



The Impact of Physical Education on Academic Achievement: Connecting Physical and Cognitive

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Abstract: Physical education is often viewed primarily as a means of developing students' physical skills, health, and fitness, while academic achievement is generally associated with performance in academic subjects. However, physical activity and academic development are interconnected through physiological, cognitive, and psychological processes. This article aims to examine the relationship between physical education, physical activity, cognitive function, and academic achievement based on relevant literature presented in the context of physical education and academic learning. A narrative literature review approach was employed by synthesizing studies addressing brain function, cognitive performance, academic achievement, stress and anxiety, learning motivation, mood, and interdisciplinary integration. The literature indicates that regular physical activity may support brain function through neurogenesis and increased cerebral blood flow, which are associated with attention, memory, and executive function. Empirical evidence also indicates associations between physical activity and academic performance, motivation, attention, and learning behavior. In addition, physical activity may contribute to reducing stress and anxiety and improving mood, which can support students' learning engagement. Integrating physical education with academic subjects may further provide opportunities for simultaneous development of physical and cognitive competencies. Nevertheless, the effects of physical activity may vary according to individual characteristics, intervention types, and educational contexts. Therefore, physical education should be considered as an integral component of holistic education rather than solely as a means of developing physical fitness and motor skills. Further empirical research is needed to examine the mechanisms and magnitude of the relationship between physical activity and academic achievement.

Keywords: Physical Education; Physical Activity; Academic Achievement; Cognitive Function; Learning Motivation

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INTRODUCTION

Physical education (PE) is an important component of the educational process because it contributes not only to students' physical development but also to their cognitive, emotional, and social development. Traditionally, physical education and academic achievement have often been viewed as two separate dimensions of students' educational experiences. Physical education is generally associated with the development of physical skills, health, and physical fitness, whereas academic achievement is commonly assessed through students' performance in academic subjects such as mathematics, language, and science. However, this distinction does not fully reflect the complex relationship between physical activity and learning. Increasing

evidence suggests that physical activity may influence cognitive processes and psychological conditions that are important for students' learning and academic development.

The relationship between physical activity and academic development can be explained through several physiological and neurological mechanisms. Regular physical activity may promote structural and functional changes in the brain, particularly in areas associated with learning and memory, such as the hippocampus and prefrontal cortex. Physical activity also stimulates the production of neurotrophic factors that support neuronal growth and survival. In addition, increased cerebral blood flow during physical activity may contribute to cognitive functions, including attention, memory, and executive function (Maugeri et al., 2023; Kantawala et al., 2023; Spytska, 2024). These mechanisms indicate that physical activity may provide a physiological foundation that supports students' readiness to learn and engage in academic activities.

Beyond its physiological effects, physical activity is also associated with cognitive and psychological outcomes relevant to academic achievement. Aerobic exercise, for example, has been associated with improvements in memory and executive function. A meta-analysis reported a moderate effect of aerobic exercise on memory among adults with major depressive disorder (Ren et al., 2024). Although such findings should be interpreted according to the characteristics of the population and intervention examined, they provide an important basis for understanding how physical activity may be connected with cognitive functioning. Thus, the potential contribution of physical education to academic development should not be limited to the acquisition of motor skills but should also consider its possible influence on cognitive processes.

Empirical evidence also indicates a relationship between participation in physical activity and academic outcomes. A study involving 2,219 university students found that students who engaged in regular running demonstrated higher academic performance than their peers, highlighting the potential importance of consistent physical activity (Du et al., 2023). Furthermore, a systematic review reported that physical education and sport can contribute to motivation, attention, and behavior, which are important factors in students' educational outcomes (Diabor, 2024). These findings suggest that physical activity may contribute to academic development through multiple pathways, including improved attention, learning engagement, and behavioral regulation.

Another important pathway concerns students' emotional well-being. Physical activity may help reduce stress and anxiety, particularly among children and adolescents. Regular exercise has been associated with reductions in stress-related physiological responses and improvements in mood, while activities such as running and yoga may support attention and resilience. Improved psychological well-being may subsequently support students' ability to focus and participate in learning activities. Physical activity has also been associated with cognitive functioning that is relevant to academic performance, while its potential role in reducing stress and anxiety may provide additional support for students' learning experiences (Geller et al., 2024).

Physical education may also contribute to learning motivation. Participation in physical education and physical activity has been associated with positive motivational indicators, suggesting that physically active students may demonstrate greater engagement in the learning process (Utama et al., 2023; Honchar, 2023). In addition, improvements in mood may be related to increased engagement and motivation in academic environments (Suguis & Belleza, 2022; Stoduto et al., 2023). Nevertheless, the relationship between physical activity, psychological outcomes, and learning should not be interpreted as uniform for all students. Previous research indicates that the effects of

physical activity may vary according to individual circumstances and the type of intervention implemented (Anker et al., 2024).

An additional approach is to integrate physical education with academic subjects through interdisciplinary learning. Such integration can provide opportunities for students to develop physical and cognitive competencies simultaneously. For example, physical activity can be connected with science learning to help students understand concepts such as physics through sport. Similarly, curriculum approaches that combine martial arts with art and music have been reported to improve academic performance and physical fitness (Liu, 2023; Wang, 2022). However, the implementation of interdisciplinary integration may face challenges related to curriculum demands and resource allocation.

Based on these considerations, understanding the relationship between physical education, physical activity, cognitive function, and academic achievement is important for developing a more holistic approach to education. Physical education should be considered not merely as a subject concerned with physical fitness and motor skills but also as a potential contributor to cognitive and academic development. Therefore, this article aims to examine the relationship between physical education and academic achievement by discussing the potential mechanisms through which physical activity influences cognitive function, emotional well-being, learning motivation, and students' academic outcomes.

METHOD

This article employed a narrative literature review approach to examine the relationship between physical education, physical activity, cognitive function, and academic achievement. The approach was used to synthesize and describe findings from previously published studies that were relevant to the relationship between physical activity and students' cognitive, psychological, and academic development. The literature discussed in this article was derived from the scientific sources cited in the original conference presentation on the impact of physical education on academic achievement.

The literature sources consisted of scientific publications addressing several major themes, including the effects of physical activity on brain function, neurogenesis, cognitive function, memory, attention, executive function, academic achievement, stress and anxiety, learning motivation, mood, and interdisciplinary integration of physical education with academic subjects. The sources cited in the original presentation included studies published by Maugeri et al. (2023), Kantawala et al. (2023), Splytska (2024), Ren et al. (2024), Du et al. (2023), Diabor (2024), Geller et al. (2024), Anker et al. (2024), Utama et al. (2023), Honchar (2023), Suguis and Belleza (2022), Stoduto et al. (2023), Liu (2023), and Wang (2022). These sources were used to support the discussion of the relationship between physical activity and cognitive, emotional, motivational, and academic outcomes. The cited literature in the presentation covers empirical studies, systematic review evidence, and studies concerning interdisciplinary curriculum integration.

The literature was examined through a thematic synthesis process. Relevant findings were identified and organized according to the main themes emerging from the reviewed sources. The themes included: (1) physical activity and brain function, (2) cognitive function and learning, (3) physical activity and academic achievement, (4) stress, anxiety, and emotional well-being, (5) learning motivation and mood, and (6) interdisciplinary integration of physical education and academic subjects. Findings from the selected literature were subsequently synthesized descriptively to explain the

possible connections between physical education, physical activity, cognitive development, and academic achievement.

The analysis focused on identifying similarities, complementary findings, and contextual differences among the studies rather than calculating a pooled effect size. Particular attention was given to evidence concerning cognitive function, academic outcomes, psychological well-being, and learning engagement. For example, the presentation reported evidence involving 2,219 university students in relation to regular running and academic performance, as well as evidence from a systematic review concerning motivation, attention, and behavior.

This review was designed as a narrative synthesis and therefore does not claim to be a systematic review or meta-analysis. The original presentation does not provide a detailed database-search protocol, predefined inclusion and exclusion criteria, or a formal risk-of-bias assessment. Consequently, the findings should be interpreted as a synthesis of relevant literature presented in the original conference material rather than as an exhaustive systematic assessment of all available evidence..

RESULT AND DISCUSSION

Result

The literature reviewed in this article indicates that physical activity and physical education are associated with several dimensions of students' development, including cognitive function, academic achievement, emotional well-being, learning motivation, and interdisciplinary learning. The findings were organized into five main themes: brain and cognitive function, academic achievement, stress and emotional well-being, learning motivation, and integration of physical education with academic learning.

Table 1. Summary of Literature Findings on Physical Activity and Academic Development

No	Theme	Main Finding	Source
1	Brain function	Physical activity is associated with neurogenesis, neuronal support, and changes in brain regions related to learning and memory	Maugeri et al. (2023)
2	Cognitive function	Increased cerebral blood flow during exercise is associated with attention, memory, and executive function	Kantawala et al. (2023); Spytska (2024)
3	Memory and executive function	Aerobic exercise is associated with improvements in memory and executive function	Ren et al. (2024)
4	Academic achievement	Regular running was associated with academic performance among 2,219 university students	Du et al. (2023)
5	Motivation, attention, and behavior	Physical education and sport were associated with improvements in motivation, attention, and behavior	Diabor (2024)
6	Cognitive and psychological outcomes	Physical activity is associated with cognitive function and psychological well-being	Geller et al. (2024)
7	Learning motivation	Participation in physical education and physical activity is positively associated with motivational indicators	Utama et al. (2023); Honchar (2023)
8	Mood	Improved mood may contribute to engagement and motivation in academic environments	Suguis & Belleza (2022); Stoduto et al. (2023)
9	Interdisciplinary learning	Integration of physical activity with academic subjects provides opportunities for cognitive and physical development	Liu (2023); Wang (2022)

The findings summarized in Table 1 show that the relationship between physical activity and academic development is multidimensional. The evidence does not indicate that physical activity affects academic achievement through a single mechanism. Rather,

the literature discussed in the original presentation points to interconnected physiological, cognitive, psychological, and educational pathways. The original presentation specifically identified neurogenesis, cerebral blood flow, cognitive function, academic achievement, stress reduction, motivation, and interdisciplinary learning as important components of this relationship.

Discussion

The literature indicates that physical activity may influence brain function through physiological and neurological mechanisms. Regular exercise has been associated with structural and functional changes in brain regions such as the hippocampus and prefrontal cortex, which are important for learning and memory. Physical activity may also stimulate the production of neurotrophic factors that support neuronal growth and survival. Furthermore, increased cerebral blood flow during exercise may contribute to cognitive processes such as attention, memory, and executive function (Maugeri et al., 2023; Kantawala et al., 2023; Spytska, 2024).

These findings provide a possible explanation for why physical activity can be relevant to educational outcomes. Learning requires students to sustain attention, process information, remember previously learned material, and regulate their behavior. The cognitive functions discussed in the literature are therefore closely related to the processes involved in classroom learning. From this perspective, physical education may provide benefits that extend beyond physical fitness by creating opportunities for students to engage in activities that are potentially supportive of cognitive functioning.

However, the relationship should not be interpreted as a direct or universal causal pathway. The studies included in the presentation address different populations and contexts. Therefore, the findings are more appropriately understood as evidence of an association and potential mechanism rather than proof that participation in physical education automatically produces higher academic achievement.

The reviewed literature also indicates a relationship between aerobic physical activity and cognitive function. Ren et al. (2024), for example, reported a moderate effect size for memory in a meta-analysis involving adults with major depressive disorder. This finding is relevant to the broader discussion because memory and executive function are important components of learning.

The potential cognitive benefits of physical activity may be particularly important within educational settings. Students are required to maintain concentration, retrieve information, solve problems, and manage competing demands during learning. Physical activity may contribute to these processes through physiological changes associated with exercise. Nevertheless, because the evidence cited in the original presentation includes different populations, the findings should be applied to school and university students with appropriate consideration of contextual differences.

One of the most direct relationships identified in the literature concerns physical activity and academic performance. Du et al. (2023) examined 2,219 university students and reported that students who engaged in regular running demonstrated higher academic performance than their peers. The presentation highlighted running once per week for approximately 16–25 minutes as part of the reported activity pattern.

In addition, Diabor (2024) reported through a systematic review that physical education and sport were associated with improvements in motivation, attention, and behavior, which are relevant to academic outcomes.

Taken together, these findings suggest that the possible contribution of physical education to academic achievement may occur indirectly. Rather than physical activity

simply increasing academic scores, it may influence intermediate factors such as attention, motivation, behavior, and cognitive functioning. These factors can subsequently support students' participation in academic learning.

This interpretation is important because it positions physical education as part of the broader learning environment rather than as an activity competing with academic subjects. Maintaining opportunities for meaningful physical activity may therefore be compatible with educational goals when appropriately incorporated into the curriculum.

Another important finding concerns the relationship between physical activity and psychological well-being. The literature discussed in the presentation indicates that physical activity can contribute to reducing stress and anxiety while supporting focus and learning ability. Exercise has been associated with physiological and psychological responses involving stress hormones, mood, attention, and resilience.

This relationship is particularly relevant to education because students' ability to learn is influenced not only by cognitive ability but also by their emotional condition. High levels of stress or anxiety may interfere with attention and engagement, whereas improved psychological well-being may facilitate participation in learning activities. Geller et al. (2024), as cited in the presentation, further support the relevance of physical activity to cognitive function and psychological well-being.

At the same time, the evidence indicates that the effects of physical activity are not necessarily identical for every individual. Anker et al. (2024) reported that outcomes may vary according to individual circumstances and the type of intervention implemented. This variation suggests that educational practitioners should consider students' characteristics and the nature, intensity, and context of physical activity when designing learning programs.

The literature also identifies learning motivation and mood as important pathways connecting physical activity with academic engagement. Participation in physical education has been associated with positive motivational indicators, suggesting that active students may demonstrate greater engagement in the learning process (Utama et al., 2023; Honchar, 2023).

Mood is another relevant factor. The presentation indicates that improved mood may contribute to greater engagement and motivation within academic environments (Suguis & Belleza, 2022; Stoduto et al., 2023).

These findings reinforce the view that the contribution of physical education to academic development should be considered broadly. Academic achievement is not determined only by cognitive capacity but also by students' willingness to participate, emotional readiness, and ability to maintain engagement in learning activities. Physical education can provide an environment in which students participate actively, interact socially, experience achievement, and develop positive emotional experiences that may be relevant to their broader educational engagement.

The final theme concerns the integration of physical education with academic subjects. The literature presented indicates that interdisciplinary approaches can provide opportunities to develop physical and cognitive competencies simultaneously. For example, physical activity can be integrated with science learning to help students understand physical concepts through sport. Curriculum approaches combining martial arts with art and music have also been reported to improve academic performance and physical fitness, with one study reporting a 3.13% increase in academic scores (Liu, 2023; Wang, 2022).

This approach provides an alternative to viewing physical education and academic learning as competing components of the curriculum. Instead, physical activity

can become a context for learning concepts, developing problem-solving skills, and strengthening student engagement. Such integration may also support a more holistic educational model in which physical, cognitive, emotional, and social development are addressed simultaneously.

Nevertheless, the implementation of interdisciplinary physical education may face practical challenges, particularly regarding curriculum demands and resource allocation. The literature presented recognizes these challenges while also identifying potential benefits for student engagement and learning outcomes.

The literature synthesized in this article indicates that the relationship between physical education and academic achievement involves multiple interconnected pathways. Physical activity may influence brain function and cognitive processes, while also contributing to emotional well-being, motivation, attention, and learning engagement. These factors provide possible pathways through which physical education may be associated with academic development.

Physical education should be considered within a broader educational framework. Its contribution is not limited to improving physical fitness or motor skills but may also support conditions that are important for learning. At the same time, differences among populations, interventions, and individual circumstances mean that the relationship should be interpreted carefully rather than as a universal causal effect.

CONCLUSION

The literature reviewed in this article indicates that physical education and physical activity are closely connected with several factors that support students' educational development. The potential contribution of physical activity to academic achievement can be understood through multiple pathways, including brain function, cognitive processes, emotional well-being, learning motivation, attention, and behavioral engagement. Regular physical activity may support cognitive functions such as memory, attention, and executive function, while also contributing to the reduction of stress and anxiety and the improvement of mood and learning motivation. The reviewed evidence also suggests that physical education should not be viewed solely as a subject concerned with physical fitness and motor skill development. Its potential contribution extends to the broader educational process through the development of conditions that support learning. Integrating physical education with academic subjects may provide additional opportunities to develop students' physical and cognitive competencies simultaneously. The relationship between physical activity and academic achievement should be interpreted with consideration of differences in individual characteristics, intervention types, and educational contexts. The present article is limited by its narrative literature review approach and by the literature available in the original conference presentation. Therefore, future research should employ systematic review procedures or empirical research designs to examine the magnitude and causal mechanisms of the relationship between physical activity, physical education, cognitive function, and academic achievement.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest related to the preparation and publication of this article.

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