longitudinal analysis of body composition, physical function and academic performance in children). Retos, 47(SE-Artículos de carácter científico: investigaciones básicas y/o aplicadas), 268–274. https://doi.org/10.47197/retos.v47.95102

Permana, R., Isti'adah, F. N., Dewi, R. S., Nurkamilah, M., Fitri, S., Nofrizal, D., Purba, P. H., Pranata, D. Y., & Sari, L. P. (2024). Instrument for Assessing Physical Literacy Skills Competence in Primary School Tasikmalaya, Indonesia. Retos: Nuevas Perspectivas de Educación Física, Deporte y Recreación, 58, zz. https://doi.org/https://doi.org/10.47197/retos.v58.107671

Priadana, B. W., Saifuddin, H., & Prakoso, B. B. (2021). Kelayakan pengukuran aspek pengetahuan pada instrumen physical literacy untuk siswa usia 8-12 tahun. Multilateral : Jurnal Pendidikan Jasmani Dan Olahraga, 20(1), 21. https://doi.org/10.20527/multilateral.v20i1.9675

Priftis, N., & Panagiotakos, D. (2023). Screen time and its health consequences in children and adolescents. Children, 10(10), 1665.

Rahayu, A., Setyawan, H., Sabariah, S., Rufi'i, R., Hendri, N., Safrudin, S., Nurkadri, N., Gontara, S. Y., Arien, W., Susanto, S., & Sanjaykumar, S. (2024). Article RETRACTED due to manipulation by the authors Estrategias para aumentar la actividad física de los niños de primaria en la era digital para favorecer un estilo de vida saludable: Article RETRACTED due to manipulation by the authors. Retos, 61(SE-Revisiones teóricas sistemáticas y/o metaanálisis), 1410–1421. https://doi.org/10.47197/retos.v61.110184

Ramer, J. D., & Bustamante, E. E. (2022). Longitudinal Path Analysis Of Child Behavior Difficulties And Physical Activity Behaviors From Early Childhood To Adolescence.: 370. Medicine & Science in Sports & Exercise, 54(9S). https://journals.lww.com/acsm-msse/fulltext/2022/09002/longitudinal_path_analysis_of_child_behavior.270.aspx

Robinson, L. E., Stodden, D. F., Barnett, L. M.,

Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. Sports Medicine, 45(9), 1273–1284.

Rudd, J. R., Pesce, C., Strafford, B. W., & Davids, K. (2020). Physical Literacy - A Journey of Individual Enrichment: An Ecological Dynamics Rationale for Enhancing Performance and Physical Activity in All. Frontiers in Psychology, 11(July), 1–13. https://doi.org/10.3389/fpsyg.2020.01904

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68.

Sari, A. P., Aswara, A. Y., & Bekti, S. (2023). Budaya berolahraga anak Jawa Timur: Studi kontrastif berdasarkan urbanitas dan jenis sekolah. Jurnal Ilmiah Mandala Education, 9(1), 543–548. https://doi.org/10.58258/jime.v9i1.4695

Septian, I. B., & Adi, S. D. (2025). Dasar di Dataran Rendah dan Dataran Tinggi ? 17, 190–209.

Setyawan, H. (2021). Physical Education in Primary Schools As an Effective Means. Jurnal Pendidikan Dasar Dan Aktifitas Jasmani, 1, 33–41.

Soenyoto, T., Adi, S., Darmawan, A., Aliriad, H., & Utama, M. B. R. (2025). Smart physical education: Integrating flipped classroom with IoT and android for enhanced learning. Journal of Human Sport and Exercise, 20(4), 1122–1132.

St. John, L., Dudley, D., & Cairney, J. (2021). A longitudinal examination of enjoyment of physical education in children with developmental coordination disorder through a physical literacy lens. PROSPECTS, 50(1), 127–139. https://doi.org/10.1007/s11125-020-09469-y

Tang, Y., Algurén, B., Pelletier, C., Naylor, P.-J., & Faulkner, G. (2023). Physical Literacy for Communities (PL4C): physical literacy, physical activity and associations with wellbeing. BMC Public Health, 23(1), 1266. https://doi.org/10.1186/s12889-023-16050-7

Teich, P., Fühner, T., Granacher, U., & Kliegl, R. (2023). Physical fitness of primary school children differs depending on their timing of school enrollment. Scientific Reports, 13(1), 8788. https://doi.org/10.1038/s41598-023-35727-y

Terrón-Pérez, M., Molina-García, J., Martínez-Bello, V. E., & Queralt, A. (2021). Relationship Between the Physical Environment and Physical Activity Levels in Preschool Children: A Systematic Review. Current Environmental Health Reports, 8(2), 177–195. https://doi.org/10.1007/s40572-021-00318-4

Yapici, H., Gulu, M., Yagin, F. H., Eken, O., Gabrys, T., & Knappova, V. (2022). Exploring the Relationship between Biological Maturation Level, Muscle Strength, and Muscle Power in Adolescents. In Biology (Vol. 11, Issue 12). https://doi.org/10.3390/biology11121722

Yli-Piipari, S., Gråstén, A., Huhtiniemi, M., Salin, K., & Jaakkola, T. (2022). One-year stability of physical education-centered physical literacy indicators on objectively measured physical activity. European Physical Education Review, 28(2), zz. https://doi.org/10.1177/1356336X211046302

Yulia, C., Khomsan, A., Sukandar, D., & Riyadi, H. (2018). Nutritional Status, Physical Activity, Sedentary Activity of School Children in Urban area, West Java, Indonesia. Jurnal Gizi Dan Pangan, 13(3), 123–130. https://doi.org/10.25182/jgp.2018.13.3.123-130

Yuwono, C., Adi, S., Annas, M., Darmawan, A., Billiandri, B., Putri, D. T., & Pratama, A. B. (2024). Determinants of Performance of 12-Year-Old Soccer School Players in Central Java. ACTIVE: Journal of Physical Education, Sport, Health and Recreation, 13(2), zz.