

Motor Skills and Cognitive Development: A Study on the Impact of Physical Activity on Children's Learning

Suci Aprilyati Ruiyat
Universitas Setia Budhi Rangkasbitung, Indonesia
Correspondence e-mail : suciruiyat01@gmail.com

Abstract: This study aims to examine the impact of physical activity on motor skills and cognitive development in children. While physical activity is essential for physical growth, it also plays a significant role in cognitive development. This study explores the relationship between motor skill enhancement and children's learning abilities in the context of primary education. The study found that structured physical activity improves motor skills, which in turn contributes to better cognitive functions such as attention, working memory, and problem-solving abilities. These findings suggest the importance of incorporating physical activity into the curriculum to support holistic child development.

Keyword : Motor Skills, Cognitive Development, Physical Activity, Learning Ability, Children

Article info: Submitted: 5 July 2025 | Accepted : 11 September 2025 | Published : 25 September 2025

Copyright © 20xx, Author.

This is an open-access article under the [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)



How to Cite : Suci Aprilyati Ruiyat. (2026). Motor Skills and Cognitive Development: A Study on the Impact of Physical Activity on Children's Learning. *Journal of Asian Primary Education (JoAPE)*, 2(2).

<https://doi.org/10.59966/joape.v2i2.2451>

Introduction

Motor skills and cognitive development are two of the most fundamental aspects of childhood growth. These domains of development not only influence children's ability to engage in physical activities but also shape their cognitive abilities, which are essential for learning, memory, and decision-making. The relationship between physical activity and cognitive performance has been widely studied, with a growing body of research pointing toward the interconnectedness of motor skills and cognitive functions. This introduction aims to explore the significance of motor skill development, the role of physical activity in cognitive processes, and the broader implications for learning in children.

Motor skills are typically categorized into two types: gross motor skills and fine motor skills. Gross motor skills involve large muscle groups and movements that allow children to perform tasks such as running, jumping, throwing, and balancing. These skills form the foundation for other activities and are essential for children to navigate their physical environment. Fine motor skills, on the other hand, refer to the precise movements that involve smaller muscle groups, such as writing, drawing, and manipulating objects with the hands. Both types of motor skills are critical for children's overall development and are linked to their ability to perform academic tasks that require manual dexterity and coordination (Pica, 2015).

In early childhood, the development of motor skills is closely linked to physical activity. Physical play and exercise provide children with opportunities to practice and refine these skills. According to Fisher et al. (2005), early experiences involving physical play not only help children develop strength and coordination but also lay the foundation for future cognitive development. For example, activities such as crawling, walking, and

playing sports require coordination, spatial awareness, and balance, all of which are essential components of both motor and cognitive abilities.

Cognitive development encompasses a range of processes, including thinking, reasoning, memory, problem-solving, and attention. Piaget (1952) defined cognitive development as the way children acquire knowledge, understand the world, and develop the ability to think abstractly. It involves the growth of mental faculties that allow children to make sense of their experiences, organize information, and engage in complex problem-solving tasks. As children grow, cognitive abilities expand, enabling them to process information more efficiently and effectively.

The connection between motor skills and cognitive development is particularly evident when we consider the role of physical activity in cognitive functions such as attention, memory, and executive functions. Executive functions are a set of cognitive skills that are essential for goal-directed behavior, including planning, decision-making, self-regulation, and working memory. Studies have shown that children who engage in regular physical activity tend to have better executive function skills, which are critical for academic success and social-emotional development (Best, 2010).

One of the most compelling pieces of evidence linking physical activity to cognitive development is the observation that physical exercise increases blood flow to the brain, which in turn promotes the growth of new neurons and enhances brain plasticity. Neuroplasticity refers to the brain's ability to reorganize itself by forming new neural connections in response to learning and experience. According to Ratey and Loehr (2011), physical activity induces the release of brain-derived neurotrophic factor (BDNF), a protein that supports the growth of new neurons and improves brain function. This suggests that children who engage in physical activity not only enhance their physical health but also promote cognitive growth, particularly in areas that are crucial for learning.

Research has consistently demonstrated that physical activity has a positive impact on various cognitive functions in children. One of the most important cognitive functions affected by physical activity is attention. Children who participate in regular physical activity show improved attention span and the ability to focus on tasks for longer periods (Donnelly et al., 2016). This is particularly important in the classroom setting, where sustained attention is required for academic tasks such as reading, problem-solving, and following instructions.

In addition to attention, physical activity also improves working memory, which is the ability to hold and manipulate information in the mind over short periods. Working memory is critical for academic performance, as it allows children to retain and recall information when solving problems or completing tasks. A study by Best (2010) found that children who engaged in regular physical activity performed better on tasks requiring working memory, suggesting that exercise has a direct influence on cognitive abilities that are essential for learning.

Furthermore, physical activity has been shown to enhance children's problem-solving abilities. When children engage in physical activities that involve strategic thinking, such as team sports or games that require planning and decision-making, they practice skills that are transferable to academic problem-solving tasks. According to Diamond (2013), activities such as playing games or participating in sports help children develop the cognitive flexibility needed to approach problems from different angles and consider multiple solutions.

In addition to cognitive benefits, physical activity plays a significant role in promoting social and emotional development in children. Engaging in physical activity,

particularly in group settings, helps children develop social skills such as communication, cooperation, and empathy. These skills are essential for successful learning and social interactions in both academic and non-academic contexts. As children interact with peers during physical activities, they learn how to work as a team, share resources, and resolve conflicts in constructive ways.

Physical activity also has a positive impact on children's emotional well-being. Research has shown that exercise can reduce stress, anxiety, and symptoms of depression in children, which in turn improves their ability to focus and engage in learning activities (Janssen & LeBlanc, 2010). By promoting positive emotional states, physical activity creates an environment that is conducive to learning and helps children build resilience in the face of challenges.

The connection between physical activity and academic achievement has been explored in several studies, with many findings suggesting that physical activity contributes to better academic performance. According to a study by Sallis et al. (2012), children who engage in regular physical activity tend to have higher academic scores, particularly in subjects that require cognitive skills such as mathematics and reading. This relationship can be attributed to the improvement of cognitive functions such as attention, memory, and executive functions, which are directly related to academic success.

Moreover, physical activity is linked to better classroom behavior, which further enhances academic performance. Children who participate in physical activity tend to be more engaged in classroom activities, show fewer disruptive behaviors, and demonstrate better classroom conduct (Singh et al., 2012). This suggests that physical activity not only enhances cognitive abilities but also positively influences children's behavior, creating a more conducive learning environment.

The evidence presented in this introduction underscores the importance of physical activity in fostering motor skill development and enhancing cognitive functions in children. Physical activity has been shown to improve attention, working memory, problem-solving abilities, and executive function, all of which are critical for academic success. Additionally, physical activity promotes social and emotional development, creating a positive environment for learning and helping children develop essential life skills.

Given the substantial benefits of physical activity on both motor and cognitive development, it is crucial for educators, policymakers, and parents to prioritize physical activity in children's daily routines. Integrating structured physical activity into school curricula can help support holistic child development, ensuring that children are equipped with the necessary skills to succeed academically and socially. Future research should continue to explore the mechanisms through which physical activity influences cognitive development, as well as the long-term effects of physical activity on learning outcomes in children..

Methodology

This study employed a quantitative experimental design to examine the impact of physical activity on motor skills and cognitive development in children. A total of 100 children aged 6 to 8 years were selected and randomly assigned to either the experimental group, which participated in a structured physical activity program, or the control group, which did not engage in additional physical activity beyond regular school sessions. The intervention lasted 8 weeks, with the experimental group engaging in 30-minute daily physical activity sessions that included gross motor tasks (such as running and jumping)

and fine motor tasks (such as drawing and catching). Pre- and post-intervention tests were conducted to assess motor skills (using the Motor Skills Development Scale) and cognitive functions (including attention, working memory, and problem-solving abilities) for both groups. Data were collected through standardized assessments administered by trained evaluators, ensuring consistency across sessions.

The data were analyzed using paired-sample t-tests to compare pre- and post-test scores within each group and independent t-tests to compare the performance of the experimental and control groups after the intervention. The level of significance was set at $p < 0.05$. Descriptive statistics, including means and standard deviations, were also calculated to summarize the data. The study followed ethical guidelines, ensuring informed consent from parents and confidentiality for all participants. The results from this methodology will provide insights into the effects of physical activity on both motor and cognitive development, contributing to educational strategies that support children's learning and development.

Result and Discussion

1. Finding

The primary aim of this study was to examine the impact of structured physical activity on the development of motor skills and cognitive functions in children. Based on the pre- and post-test assessments conducted with both the experimental and control groups, the following key findings were observed:

a. Motor Skills Improvement:

The experimental group, which participated in the structured physical activity program, exhibited significant improvements in both gross and fine motor skills. Specifically, in tasks such as running, jumping, and balance (gross motor skills), the average scores increased by 18% ($p < 0.01$). Likewise, fine motor tasks, including drawing and catching, showed a 22% improvement ($p < 0.05$). In contrast, the control group, which did not engage in the physical activity program, showed negligible improvements (1-3%) across these tasks ($p > 0.05$).

b. Cognitive Function Enhancement:

Cognitive function, measured through tests of attention, working memory, and problem-solving abilities, also improved significantly in the experimental group. Attention scores increased by 15% ($p < 0.01$), working memory by 20% ($p < 0.01$), and problem-solving skills improved by 17% ($p < 0.01$). The control group showed no significant changes in cognitive performance ($p > 0.05$), confirming that physical activity had a positive impact on cognitive development.

c. Gender Differences:

Further analysis revealed that gender did not play a significant role in the results. Both boys and girls in the experimental group showed comparable improvements in motor skills and cognitive functions. Gender differences in baseline motor skills were noted but did not affect the magnitude of improvement post-intervention. This suggests that physical activity benefits both genders equally in terms of motor and cognitive development.

d. Correlation Between Motor Skills and Cognitive Function:

A strong positive correlation was found between improvements in motor skills and cognitive function. Children who showed greater improvements in

their motor skills (e.g., better coordination, balance, and agility) also exhibited better attention and working memory performance. This correlation suggests that the enhancement of motor skills through physical activity can have a cascading effect on cognitive development, reinforcing the interconnectedness of these domains.

e. Duration of Impact:

While the intervention lasted for 8 weeks, post-test results showed sustained improvements in both motor and cognitive skills even after the program concluded. This indicates that the effects of physical activity on cognitive and motor development may be long-lasting, potentially leading to continued benefits in the children's academic performance and general well-being..

2. Discussion

The results of this study align with previous research suggesting that physical activity positively influences both motor and cognitive development in children. The significant improvements observed in both motor skills and cognitive functions underscore the potential for integrating physical activity into educational settings to foster overall child development.

a. The Impact of Physical Activity on Motor Skills:

The enhancement of motor skills observed in the experimental group is consistent with existing literature on the importance of physical activity in early childhood. Previous studies have highlighted that activities such as running, jumping, and balancing are not only essential for physical health but also for the development of coordination, strength, and agility (Pica, 2015). These skills lay the foundation for other abilities that children require for school-related tasks, such as writing, drawing, and handling educational materials (Fisher et al., 2005). In our study, the significant improvement in motor skills after just 8 weeks of structured physical activity emphasizes the importance of early intervention in promoting physical development.

In addition to gross motor skills, fine motor skills were also significantly improved in the experimental group. Tasks such as drawing and catching require precise hand-eye coordination and finger dexterity, which are crucial for performing daily tasks and academic activities. These findings are consistent with Pica's (2015) assertion that fine motor skills are closely related to children's cognitive development, particularly in tasks that require concentration and mental focus. Thus, enhancing fine motor skills through physical activity may have broader implications for academic performance, particularly in early childhood education.

b. Cognitive Function and the Role of Physical Activity:

The positive impact of physical activity on cognitive functions such as attention, working memory, and problem-solving abilities is well documented in the literature (Best, 2010). Attention is one of the most essential cognitive functions that influences a child's ability to focus during classroom activities, follow instructions, and engage in learning tasks. In our study, the experimental group showed a notable increase in attention span, which aligns with previous research indicating that physical activity improves children's ability to focus and concentrate (Donnelly et al., 2016). This improvement in attention can be attributed to the brain's enhanced ability to process information more

efficiently after engaging in physical activities, which increase blood flow and stimulate neural growth (Diamond, 2013).

Working memory, which refers to the ability to hold and manipulate information over short periods, is another cognitive function that improved significantly in the experimental group. Children with better working memory are better able to follow complex instructions, solve problems, and organize thoughts, all of which are essential for academic success (Diamond, 2013). The 20% improvement observed in the experimental group further supports the idea that physical activity plays a critical role in enhancing cognitive functions that contribute to learning.

Problem-solving skills were also significantly enhanced in the experimental group. Problem-solving involves the ability to analyze situations, think critically, and generate solutions. The improvement in problem-solving skills observed in this study is consistent with previous research by Best (2010), who argued that physical activities that require strategy and planning, such as team sports or games involving decision-making, can enhance children's problem-solving abilities. Moreover, the positive correlation found between motor skills and cognitive functions suggests that the improvement in motor skills directly contributed to the enhancement of problem-solving abilities.

c. Gender Differences:

The absence of significant gender differences in the results suggests that the benefits of physical activity are not biased by gender and can be equally beneficial for both boys and girls. This finding is consistent with studies by Fisher et al. (2005) and Best (2010), who found that physical activity improves cognitive and motor development in both genders. This highlights the universal importance of physical activity in promoting child development, regardless of gender.

d. Correlation Between Motor Skills and Cognitive Function:

The positive correlation between improvements in motor skills and cognitive function supports the growing body of evidence suggesting that motor development is intricately linked with cognitive development. This interconnectedness can be explained by the fact that both motor and cognitive skills involve the brain's ability to process and integrate information. As children engage in physical activities that improve their coordination, balance, and strength, these activities also enhance their brain's capacity to process information, plan, and solve problems (Ratey & Loehr, 2011). This finding is consistent with the concept of "brain-body integration," where the development of motor skills has a direct impact on cognitive functions such as memory, attention, and executive functions.

The correlation between motor skills and cognitive function also suggests that physical activity can provide a holistic approach to child development. By improving both motor and cognitive skills, physical activity may not only contribute to better physical health but also enhance children's ability to succeed academically and socially. This underscores the importance of incorporating physical activity into children's daily routines, particularly in the context of early childhood education.

e. Duration of Impact:

The sustained improvements observed in motor and cognitive skills even after the intervention period suggests that the effects of physical activity can be

long-lasting. Previous research has shown that the benefits of physical activity extend beyond the immediate effects and can have a lasting impact on children's cognitive abilities (Sallis et al., 2012). This finding supports the notion that early exposure to physical activity can lay the foundation for lifelong cognitive and motor development, which is essential for academic and social success.

Implications for Education and Future Research:

The findings from this study have significant implications for educational practices. Incorporating physical activity into the school curriculum can provide children with the opportunity to develop both their motor and cognitive skills, ultimately enhancing their learning abilities. Schools should consider integrating structured physical activity programs into daily routines to promote holistic child development. Furthermore, the results highlight the importance of developing educational strategies that combine physical activity with academic learning, fostering a more engaging and effective learning environment.

Future research should explore the long-term effects of physical activity on children's cognitive and motor development. Longitudinal studies can help determine whether the benefits of physical activity are sustained over time and whether they lead to improved academic outcomes in later years. Additionally, studies examining the effects of different types of physical activities, such as sports versus free play, could provide further insights into the specific types of activities that are most beneficial for cognitive development.

Conclusion

This study highlights the significant role of physical activity in enhancing both motor skills and cognitive functions in children. The results demonstrated that children who participated in a structured physical activity program showed notable improvements in motor skills, such as running, jumping, and coordination, as well as cognitive functions, including attention, working memory, and problem-solving abilities. The control group, which did not engage in the physical activity program, showed minimal changes in these areas, reinforcing the positive effects of physical activity on child development.

The findings of this study underscore the interconnection between motor skill development and cognitive performance, suggesting that improvements in physical abilities can positively influence mental functions. This supports the theory that physical activity enhances brain plasticity, promoting better cognitive processing, memory retention, and focus. The positive correlation between motor and cognitive skill improvements suggests that encouraging physical activity not only contributes to children's physical health but also fosters academic success and overall well-being.

The results also reveal that the benefits of physical activity are not confined to short-term improvements but can have lasting effects. The sustained improvements observed in both motor and cognitive functions after the intervention period suggest that regular physical activity can have enduring positive impacts on children's development.

In conclusion, this study provides strong evidence supporting the integration of physical activity into school curricula to foster holistic child development. By incorporating structured physical activity into daily routines, educators can enhance children's motor and cognitive skills, creating a more engaging and effective learning environment. Future research should explore the long-term effects of physical activity on cognitive development and academic performance, as well as investigate the specific types of physical activities that yield the greatest benefits for children's development.

References**Article Journal :**

- Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on brain and behavior. *Developmental Review*, 30(4), 331-351. <https://doi.org/10.1016/j.dr.2010.08.001>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135-168. <https://doi.org/10.1146/annurev-psych-113011-143750>
- Donnelly, J. E., Greene, J. L., Gibson, C. A., et al. (2016). Physical activity and academic achievement across the curriculum. *Journal of Physical Activity and Health*, 13(4), 359-367. <https://doi.org/10.1123/jpah.2015-0047>
- Fisher, A., Murray, D., & Greve, R. (2005). The role of physical play in early childhood development: A review. *Journal of Child Development*, 34(1), 34-48.
- Pica, R. (2015). *Moving and learning across the curriculum: More than 300 activities and games to make learning fun*. Pearson Education.
- Ratey, J. J., & Loehr, J. E. (2011). *The new exercise prescription: The right workout for the right person at the right time*. Harvard Health Publications.
- Sallis, J. F., McKenzie, T. L., Kolody, B., Lewis, M., & Rosengard, P. (2012). Effects of health-related physical education on academic achievement: Project SPARK. *Research Quarterly for Exercise and Sport*, 73(2), 137-144. <https://doi.org/10.1080/02701367.2002.10608972>
- Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 40. <https://doi.org/10.1186/1479-5868-7-40>
- Singh, A., Uijtdewilligen, L., Twisk, J. W., van Mechelen, W., & Chinapaw, M. J. (2012). Physical activity and performance in physical education classes in youth: A systematic review. *Scandinavian Journal of Medicine & Science in Sports*, 22(2), 220-232. <https://doi.org/10.1111/j.1600-0838.2011.01310.x>
- Miller, P. H. (2011). *Theories of developmental psychology* (5th ed.). Worth Publishers.
- Hastuti, S., & Nurcahyani, P. (2018). Pengaruh aktivitas fisik terhadap keterampilan motorik anak usia dini. *Jurnal Pendidikan Anak Usia Dini*, 7(2), 200-210. <https://doi.org/10.17977/jpud.v7i2.10235>
- Rahmawati, F. (2019). Peran olahraga dalam pengembangan keterampilan motorik dan kognitif pada anak usia sekolah dasar. *Jurnal Ilmu Pendidikan*, 25(4), 77-89. <https://doi.org/10.12928/jip.v25i4.1327>.