



Beyond barriers: assessing physical literacy in children with special needs

Más allá de las barreras: evaluación de la alfabetización física en niños con necesidades especiales

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Abstract

Introduction and Objective. Physical literacy is a holistic concept integrating physical, cognitive, and affective dimensions, yet its development among children with special needs in Indonesia remains understudied. This study aims to describe the level and characteristics of physical literacy among students with special educational needs in Semarang City, focusing on variations across educational stages and disability types.

Methodology. Using a quantitative descriptive design with a cross-sectional approach, data were collected from 228 students aged 6–16 years enrolled in special schools. The adapted PLAYself and PLAYinventory instruments were administered through guided observation and structured online questionnaires over three months. Descriptive statistical analysis was used to calculate means and percentage distributions for each domain of physical literacy.

Results. The findings revealed that most students were categorized within the initial and emerging levels, with improvements at the junior secondary stage followed by a decline at the senior level. The highest average scores appeared in the self-description and environment domains, while literacy and numeracy showed lower values, indicating limited cognitive integration in physical activity contexts.

Conclusion. These results suggest that the development of physical literacy in children with special needs is shaped not only by motor competence but also by psychosocial and contextual influences. The study concludes that inclusive, sustainable, and experience-based pedagogical strategies are essential to strengthen both cognitive and affective components of physical literacy, contributing to a more equitable and meaningful physical education framework for students with diverse abilities.

Keywords

Physical literacy; children with special needs; inclusive Physical Education; Semarang city.

Resumen

Introducción y Objetivo. La alfabetización física constituye un concepto holístico que integra dimensiones físicas, cognitivas y afectivas; sin embargo, su desarrollo en niños con necesidades educativas especiales en Indonesia sigue siendo poco investigado. El objetivo de este estudio fue describir el nivel y las características de la alfabetización física en estudiantes con necesidades educativas especiales en la ciudad de Semarang, analizando las variaciones según el nivel educativo y el tipo de discapacidad.

Metodología. Se empleó un diseño descriptivo cuantitativo con un enfoque transversal. Los datos se recopilieron de 228 estudiantes de entre 6 y 16 años matriculados en escuelas especiales. Los instrumentos PLAYself y PLAYinventory, adaptados al contexto local, se aplicaron mediante observación guiada y cuestionarios estructurados durante tres meses. El análisis estadístico descriptivo permitió calcular los promedios y las distribuciones porcentuales de cada dominio de alfabetización física.

Resultados. Los resultados mostraron que la mayoría de los estudiantes se ubicaron en los niveles inicial y emergente, con una mejora en la etapa de secundaria básica seguida de un descenso en la etapa superior. Los puntajes más altos se observaron en los dominios de autodescripción y entorno, mientras que los de alfabetización y numeración fueron menores, lo que refleja una limitada integración cognitiva en las actividades físicas.

Conclusiones. Se concluye que el desarrollo de la alfabetización física en estos estudiantes está determinado no solo por la competencia motora, sino también por factores psicosociales y contextuales. Se recomienda implementar estrategias pedagógicas inclusivas, sostenibles y basadas en la experiencia para fortalecer la alfabetización física de manera integral.

Palabras clave

Alfabetización física; niños con necesidades especiales; Educación Física inclusiva; ciudad de Semarang.



Introduction

Physical literacy, particularly in children with Special Educational Needs (SEN), represents not only a foundation for active participation but also a developmental pathway that supports autonomy, inclusion, and adaptive functioning (Jones et al., 2018). This concept has gained widespread attention in the fields of education and health as it plays an important role in shaping an active, healthy, and inclusive lifestyle from an early age. In the context of modern physical education, physical literacy is seen as a paradigm that integrates physical, cognitive, and affective aspects of fitness holistically across the life span (Durden-Myers & Bartle, 2023; Valle-Muñoz et al., 2025).

In addition to providing physical health benefits, physical literacy also contributes to children's cognitive, social, and emotional development. However, children with special needs often face significant barriers in developing physical literacy due to motor and sensory limitations, as well as environmental and social barriers (Cairney et al., 2019; Pushkarenko et al., 2023). These barriers often lead to isolation, exclusion, and a lack of access to adaptive physical activity programs (X. Liu et al., 2025).

In the Indonesian context, the implementation of inclusive physical education in Sekolah Luar Biasa (SLB) remains uneven. In Semarang City, SLB represent the primary educational setting for children with NEE, where physical activity programs are often limited to basic motor training without systematic assessment of physical literacy. However, children with special needs still face major challenges in obtaining opportunities to participate in meaningful physical activities that are appropriate to their abilities (Martin Ginis et al., 2021). Data from the Ministry of Education, Culture, Research and Technology (2023) shows that approximately 135,946 students with special needs are enrolled in various levels of education, but this number may not reflect the entire population due to data collection issues in various regions. In addition, the 2020 Population Census data released by the Central Bureau of Statistics shows a high number of people aged five years and above who experience difficulties in daily activities, including taking care of themselves, learning, and communicating (Ikawati et al., 2024; Kementerian Pendidikan, 2023).

To date, studies assessing physical literacy among children with NEE in SLB contexts remain scarce in Indonesia. No prior research has systematically measured their physical literacy using adapted international tools such as PLAYself and PLAYinventory. So far, the available data on physical activity levels is still generalized (de Vaan et al., 2016; Miller et al., 2024). Semarang City, as one of the major cities with a growing number of inclusive schools, requires data collection on physical literacy assessments. Semarang is one of the major cities in Indonesia that has seen an increase in the number of inclusive education institutions, with 18 primary schools and 7 junior secondary schools implementing inclusive programs (Yusrul et al., 2021). This calls for a standardized approach to measuring physical literacy for children with special needs, so that the controlled development of inclusive education can be achieved.

Globally, assessment models such as the Canadian Assessment of Physical Literacy (CAPL and CAPL-2) and PLAY tools have been adapted and tested in various countries. For example, they were successfully validated with children in China, Greece and Denmark, proving their flexibility and ability to adapt the conceptual framework to different cultural contexts (Caldwell et al., 2020; Elsborg et al., 2021a, 2021b; Y. Liu et al., 2023). Moreover, the association between physical literacy measured through a combination of PLAY tools with health indicators such as aerobic fitness and motivation has been proven in Canada, while normative results of CAPL have shown significant associations between physical literacy and sedentary behavior as well as cardiovascular fitness in primary school age groups (8-12 years) (Tremblay et al., 2018). However, in Indonesia, attention to physical literacy at the primary, junior secondary, and senior secondary education levels is still limited. This study aims to (1) quantify the level of physical literacy among students with special educational needs enrolled in SLB in Semarang City using adapted PLAYself and PLAYinventory instruments, and (2) compare literacy profiles across educational stages (primary, junior secondary, senior secondary).



Method

Participants

This study used a descriptive quantitative design with a cross-sectional approach to describe the level of physical literacy among children with special needs in Semarang City. This approach was chosen because it is suitable for capturing actual conditions without conducting experimental interventions (Barnett et al., 2023). The target population included children aged 6–16 years enrolled in special schools in Semarang City. The inclusion criteria were: (1) active students at the elementary, junior high, or high school level; (2) diagnosed with special needs such as intellectual disability, autism, or visual impairment; and (3) able to participate in the assessment with or without an assistant. Exclusion criteria included severe communication or cognitive impairments that hindered the assessment process and the unwillingness of parents/guardians to give permission. The recruitment process was carried out after obtaining ethical approval from the Semarang City Education Office and written consent from the school and parents. The ethical procedures of the study followed international guidelines (Huang et al., 2024).

Procedure

The instruments used consist of two assessment tools that have undergone linguistic and cultural adaptation, namely PLAYself and PLAYinventory.: (1) PLAYself is used to measure children's self-perceptions of physical literacy through five main domains: self-description (perceptions of one's abilities), literacy (understanding of physical activity concepts), numeracy (ability to relate activities to quantitative aspects such as time and distance), environment (comfort participating in various activity environments), and overall physical literacy (general assessment of physical literacy) (Sum et al., 2018). This questionnaire consists of 22 items on a 1–5 Likert scale, where higher scores reflect a more positive perception of physical literacy. (2) The PLAYinventory is completed by teachers or parents to document the types and frequency of physical activities performed by children at home and at school (Carl et al., 2022; Yudhistira et al., 2025). There are 25 questions covering the frequency, variety, and context of activity participation. Each item is assessed based on relative duration and intensity, with a score range of 0 (never) to 4 (very often). The language adaptation process was carried out using the translation–back translation technique by experts in physical education and linguistics (Akhiruyanto & Yudhistira, 2024; Chagas et al., 2020). Initial trials involved 10 respondents to ensure language clarity and content consistency. Data was collected at schools over a period of three months with the assistance of accompanying teachers. For students who could not read, structured interviews were used to ensure understanding of each question. The enumerator team was trained to ensure that instructions were delivered consistently and in accordance with research ethics.

Data analysis

Each response on the PLAYself questionnaire is summed to obtain domain and total scores, which are then normalized on a scale of 0–100 for statistical description purposes. Because this study focuses on initial descriptive exploration and does not yet have a strong psychometric basis (e.g., α or ω coefficients), the interpretation of the results is not classified into ability level categories (initial, emerging, proficient, competent) as in previous studies (Li et al., 2020; Yudhistira et al., 2021). but are presented descriptively in the form of means, standard deviations, and percentage distributions. Data analysis was performed using descriptive statistics (mean, standard deviation, and percentage) with the help of Microsoft Excel. Visualization was presented through bar charts and heatmaps to illustrate the variation in scores between domains. The reporting approach followed the STROBE guidelines to maintain data transparency and accountability (Ofori et al., 2025).

Results

The research findings were derived from the PLAYSelf and PLAY Inventory questionnaires. A total of 228 children participated in this study.

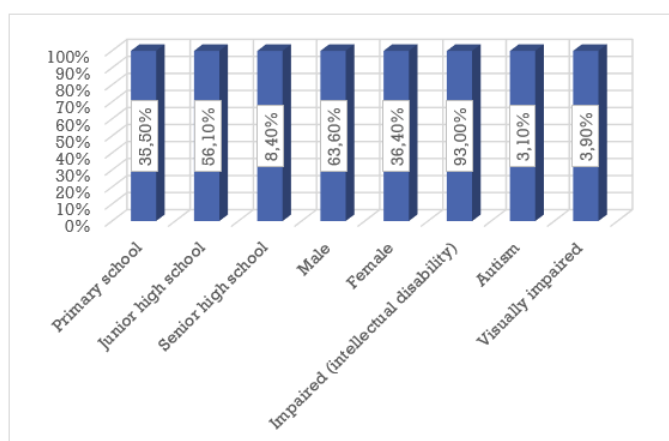


Table 1. Participants Demographics

Variable	Grades	n	Count
Education Level			
Primary school	81	35,5%	35,5%
Junior high school	128	56,1%	56,1%
Senior high school	19	8,4%	8,4%
Gender			
Male	145	63,6%	63,6%
Female	83	36,4%	36,4%
Type of Special Needs			
Impaired (intellectual disability)	212	93,0%	93,0%
Autism	7	3,1%	3,1%
Visually impaired	9	3,9%	3,9%

The majority of respondents were from junior secondary level (56.1%) and were male students (63.6%). Most of them were categorized as having special needs of tunagrahita (93%). This data suggests that the study population reflects the real conditions in special schools in Semarang City, which are dominated by students with intellectual disabilities.

Figure 1. Physical Literacy Self-Description



The results showed that most primary school students were in the initial (41.1%) and emerging (45.2%) categories, while only 13.7% reached the proficient category and none were classified as competent. At the junior high school level, the proportion of proficient increased to 35%, and 2.5% of students began to show competent achievements. However, at the senior high school level, the trend decreased again: 50% were in the initial category, 25% emerging, 20% proficient, and 5% competent. Overall, this pattern forms an inverted pyramid-like distribution: the higher the level of education, the smaller the proportion of students in the high physical literacy category. This means that an increase in school level is not always accompanied by an increase in physical literacy skills.

Table 2. Average Score of PLAYself Domain by Education Level

Domain	primary school	Junior high school	senior high school	Average	Standart deviasi
Environment	271	287	666	408,0	223,6
Self-Description	668	641	230	513,0	245,5
Literacy	104	276	60	146,7	114,2
Numeracy	132	232	56	140,0	88,3
Overall Physical Literacy	271	287	230	262,7	29,4

Figure 2. PLAYSelf Categories According to Participants' Disability

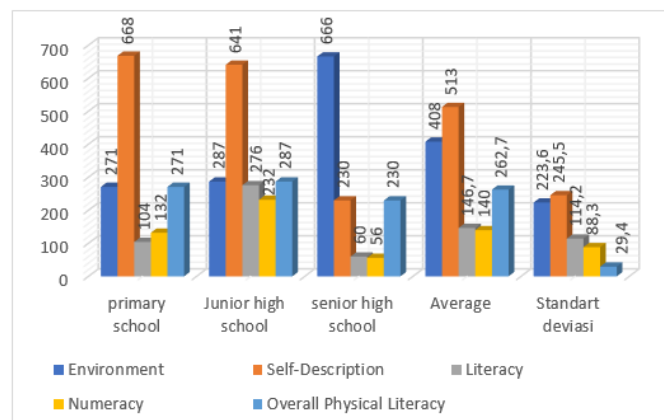


Table 2 and Figure 2 display the mean scores of the five physical literacy domains measured using the PLAYself instrument. The pattern of scores shows clear variations between education levels. In the primary school group, the highest score was in the self-description domain (668), indicating a positive self-perception of basic movement skills. In contrast, literacy (104) and numeracy (132) scores were relatively low, reflecting the limited integration of cognitive understanding in the context of physical activity at this early level of education.

At the junior secondary level, almost all domains showed improvement. The most noticeable increase occurred in the literacy (276) and numeracy (232) domains. This increase can be interpreted as a form of developmental maturity supported by more diverse learning experiences, both in the school environment and activities outside the classroom. The score in the self-description domain (641) remained high, indicating that confidence in physical abilities is still maintained during the transition to adolescence.

The situation was different at the upper secondary level. Scores in most domains fell sharply, particularly in literacy (60) and numeracy (56). These declines indicate that reflective skills and conceptual understanding of physical activity are weakening as academic pressures increase and time for physical activity decreases. Only the environment domain (666) showed a notable increase, indicating that students at this level have better environmental adaptation skills, such as spatial understanding and awareness of the social context of activity.

When all domains are compared in general, it can be seen that the pattern of physical literacy development is not linear. The most significant progress occurs at the junior secondary level, while at the senior secondary level the trend of improvement actually slopes or decreases. This phenomenon shows that the development of physical literacy in children with special needs is influenced by many factors, including learning approaches, support from the school environment, and psychosocial conditions that change with age.

Discussion

The main objective of this study is to describe the level of physical literacy of children with special needs in Semarang City based on the percentage of achievement in each domain of the PLAYself and PLAYinventory instruments. This study does not aim to measure differences between groups, but rather to map patterns of physical literacy development according to education level and special needs category. Thus, the discussion focuses on interpreting data trends, influencing factors, and their relevance to physical literacy theory and previous research.

The results show that most participants were in the initial and emerging categories, with the highest proportion in elementary school. This pattern is consistent with the research by Bingham et al. (2025), which explains that children with developmental disabilities tend to take longer to reach the phase of motor maturity and understand the meaning of physical activity as a whole (Bingham et al., 2025). In

the junior high school group, the proportion of the proficient category increased, indicating that this period is the optimal phase for the formation of physical literacy through more diverse motor experiences and increased social stimulation.

However, the decline in achievement at the senior high school level indicates stagnation in the development of physical literacy. These findings are consistent with the results of a study by Temple and Jefferies et al. (2019), which found that the transition to adolescence is often accompanied by a decline in physical activity due to academic pressure, changes in interests, and limited opportunities to participate in adaptive sports (Jefferies et al., 2019). In the context of special education, this decline can also be attributed to the limited availability of physical training programs tailored to students' abilities and motivation.

When viewed from the instrument domain, the highest scores were obtained in self-description and environment, while the lowest scores appeared in literacy and numeracy. This indicates that the affective and environmental adaptation dimensions of children with special needs are relatively better developed than the cognitive aspects. According to Donnelly et al. (2016), physical literacy involves not only physical abilities but also conceptual understanding, motivation, and confidence to participate in various activity contexts actively (Donnelly et al., 2016). In the context of participants with intellectual disabilities, cognitive understanding is often a major obstacle, so that literacy and numeracy dimensions develop more slowly than basic motor skills.

Improvements in the environment domain at the high school level indicate that social interaction and movement experiences in real-world contexts contribute significantly to physical behavior adaptation. This finding is in line with, who found that exposure to a supportive learning environment, such as a safe space for movement and individual guidance, can increase the confidence of children with special needs in physical activities (Shanshan et al., 2025).

Conversely, the decline in literacy and numeracy scores at the high school level indicates the need for integration between the academic curriculum and more contextual physical education. In the study by Domínguez-Martín et al. (2024), the physical literacy of children with intellectual disabilities increased significantly when teachers incorporated cognitive learning components such as symbol recognition, simple calculations, or movement terminology into physical activities (Domínguez-Martín et al., 2024). In other words, the success of strengthening physical literacy requires an interdisciplinary approach between physical education teachers and academic teachers.

Descriptive analysis shows variations between types of special needs, although this study does not aim to test inferential differences. Children with intellectual disabilities have relatively stable scoring patterns across all domains, while children with autism show sharp variations between environmental adaptation abilities and cognitive understanding. This phenomenon is in line with the findings of Miller et al. (2024), who explain that individuals with autism have unique sensory preferences and motor strategies that can strengthen one particular domain but weaken other aspects (Miller et al., 2024).

Meanwhile, the blind group showed strength in the environment domain, which can be attributed to compensatory mechanisms through hearing and proprioception. A study by Dameria and Yudhistira (2025) shows that orientation and mobility training based on rhythmic movement can improve the spatial perception of visually impaired children in the context of physical activities (Dameria & Yudhistira, 2025). These findings reinforce the results of the current study that physical literacy does not solely depend on visual input, but also on repeated sensory experiences and adaptive pedagogical support.

From a theoretical perspective, the results of this study support the concept of Physical Literacy as described by Edwards et.al (2017), namely that physical literacy is holistic, encompassing physical, affective, cognitive, and social dimensions (Edwards et al., 2017). The pattern that emerges from the data shows that a balance between these dimensions has not yet been achieved in children with special needs. This is an important basis for designing a learning approach that prioritizes meaningful movement experiences, rather than just mechanical physical exercises.

In practical terms, the results of this study provide an overview for educators and trainers in special schools to strengthen the cognitive domain (literacy and numeracy) through an activity-based approach. The integration of educational games, environmental exploration, and the use of simple visual and



auditory media can increase student engagement. Recent research by Adi et al. (2025) confirms that contextual and inclusive physical learning has been proven effective in increasing the intrinsic motivation and perceived competence of children with special needs (Adi et al., 2025).

The main limitation of this study lies in its descriptive nature, which does not allow for statistical testing of differences between groups. In addition, the data were obtained through questionnaires, which may be subject to perceptual bias, especially in the affective domain. Nevertheless, the results of this study still make an important contribution as a basis for the development of a more comprehensive physical literacy assessment model in the future.

Further research is recommended to use a mixed-method design with direct observation and correlation tests between domains to gain a deeper understanding. Analysis of the relationship between physical literacy and environmental factors (e.g., teacher support, school infrastructure, or family participation) is also worth further study. With such an approach, it is hoped that more contextual, adaptive, and effective learning strategies for children with special needs can be found.

Conclusions

This study provides a descriptive overview of physical literacy among children with special needs in Semarang City. The findings indicate that the majority of students are positioned within the initial and emerging categories, with improvement observed at the junior secondary level before declining at the senior level. Variations across domains reveal that affective and environmental dimensions, particularly self-description and environmental adaptation, develop more consistently than cognitive aspects such as literacy and numeracy. These trends highlight that the growth of physical literacy is shaped not only by motor competence but also by psychosocial and contextual factors. The results emphasize the necessity for inclusive, continuous, and experience-based physical education that accommodates the diversity of learners. Sustainable pedagogical strategies that integrate motivation, cognition, and adaptive movement experiences are essential to ensure equitable development of physical literacy at every educational stage.

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