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From Greek *paideia* to modern educational systems: evidence for the need to integrate physical activity into academic settings

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The ancient Greek educational system, based on *paideia*, sought to shape well-rounded citizens through the integration of physical and intellectual education, thus promoting a balance between body and mind. This educational philosophy, centered on holistic development, was embodied in institutions such as the gymnasium, where physical training not only strengthened the body but also enhanced the character and morality of young people. In the current context, scientific studies have shown that physical activity within the academic environment significantly improves both physical and mental health, enhances cognitive performance, and counteracts increasingly prevalent issues in our society, such as sedentary behavior, obesity, depression, and anxiety among students. Despite this evidence, current educational systems tend to prioritize intellectual learning over physical education, posing a challenge for modern education. Given that most students lack sufficient time for exercise, there is a growing need to reform school curricula to more effectively integrate movement and exercise. This review examines the educational value of *paideia* and the Greek gymnasium as fundamental historical antecedents for contemporary educational systems, exploring studies that support the need to place greater emphasis on physical activity and various models that can be implemented in the actual academic context. Likewise, different barriers, challenges and opportunities for a better integration of physical activity in modern educational systems will be summarized as well. Drawing inspiration from the Greek model of body–mind integration can offer a more balanced and health-oriented approach to student development, promoting not only their physical and mental well-being but also their readiness to face contemporary challenges.

KEYWORDS

paideia, physical education, educational models, body–mind connection, academic performance

1 Introduction

Since ancient times, education has been conceived as a comprehensive process encompassing both intellectual and physical development. In ancient Greece, this concept was central to the ideal of *paideia*, an educational philosophy aimed at forming well-rounded citizens capable of actively contributing to society in mind, body, and spirit. The Greeks held a firm belief that academic learning and physical conditioning were inseparable components of education; this philosophy was embodied in institutions such as the gymnasium, where young people not only trained their bodies but also prepared in moral, social, and civic skills (Demirel and Yildiran, 2013). Physical activity, within this framework, not only strengthened the body but also enhanced character and intellect, creating citizens equipped to face the challenges of public and private life (Tountas, 2009).

Currently, a growing body of scientific studies has begun to reaffirm the importance of this holistic vision of education. Numerous studies highlight the benefits of integrating physical activity into academic settings, indicating that movement and exercise not only improve students' physical health but also enhance cognitive performance, concentration, and emotional well-being (Cappelen et al., 2017; Fraile-Martinez et al., 2024). Evidence suggests that, as in ancient Greece, modern educational systems can benefit from an approach that combines physical development with academic learning, promoting an education that fosters not only intellectual skills but also a healthy, balanced lifestyle (Tountas, 2009; Young, 2005). However, we currently face a radically different situation, as sedentary behavior has become a growing problem in our society, linked to a range of health issues, underscoring the urgent need to address these inactive habits from early childhood (Bull et al., 2020; Hanifah et al., 2023; Park et al., 2020).

This article argues that the ancient Greek concept of *paideia* provides valuable insights for modern education systems, particularly in the integration of physical and intellectual education to foster holistic student development. By revisiting the Greek approach, this study highlights the potential benefits of incorporating structured physical education within academic curricula to enhance not only physical health but also cognitive and socio-emotional skills. Having this aim, we firstly review the educational value of *paideia* and the Greek gymnasium as relevant historical antecedents for modern educational systems, examining the scientific evidence supporting the integration of physical activity within academic environments. In doing so, it aims to highlight how the Greek perspective on education and physical conditioning was not only revolutionary in its time but may also offer solutions to contemporary educational challenges. Finally, practical conclusions and a call for action will be drawn based on the insights that the Greek model of holistic education can offer for modern education.

2 Physical activity as a pivotal element of the Greek education (*paideia*)

2.1 The Greek idea of holistic education

Education in Ancient Greece promoted the holistic development of citizens through the balance of body and mind, an idea embodied in the concept of *kalokagathia*, meaning beauty and goodness. This

ideal encouraged physical and moral excellence through activities designed to strengthen both body and character, encompassing physical activity, the arts, arithmetic, and other disciplines, with the *gymnasium* serving as the venue for these various pursuits (Demirel and Yildiran, 2013).

For the Greeks, exercise contributed to the transmission of values as valuable as they were diverse, applicable both to the battlefield and to athletic practice, including discipline, courage (*andreia*), excellence (*areté*), balance (*sofrosyne*), competition (*agon*), and glory (*kleos*) (Echeverría Rey, 2010). Over time, gymnasiums grew increasingly central in the urban landscape, eventually becoming one of the essential public spaces in every Greek polis. Additionally, the aristocracy's interest in the educational system grew, with the gymnasium emerging as a hub of civic education for future generations. During the Classical period, however, it was due to prominent figures like Hippocrates of Cos, Plato, and Aristotle that physical conditioning and intellectual training were integrated within an academic context, presenting a unified approach to exercising the body and enriching the soul. Beginning with Hippocrates, considered the father of medicine in the Western world, his focus was primarily on medicine rather than education per se; however, his writings contributed to a holistic view of well-being in Ancient Greece. Hippocrates, a strong proponent of humoral theory, emphasized the importance of moderate exercise as a way to balance the body's humors, prevent disease, and support overall health. He recognized that both excessive and insufficient exercise could lead to health issues, suggesting that exercise should be tailored to individual needs and conditions. In Book I of *Regimen*, he noted, "Even when all this is known, the care of a man is not yet complete, because eating alone will not keep a man well; he must also take exercise, highlighting the integral relationship between diet and physical activity (Tipton, 2008). He categorized exercises as either natural, which included walking and basic movements, or violent, interpreted as excessive, as it is underlined in *Nature of Man* where he wrote [101, p. 25]

Those due to exercise are cured by rest, and those due to idleness are cured by exercise."

Or in a fragment of the *Corpus Hippocraticum* (composed by his students and later followers in the 5th and 4th century BC)

Exercises should be neither excessive nor rapid, but always moderate. Take morning walks, sufficient according to one's personal condition, and after gymnasium exercises suitable to the effort expended. After dinner, one should not walk [...] (Hippocrates, De victu. 1. 82.)

Overall, Hippocrates prescribed specific exercise regimens based on patients' conditions and believed that exercise contributed to physical benefits like increased stature, muscle tone, endurance, and digestion. These views were also shared by his disciples like Diocles, who advised children to visit the gymnasium twice daily for its exercise benefits, whereas older individuals were encouraged to take moderate walks or by another figures like Erasistratus, who similarly prescribed exercise, gymnastic activities, diet, and minimal medication, highlighting the value of lifestyle in maintaining health (Tipton, 2014). Collectively, these physicians underscored the

foundational role of balanced physical activity in ancient Greek medicine.

Plato advocated for the importance of combining physical development with intellectual growth to promote a comprehensive education (Patel et al., 2022). Plato means in Greek “broad,” and was allegedly a nickname for the breadth of his shoulders. He was disciple of Socrates, who despite believing that cultivating the mind was the highest form of personal development, also recognized physical education as a necessary activity to strengthen the soul and support mental health. Plato expanded on this idea in *The Republic*, where he proposed an educational model that integrated gymnastics and music. For instance, in a passage from this work, Plato emphasizes the significance of state planning to ensure an educational system aligned with tradition, where gymnastics is already established as a widespread and appropriate practice among the Greeks.

In brief, this must be firmly instilled in those who are to guard the State, so that they do not inadvertently become corrupt. They must ensure that no innovations in gymnastics and music are introduced contrary to what has been prescribed, fearing when someone claims that the songs most esteemed by men are the most recent ones, sung by the aoidos, that traverse the air (Plato, Republic. 4.424b).

In his view, this combination promoted both physical strength and moral and intellectual clarity, which were essential for achieving balance in personality. He believed that neglecting any of these aspects led to disharmony, resulting in individuals who were either excessively aggressive or overly meek. In his vision of an ideal state, citizens—especially warriors—needed both mental agility and physical strength, enabling them to defend the polis and comprehend the philosophical principles underpinning their government (Stonehouse et al., 2011):

...are not intended the one to train body, the other mind, except incidentally, but to ensure a proper harmony between energy and initiative on the one hand and reason on the other, so we may venture to assert that anyone who can produce the perfect blend of the physical and intellectual sides of education and apply them to the training of character, is producing harmony of far more importance (Plato, Republic. 3. 411e412a).

Aristotle, a disciple of Plato who later established his own school in Athens, regarded physical education as an essential component of the Greek educational system. In fact, his philosophical school came to be known as the Peripatetics (from the Greek *peripatētikós*, meaning ‘walking around’), as Aristotle was characterized by teaching his students through deep learning and discussions while walking (Murphy and Mannion, 2021). Thus, Aristotle argued that exercise not only favored physical development but was also crucial for mental health, as good physical condition contributed to the well-being of the soul. In his work *Politics*, he posits that physical training should be prioritized, as a healthy and well-formed body produced robust youths capable of defending the city during times of war and contributing to its well-being in times of peace. He also believes that education should include a combination of moderate physical exercise and intellectual activities, tailored to the age and development of each individual. For example, in Book IV of *Politics*, he specifically refers to training, delineating the importance of *paidotribia* (the art of

physical training) to adapt to the demands and requirements of students, thus ensuring beneficial rather than detrimental execution in youth:

In all the arts and sciences that do not limit themselves to one part, but comprehensively encompass a certain genre with the regimes of objects, it is proper for a single discipline to consider what corresponds to each genre: for example, which exercise is suitable for which body and what is the best (since the most perfect and naturally gifted necessarily deserves the best exercise), and what exercise, in general, is appropriate for the majority (as this is also the task of gymnastics); moreover, if someone does not desire the appropriate physical constitution or knowledge for competition, it will likewise be the duty of the gymnastics instructor and trainer to provide him at least with that capacity” (Aristotle. Politics. 4.1288b).

For Aristotle, therefore, education must balance physical, intellectual, and emotional development, thus ensuring a comprehensive formation of the individual.

2.2 Origin, evolution and structure of the gymnasiums. The integrated model of Greek education

While debated, the origin of the first *gymnasiums* can be traced chronologically between the late 7th century BCE and the mid-6th century BCE, during the Archaic period. These spaces, located outside city walls and lacking a fully defined architectural layout, were associated with two types of physical activities. First, closely tied to Greek mythological folklore and emerging from a martial culture, they served as tools for urban elites to maintain their warriors (hoplites) in good condition. The second possibility lies in the increasing popularity of athletic competitions in Greek society, such as the celebration of the first Olympic Games in 776 BCE, later joined by other prominent events belonging to the Panhellenic Games or the Herean Games (Scanlon, 2002). The prestige and recognition achieved not only by the athlete but also by the victorious *polis* underscored the importance of creating specialized infrastructure for training amidst growing competitiveness among the participating city-states. Furthermore, the Games were an integral part of religious life in Ancient Greece, honoring gods and heroes through their celebration. Major figures from mythology were associated with physical attributes such as Hermes’ speed or Heracles’ superhuman strength, and they were venerated by athletes in competitions like the Hermaia or the Herakleia. Although the military factor seems to have been the initial trigger for gymnasium development, the competitive performance aspect also became a major driver at the societal level. In any case, both aspects appear fundamental for understanding the foundations of Hellenic physical culture, which would progressively be incorporated and integrated into the Greek educational system.

With the diversification of populations across Europe and Asia following the conquests of Alexander the Great, a disciple of Aristotle, there was a search for a unified educational model that could integrate those aspects inherent to their culture and propagate them throughout the Greek *ecumene*. The objective was to enhance the mental and physical development of youth, which complemented one another. The *paideia* reflects Greek unity, symbolizing civilization in contrast

to the barbarians, and the gymnasium should be considered its material representation (Appelboom et al., 1988).

The archaeological evolution of Greek gymnasiums highlights their transformation from informal training areas in rural spaces to well-defined architectural structures by the 4th century BCE. The Hellenistic gymnasium was equipped with infrastructure suitable for physical practice and intellectual training (Paganini, 2021): The *palestra* was the center for wrestling, combat sports and different types of strength training and the *stadium* (for running and other athletic events). These spaces were not merely for sports and these spaces could be often used for intellectual training. Thus, they embodied the Greek concept of *paideia*, which emphasized the harmonious development of body and mind. The *xystos*, a covered running track, and the *paradromis*, an open-air track, provided facilities for training under different conditions, while adjacent *loutra* (baths) and *apodyteria* (changing rooms) supported hygiene and recovery. They included *exedras*—semi-circular benches where philosophical and rhetorical discussions took place—along with *ephebia* (youth training rooms), *acrotéria* (lecture halls), and libraries. These spaces were essential for the education of young Greek men, particularly the *ephebes*, who underwent both military and philosophical instruction under the guidance of gymnasiarchs and scholars (García Sánchez, 2015). This integration of physical and intellectual training reflected the Greek ideal of a well-rounded citizen. As Hellenistic influence spread, gymnasiums became key urban institutions across regions like Asia Minor, Egypt, and Bactria, adapting to different cultural settings. Even under Roman rule, many gymnasiums merged with bath complexes, but their dual function as centers for both athletic and intellectual formation persisted, particularly in the eastern provinces of the Empire. Indeed, the gymnasiums can be considered authentic universities of the Ancient World, possessing specialized spaces and gathering the best educators for teaching and knowledge-seeking (Delvoye, 1960).

Although Greek education and the gymnasium represented a unified model, there were specific differences among the various regions of the Greek World. To pinpoint a prototypical model of this educational framework, one must refer to the Athenian *ephebia*. It is worth highlighting Aristotle once again (Aristot. *Const. Ath.* 42.), who provides valuable information about its functioning. Once the Athenian adolescent reached the age of 18, he was required to undergo physical training applied to the military sphere, confirmed by the *ekklesia* as a representative of the *demos*. Skills in combat, proficiency with weapons, endurance running, wrestling practices such as *pankration*, and javelin throwing were part of the physical training the youths received (García Sánchez, 2015). In addition to military service itself, the *ephebe* was also expected to develop intellectually. The subjects covered ranged from grammar to arithmetic, including literature and philosophy, although the disciplines evolved over the centuries, always maintaining both a practical and theoretical foundation. Additionally, values such as discipline and commitment to the homeland were instilled in them, indicating the complex social, moral, and cultural training they underwent (Marrou, 1982). The ideals of the fully recognized citizen encompassed a love for knowledge, the pursuit of aesthetics, deep sensitivity, unwavering ethics, and exceptional physical ability—both body and mind were considered equally important.

On the other hand, inherited from a warrior culture, the Spartan *agoge* consisted of a complex and strict military training program

from ages 7 to 30, aiming for physical excellence in the art of war, placing less emphasis on literacy and other academic disciplines (Although, similar to almost all educational systems, a wide variety of changes in its structure can be recognized throughout the time it was established, although the precise structure of these changes is not explored in this article). It is noteworthy that, while most Greek states included only males in the educational system, Spartan women received greater education compared to those from other states and were also physically trained. In general terms, they enjoyed more independence, and despite they were mainly educated to be mothers of warriors they had more responsibilities when the men were under military obligations (Demirel and Yildiran, 2013; Tipton, 2014). However, physical activity formed an integral part of the educational and social process in Ancient Greece, consolidating a cultural ideal that valued the balance between physical abilities and the moral and spiritual training of the citizen. This evolution laid the groundwork for a culture in which the holistic development of the individual was seen as essential for the well-being of the *polis*.

Overall, the worship and training of the body and its interdependence with intellectual and moral education represent a characteristic sign of Greek civilization. This interest manifests in multiple dimensions, from mythology and the artistic idealization of the athlete to philosophy and medicine, reflecting a culture that understood that physical well-being was intrinsically linked to intellectual and spiritual development. For the Greeks, the balance between body and mind was essential both as a display of virtue and for fulfilling civic and military responsibilities in a society that valued both physical strength and mental acuity. The Greek educational ideal, later assimilated by Roman culture, embodies the ideal expression of the Latin phrase “*mens sana in corpore sano*” (Juvenal 4.10).

3 From *paideia* to the present times: the need to integrate physical activity into modern educational systems

The Greek *paideia* model illustrates how this civilization regarded the education of the body and mind as an inseparable entity. From a contemporary perspective, it is clear that this system was not perfect and should not be idealized, as it included aspects that modern society strives to overcome—such as the exclusion and limitation of women's education and the restriction of learning opportunities for certain social classes. Additionally, one might argue that this educational approach was designed to foster a strong collective identity, potentially limiting an individual's ability to develop according to their own ideas and needs; thus, providing the State significant power over the individual. These issues could lead to profound philosophical discussions, which, however, fall beyond the scope of this paper.

Our objective is solely to highlight how the ancient Greeks were pioneers in the Western world in integrating physical, mental, and spiritual education. Furthermore, we argue that adopting similar principles—adapted with modern strategies and approaches—could greatly benefit contemporary educational systems.

This section will discuss the role of physical education and physical activity (or rather the limited emphasis placed on them) within today's educational landscape. It will present existing scientific evidence on the importance of incorporating physical activity in educational systems to promote health, cognitive functions, and

academic performance. In parallel, we will explore various educational strategies and models that increasingly support physical activity as a key element in the education of young people. Finally, we will discuss current barriers and issues to address to integrate physical activity in modern educational systems.

3.1 Physical activity in the current educational system

For the Greeks, body and mind were to be understood and developed in tandem (primarily in the physical setting of the *gymnasium*), an approach also supported by various Eastern cultures in their historical traditions (Chan and Chow, 2001). However, Cartesian Thought came to dominate the Western World, asserting that the nature of the body and mind are entirely distinct and can exist and function independently (Thibaut, 2018). For Descartes, the body was an extended, material but unthinking substance subject to mechanical laws, while the mind was unextended, immaterial, and capable of thought, not bound by these same laws (Mehta, 2011). Despite the undeniable impact of the French philosopher on society and scientific methods, recent literature has largely refuted this claim, showing that the body and mind are interdependent entities (Soulé et al., 2022). In other words, the mind affects the body and vice versa, a concept increasingly emphasized by fields such as medicine to maximize health, prevent, and even treat a wide variety of conditions (Dossett et al., 2020), just as Hippocrates and other ancient physicians supported.

Beyond its medical implications, fitness is growing in importance and popularity worldwide. Numerous studies have highlighted that personal training, fitness certification, exercise as medicine, the use of certified fitness professionals, functional fitness training, small-group training, high-intensity interval training, senior fitness programs, rehabilitation classes, and bodyweight training (calisthenics) represent some of the most prominent global fitness trends in 2023 (Btrakoulis et al., 2023; Kercher et al., 2023; Thompson, 2023). However, the topic of physical training or fitness applied to young people in educational settings does not currently receive as much attention, despite a growing body of scientific literature supporting its significance within the educational system (Fraile-Martinez et al., 2024).

The 21st century is marked by significant changes, showcasing unique distinctions compared to other eras and Greek society. While wars and physical labor persist, they do so on a much smaller scale than in past centuries. Educational systems must adapt to our contemporary world, where physical training, though no longer as essential as in the past, remains necessary for many reasons in today's landscape. Modern systems are often overloaded with essential subjects such as Mathematics, Language, Foreign Languages, and various branches of Science and Humanities. However, this structure often underestimates other areas crucial for students' holistic development, such as physical education.

Recent scientific literature suggests that current levels of physical activity in schools are insufficient. According to the World Health Organization (WHO), children and adolescents (aged between 5 and 17 years old) should do, at least, 60 min of moderate to vigorous physical activity (Bull et al., 2020). A systematic review encompassing 29 studies conducted between 1987 and 2019 found that children and adolescents accumulated an average of only 14 to 68 min of moderate

to vigorous physical activity during school hours, with adolescents achieving between 13 and 28 min. Less than a quarter of students met the recommended 30 min of moderate to vigorous physical activity during school hours, a gap particularly pronounced among girls and adolescent females (Grao-Cruces et al., 2020). Recess and extracurricular activities offer additional avenues for moderate to vigorous physical activity, but the limited time allocated to recess (around 30 min in many cases) and research findings indicate that these activities generally contribute insufficiently to overall physical activity levels (Daly-Smith et al., 2019; Grao-Cruces et al., 2019; Reilly et al., 2016). Moreover, studies suggest that students spend almost two-thirds of their school hours in sedentary behaviors (Egan et al., 2019), highlighting a major limitation of current educational systems.

The present situation poses a substantial challenge for educational systems, underscoring the need for changes at various levels (individual, family, school, and population) to enhance the quality and preparedness of education, equipping young people for life in the current world (Daly-Smith et al., 2019). The Greek system and conception of integrating body and mind into education is another example that could help improve society on multiple levels. Hereafter, the various effects and mechanisms by which physical activity benefits the educational system will be summarized.

3.2 Benefits from physical activity in educational systems

One of the primary reasons for promoting and implementing physical activity more extensively within our society is for its health benefits. Appropriate health at both the individual and population levels is fundamental for student formation and their development into functional adults. There exists a direct and bidirectional relationship between health and academic performance (Agnafors et al., 2021; Fraile-Martinez et al., 2024; Shaw et al., 2015). According to the biopsychosocial model (Bolton and Gillett, 2019), health results from the interaction of various biological, psychological, and social variables. Physical activity has demonstrated significant biological, psychological, and social benefits.

Biologically, physical activity protects against chronic diseases related to stress and inflammation by optimizing physiological and neuroendocrine stress responses, promoting an anti-inflammatory state, enhancing neuroplasticity, and facilitating the expression of various growth factors. These effects favor metabolic, cardiovascular, and behavioral resilience (Silverman and Deuster, 2014). Psychosocially, numerous studies (Donizzetti, 2023; John et al., 2020; Kanning and Schlicht, 2008; LaCaille and Marshall, 2020) have shown that physical activity can improve self-esteem, self-efficacy, and reduce symptoms of anxiety and depression. These benefits are observed across a wide range of populations, from young people to the elderly, regardless of physical ability level. Socially, physical activity often fosters social integration and improves interpersonal skills, as it frequently takes place in group or community settings, facilitating social interaction and a sense of belonging.

Furthermore, individuals who participate in exercise programs tend to report greater life satisfaction and subjective well-being, as physical exercise often generates a sense of achievement and personal control, both key for maintaining positive mental health. Additionally, physical exercise has shown its capacity to enhance cognitive

functions, such as processing speed, memory, and executive function across ages, with the most noticeable benefits seen in children, youth, and older adults (Erickson et al., 2019). Finally, factors like resilience and stress management help people better face adversity. Adopting an active lifestyle is influenced by variables such as self-efficacy and enjoyment of exercise, suggesting that physical activity not only improves physical and mental health but also global quality of life and social well-being (John et al., 2020).

On the other hand, conditions like obesity, major depressive disorder (MDD), generalized anxiety disorder (GAD), or precursor stages such as overweight, depressive episodes, or anxiety are increasingly prevalent worldwide, not only among adults or older individuals but also in children and increasingly younger subjects (Lu et al., 2024; Phelps et al., 2024; Santomauro et al., 2021; Sørensen et al., 2022). Studies indicate that approximately 1 in 5 children and adolescents display or have displayed signs of depression, with a notable increase over time (Lu et al., 2024), while other studies report similar figures for anxiety and overweight (Racine et al., 2021; Zhang et al., 2024). These conditions often coexist, as overweight and obesity are directly associated with depression and other mental health issues, which in turn also manifest in various bodily changes (Öz and Kıvrak, 2023), further supporting the previously mentioned body-mind integration.

The rise in obesity, overweight, depression, and anxiety among students has profound effects on the educational system. These conditions can impair academic performance due to cognitive difficulties, such as challenges in concentration and information processing, which translate to low academic results and a higher risk of school dropout (Lindberg et al., 2020). Additionally, mental health problems like depression and anxiety are directly linked to chronic absenteeism and social disconnection, complicating school integration and increasing dropout likelihood (Rogers et al., 2024).

Sedentary behavior or physical inactivity is not the sole cause of these conditions; however, it is a key contributing factor to these health issues (Hanifah et al., 2023). Sedentary behavior is any waking behavior characterized by an energy expenditure of ≤ 1.5 metabolic equivalents (MET) while sitting, reclining, or lying down (Tremblay et al., 2017). Physical inactivity, in turn, is defined as an insufficient level of physical activity to meet current physical activity recommendations. For children and adolescents aged 5 to 17, this entails an average of at least 60 min per day of moderate to vigorous physical activity, primarily aerobic, along with at least 3 days per week of vigorous activity, especially strength training (Bull et al., 2020). A 2016 systematic review showed that sedentary behavior, as well as excessive screen and electronic device time, is related to poorer self-rated health (Zhang et al., 2020). Although certain sedentary activities, such as reading, painting, or studying, are beneficial for cognitive development and have a positive educational impact, prolonged sedentary behavior, even in these activities, also has negative effects on cardiovascular and metabolic health (Chaput et al., 2020). Various countries across continents have established guidelines recommending limiting recreational screen time to less than 2 h per day, adjusted by age, along with ensuring minimum recommended levels of physical activity for children and adolescents (Liu et al., 2024).

All biopsychosocial effects on health also benefit students' academic performance. Interventions in populations less exposed to physical exercise, including children and adolescents who are overweight or obese, with mental health problems, or particularly girls

and female adolescents, show heightened responses and academic benefits from physical activity (Cadenas-Sanchez et al., 2020; Gordon et al., 2018; Van Dusen et al., 2011). Besides, the long-term impacts of integrating physical activity into education extend far beyond immediate academic and cognitive benefits, influencing lifelong health habits and overall well-being. Research suggests that early exposure to structured physical activity fosters a greater likelihood of maintaining an active lifestyle in adulthood, reducing the risk of chronic diseases such as obesity, cardiovascular conditions, and mental health disorders (Harold W. Kohl et al., 2013a). By embedding physical education into school curricula, educational institutions play a crucial role in shaping habits that persist into adulthood, ultimately promoting a healthier and more productive society.

In sum, physical activity influences students' health and academic performance through various mechanisms, promoting physical, psychological, and social well-being. All of this is fundamental to developing active, well-adapted adults, which is (or should be) the goal of any educational system. Scientific literature has also collected important information regarding different strategies and education models for increasing physical activity and integrating as a part of an holistic education, as will be subsequently discussed.

3.3 Current educational strategies and models for integrating physical activity

Integrating education for both body and mind remains a fundamental yet largely unmet goal in most Western educational systems. As previously discussed, high-quality physical education fosters cognitive, affective, and social competencies, complementing the limitations of traditional academic models by enhancing psychomotor development and collaboration skills. These competencies are essential for comprehensive learning and an active, healthy lifestyle. Systematic reviews and meta-analyses (Dudley et al., 2022; García-Hermoso et al., 2021) indicate that physical education interventions using pedagogical approaches, such as mastery learning and sports education, significantly improve cognitive and social development, as well as emotional and physical learning in students. These findings suggest that a hybrid model integrating PE can enhance academic performance and overall personal development, a particularly relevant outcome as holistic learning and healthy lifestyles gain importance in educational settings.

One key to achieving these benefits is giving greater emphasis to physical education and practice within academic institutions. Other strategies that increase physical activity throughout the day also represent valuable and impactful approaches. As Doherty and Forés-Miravalles accurately highlight, Western educational systems have tended to compartmentalize abstract thinking, emotions, health, and physical activity, despite their interconnected roles in learning (Doherty and Forés Miravalles, 2019).

In terms of recommendations for physical activity, it is advised that at least 50% of PE class time be allocated to moderate or vigorous physical activities. The benefits of dedicating more time to physical education and other opportunities for physical activity far outweigh those of limiting school time solely to academic tasks (Harold W. Kohl et al., 2013b). One potential strategy to be applied is to enhance physical activity as part of the extracurricular curricula. Wang D et al. (2023) and Wang J. et al. (2023) investigated whether increasing

extracurricular outdoor physical activity time affects children's academic performance in a competitive educational environment. In a randomized clinical trial involving 2,032 children in China, they found that adding 2 h of after-school physical activity did not negatively impact academic scores while significantly improving physical fitness. These findings suggest that increasing outdoor activity time can enhance children's physical well-being without compromising academic achievement. By enhancing the quality, quantity, and intensity of PE, educational policymakers can maximize children's potential for an active, healthy, and fulfilling life.

Research also underscores the role of classroom movement breaks (CMB) and Physically Active Learning (PAL), which could be defined as the integration of movement with the delivery of academic content in the classroom. While more studies with consistent experimental designs are needed, a wide range of research suggests that these interventions improve physical activity levels, health, cognitive function, classroom behavior, and academic performance. It also aids in meeting daily physical activity recommendations (Daly-Smith et al., 2018; Martin and Murtagh, 2017; Norris et al., 2015; Watson et al., 2017). Because of this, systematic reviews and meta-analysis show benefits from these types of interventions in all ages. For instance, Norris et al. (2020) included 37 studies preschool or elementary school settings and randomized clinical trials, demonstrating significant benefits from including PALs in lesson-time physical activity small increases on overall physical activity, large improvement in lesson-time educational outcomes and a small improvement in overall educational outcomes, without observing effects on cognitive or health outcomes. A systematic review (Petrigna et al., 2022) examined how academic lessons incorporating physical activity can improve academic performance in primary school children. Findings suggest that these active lessons not only increase physical activity time but also improve motor skills and general academic performance. Muntaner-Mas et al. (2024) included 11 articles with 803 children and adolescents from 6 to 16 years and observed that PAL and active breaks increased academic outcomes, especially in mathematics and language. Lynch et al. concluded from 14 studies with 5,997 university students that PAL and CMBs were feasible in the tertiary setting and increased physical activity, reduce sedentary behavior, increase wellbeing, and reduce fatigue while increasing student focus and attention in class with no detrimental effects on academic performance (Lynch et al., 2022). In a similar way, a systematic review conducted by Martínez-López et al. (2020) including 29 school-based physical activity interventions in children between 6 to 12 years old found that incorporating movement into lessons, breaks, and recess enhanced cognitive and academic performance. A 30-min PAL improves intelligence, spelling, and literacy, with math benefits observed in fine motor-based. CMBs and active recess boost attention, concentration, and executive function, with greater effects when more sessions are included. Lastly, combined physical activity enhances various cognitive and academic skills, including mathematical abilities, inhibition, verbal fluency, working memory, and mental flexibility. Generally, PAAL sessions of at least 10 min of MVPA activate cognition and support long-term academic success. Younger children (under 10) and girls tend to experience broader cognitive and academic benefits, particularly in calculation, reading, spelling, and numeracy, compared to older children and boys. The observed heterogeneity in these systematic reviews indicates that the findings

obtained should be interpreted with caution; however, preliminary evidence seems to support the potential role of these types of interventions.

Currently, more studies are being conducted in order to verify and compare interventions like CMBs and PAL in specific populations like adolescents (González-Pérez et al., 2024), whereas some preliminary findings also support significant benefits from these type of modalities in special-need children groups (Meijers et al., 2024). Implementing these strategies in educational settings shows promise in fostering a more active and effective learning environment, improving both physical well-being and cognitive and academic outcomes. Nonetheless, it is also true that to maximize the success of PAL programs, it is essential to address challenges at all levels of the socio-ecological framework: classroom, school, and national policy (Daly-Smith et al., 2019). At the classroom level, programs should enhance teachers' competence and confidence, provide resources, and promote the use of spaces beyond the classroom, such as playgrounds or gymnasiums. At the school level, active learning should be embedded in the institution's mission and vision, supported by leadership, governors, and parents. At the national level, educational and health policies should support active learning, and its inclusion in teacher training programs is essential for adequate preparation.

In regions like Norway and Finland, outdoor learning is promoted, integrating nature into lessons, which strengthen emotional well-being and cognitive development. This teaching style combines knowledge from various fields, promotes social skills, and reforce connections with the natural environment, serving to increase physical activity levels (Ratinen et al., 2023; Sarivaara and Uusiautti, 2017; Waite, 2020). In this sense, Wang D et al. (2023) and Wang J et al. (2023) examined the relationship between outdoor time and academic performance among 3,291 school-aged children. Findings showed a non-linear association, where outdoor time positively correlated with academic performance up to 2.3 h per day, beyond which the effect became non-significant. Similarly, sleep duration and out-of-school learning time followed non-linear patterns, suggesting that promoting outdoor time within optimal limits does not negatively impact academic achievement. In a similar way, (Mann et al., 2023) examined the impact of a 6-month outdoor residential learning program on academic performance, physical activity, and 21st-century skills among 14-15 years old boys. Results showed that outdoor lessons and experiential learning significantly enhanced student motivation, engagement, and skills like communication and critical thinking, with physical activity playing a key role. While motivation declined upon returning to traditional schooling, the program's benefits in academic engagement and personal development highlight the value of integrating outdoor education into standard curricula.

Furthermore, educational models such as the Waldorf approach, developed by Steiner, represent salutogenic approaches independent of mainstream systems that prioritize physical education, fostering a greater interest and engagement in academic activities such as science (Salchegger et al., 2021). Additional movement-based alternatives, such as Brain Gym, employ structured exercises that integrate eye, head, and cross-body coordination, helping improve stress management, sleep quality, self-esteem, and overall health (Thakre et al., 2024). Some studies have also documented academic performance improvements with such interventions (Ramos-Galarza et al., 2023), although further research is needed to clarify their precise effects (Simons et al., 2016).

Finally, there are some specific examples of academic institutions which have implemented physical activity as a central point of education. For instance, Naperville Central High School (Illinois, USA) in 2005 included the “0th period physical education class.” This program demonstrated that, before starting regular classes in the morning, physical activity led to significant improvements in brain function, concentration, memory, and overall classroom performance (Ratey and Hagerman, 2008). This strategy was also implemented in various schools and high schools in other countries like Korea, demonstrating similar benefits when compared to traditional education models (Jeon et al., 2021). Taiiku, in the context of Japanese educational institutions, refers to the integration of physical education as an essential discipline within the curriculum, encompassing both social, medical, and natural sciences, as well as the humanities. The Taiiku approach considers physical education to be fundamental for students’ overall well-being, promoting not only physical development but also emotional and social health. This model focuses on combining physical training with academic development, as seen in educational programs that, although not fully formalized across the Japanese school system, are being voluntarily implemented in various schools (Hayashi, 2022).

Overall, these diverse strategies, approaches, models and examples underscore the importance of physical activity within the educational system, as supported by current scientific literature. The Greeks, pioneers in recognizing these benefits, understood the indissoluble link and interconnection between body and mind in education. We can, therefore, draw valuable lessons from their legacy, which will be summarized below. But before this, it is essential to recognize the current limitations and existing barriers for implementing holistic education models based on the training of the body and the mind.

3.4 Challenges and barriers to successfully implementing physical education in modern educational systems

Despite the many benefits of physical exercise and the positive outcomes obtained from different models, available literature recognizes that the effects of physical activity interventions in schools or high schools are small, even when considering variables like gender and socioeconomic position (Love et al., 2019; Nagrale and Jiandani, 2024). This is explained by several structural, financial, and cultural barriers which impede its successful implementation. Addressing these obstacles is crucial to ensuring that holistic educational models are both feasible and effective across diverse educational contexts.

One of the primary challenges in incorporating physical education into school curricula is the lack of infrastructure and resources in many educational institutions. Schools in low-income areas often deal with inadequate facilities, outdated or insufficient equipment (Adebusoye et al., 2022). Financial constraints also limit the ability to implement comprehensive programs that require investment in sports facilities, extracurricular activities, and specialized training for educators (Nagrale and Jiandani, 2024). To address these structural and financial limitations, policymakers should consider allocating targeted funding for physical education programs, particularly in underprivileged areas. Partnerships with local sports organizations, community centers, or private sponsors can help supplement resources. Additionally, integrating movement-based learning within

existing classroom structures—such as incorporating short, structured physical activities into daily lessons—can be a cost-effective alternative that enhances student engagement without requiring significant financial investment.

Beyond logistical issues, cultural perceptions regarding physical education play a significant role in its implementation. In some educational systems, physical education is still seen as secondary to intellectual development, leading to reduced instructional time and lower prioritization. In turn, the students do report that they have not enough time to perform physical activity due to this academic load (Payán et al., 2019). In a systematic review, Nathan et al. (2018) reported that insufficient support from parents, students, or administrators were the most important barriers to implement physical activity in educational settings, along with the lack of equipment, time, staff and facilities. These observations clearly highlight the need to raise awareness among students, families, and educational institutions about the benefits of physical activity, not only for health but also for instruction and development.

On the other hand, studies indicate that girls, particularly in adolescence, perceive more intensely different barriers compared to boys to engage in physical activity, including a lack of time, energy, and motivation; social and environmental obstacles, such as limited parental encouragement, safety concerns, and a preference for sedentary activities, often influenced by peers and smartphone use; and body image concerns, low self-esteem, and fear of judgment (Rosselli et al., 2020). Additionally, in certain cultures, societal expectations regarding gender roles may discourage female participation in sports and physical activities (Deaner et al., 2012; Rasmussen et al., 2021). To promote inclusivity, schools must actively challenge these stereotypes by ensuring that physical education curricula encourage equal participation for all students. Schools can introduce diverse activities that appeal to different interests, moving beyond traditional competitive sports to include dance, martial arts, yoga, and other forms of movement. Furthermore, gender-sensitive policies—such as offering same-gender physical education sessions in regions where mixed-gender activities are culturally discouraged—could help increase participation among girls.

Socioeconomic disparities also impact access to physical education. Students from low-income backgrounds report a confluence of barriers to participation in physical activities, including a desire to avoid potential physical or emotional harm, a perception of exclusion or a lack of inclusion within team environments, financial constraints or prohibitive costs associated with participation, and logistical challenges related to transportation accessibility (Tandon et al., 2021). To this fact it must be added that these children and adolescents tend to exhibit unhealthy behaviors (e.g., early initiation of smoking, exacerbating consumption of high-energy-dense food, altered sleep patterns and involvement in drug abuse) (Gautam et al., 2023). Governments and schools can mitigate this gap by offering free or subsidized sports programs, providing necessary equipment, and promoting school-based health and wellness initiatives that extend beyond the classroom.

Other students’ characteristics such as withdrawal, overweight/obesity, mental health concerns or suffering from bullying may also negatively influence engagement to physical activity in modern educational systems. However, it is more insightful to approach this issue from the opposite perspective. The inclusion of physical activity represents essential aid and support for people suffering from these

situations. Available evidence show that students with higher levels of physical activity enjoyment had better grades and perceived higher levels of empathy and interest, better mental health and reduced risk for developing cardiovascular diseases, osteoporosis, and obesity later in life (Berki and Tarjányi, 2022). Besides, physical activity and fitness act as a protective factor against bullying, according to a broad number of studies (Benítez-Sillero et al., 2023; Galán-Arroyo et al., 2023; Garcia-Hermoso et al., 2019). Furthermore, integrating physical education into modern educational systems can foster social inclusion, enhance self-esteem, and improve students' overall well-being. However, to fully leverage these benefits, it is essential to develop effective strategies that encourage children and adolescents affected by these conditions to engage in physical activity. This can be achieved by diversifying physical education programs to include a variety of activities beyond traditional sports, allowing students to choose options that align with their interests. Additionally, fostering a supportive environment with positive reinforcement, peer encouragement, and family involvement can enhance motivation.

In an increasingly digitalized world, technology presents both challenges and opportunities for physical education. While excessive screen time has contributed to a decline in physical activity among youth, innovative technologies can also serve as tools to encourage movement and engagement. Wearable fitness devices, mobile applications, and gamified exercise programs offer new ways to integrate physical activity into students' daily routines (Sousa et al., 2023). To leverage technology effectively, schools should explore ways to incorporate digital tools into their physical education curricula. This could include using apps that track movement and set fitness goals, integrating virtual reality sports experiences, or adopting online platforms that encourage physical activity through interactive challenges. Studies suggest that gamified approaches—such as fitness challenges, virtual reality sports, or interactive movement-based learning games—can enhance motivation and participation among students who may not be inclined toward traditional physical education (Pérez-Jorge et al., 2024). However, it is essential to ensure that such technological solutions are accessible to all students, including those in low-resource settings, to avoid exacerbating existing inequalities.

Much of the existing literature on physical education focuses on Western educational systems, but global diversity must be considered when proposing holistic models. For instance, the Second Worldwide Survey on physical education in schools reveals a global disparity between policy commitments and actual implementation, with issues like insufficient curriculum time, underqualified teachers, and inadequate facilities, especially in underdeveloped regions. Rising obesity rates, declining youth fitness, and high dropout levels further highlight the need for action in these countries (Hardman, 2008). Moreover, in culturally distinct regions, the relevance of Western-style sports may be limited, requiring adaptations that align with local traditions and community practices. To ensure global applicability, education policymakers must adopt flexible, context-specific approaches to physical education. In regions with limited infrastructure, outdoor and community-based activities—such as dance or nature-based exercise—can serve as effective alternatives. Additionally, integrating physical education into broader public health initiatives, in collaboration with local organizations, can help promote active lifestyles even in areas where formal sports facilities are lacking.

Collectively, despite the well-documented benefits of integrating physical activity into education, several barriers—ranging from financial and structural limitations to cultural and technological challenges—complicate its implementation. Addressing these issues requires a multi-faceted approach that includes increased funding, inclusive and culturally sensitive policies, the strategic use of technology, and adaptations that consider global educational diversity. By tackling these challenges, schools and policymakers can create an educational model that truly embraces the holistic vision of *paideia*, ensuring that all students have access to the physical, intellectual, and emotional benefits of integrated education.

4 Practical lessons from the Greek educational system: a call for action

The Greek concept of *paideia*—a holistic education encompassing both intellectual and physical development—offers valuable lessons that can be adapted to contemporary educational systems. This holistic approach was crucial in a context where physical strength and military readiness were essential for the survival of *polis*, especially in times of political instability. History as a learning tool allows us to reflect on the achievements and mistakes of past civilizations, and Greek education is not an exception. This civilization showed us that character building, critical thinking, and the integration of body and mind are fundamental to the individual's development. These lessons, explored throughout this manuscript, are supported by scientific evidence accumulated in recent decades.

Greek education provides a valuable perspective that applies to current challenges, especially regarding the promotion of healthy lifestyle habits. Nowadays, we face significant issues like sedentarism, which has led to alarming increases in physical and mental health issues, with notable biopsychosocial changes not only in the general population but also among students. A remarkable aspect of Greek education was its emphasis on harmony between physical and intellectual education, exemplified by the ideas of Plato and Aristotle. Both philosophers argued that a healthy body contributes to a healthy and well-developed mind and vice versa, underscoring the importance of a balanced curriculum that values not only academic knowledge but also the physical and emotional well-being of students. Besides and according to literature, childhood and adolescence represent a window of opportunity to inculcate healthy habits from early stages, aiding in the prevention of future diseases and ensuring adequate mental and physical development (Fernandez-Jimenez et al., 2018; Kumar et al., 2015).

This balance between intellectual and physical progress provided an education that prepared citizens to play active, responsible roles in society, contributing to character development and essential socio-emotional skills. Greek philosophy held that physical education not only strengthened the body but also cultivated valuable qualities such as discipline and resilience, applicable in both personal and social realms. In the current context, where issues like youth stress and anxiety are on the rise, well-structured physical education can help students better manage stress and develop skills such as self-control, patience, and teamwork. This need highlights the importance of including physical education and various movement-based strategies in

school programs to foster more holistic student development. The inclusion of sports and exercise in the school routine, rather than serving merely as a break, could be seen as an essential space for emotional and social growth.

Integrating physical education with intellectual education in the modern educational system could also promote a sense of shared identity, instilling values of discipline, effort, and collaboration. In this way, sports and physical education contribute not only to individual development but also to a “human culture” that fosters a sense of belonging to a global community through universal values of competition and respect. In ancient Greece, the Panhellenic Games, which included the famous Olympic Games, were more than athletic competitions; they were a cultural unity space where all city-states, even those in conflict like Athens and Sparta, identified under a shared system of values and traditions. In this sense, sports competition was a neutral ground where the Greeks recognized their belonging to the same civilization, promoting values of honor, respect, and physical excellence—*areté*. This integrated approach helps students view sports not just as physical activity but as part of a holistic education that reinforces both character and a sense of identity and unity in a diverse global context.

Conversely, the mistakes of the past, such as the exclusion of certain social classes from the educational system, also provide important lessons. Education must be inclusive and accessible to all, regardless of origin or socioeconomic status, to avoid the inequalities that marked ancient Greece. In this sense, the benefits of unifying educational models independently from the sex — as seen in Spartan education— are well-supported by scientific literature, which even indicates that this approach would especially benefit girls and female adolescents, who currently tend to engage in less physical activity (Rosselli et al., 2020). Despite this, individualization and adaptation of physical activity to each person, as advocated by Aristotle, remain fundamental; and the sex is one of the key variables to consider, especially from adolescence onwards (Fraile-Martinez et al., 2024).

In summary, reflecting on Greek education reminds us that its legacy goes beyond mere knowledge transmission. It invites us to create an educational system that integrates physical and intellectual development, promotes inclusion, and uses history as a guide to building a more balanced and just future. Adapting these teachings to today’s context does not mean replicating the ancient model; rather, it means understanding its core principles and applying them to address the needs and challenges of the contemporary world.

To achieve this transformation, educators, policymakers, and researchers must take concrete steps to enhance the integration of physical education into modern curricula. Policymakers should advocate for the inclusion of holistic education programs in national curricula, emphasizing physical activity as an essential component of cognitive and emotional development. Schools and educators can implement pilot programs that combine academic learning with structured physical education, movement-based learning activities, and mindfulness practices to assess their impact on student well-being and performance. Some existing models or strategies like those discussed in this article could serve as a valuable reference for educational systems. Researchers play a crucial role in further investigating the long-term benefits of integrated education, providing

empirical evidence that supports policy changes and educational reform. Collaboration between these sectors is essential to ensure that education evolves to meet the needs of 21st-century students, fostering well-rounded individuals capable of facing modern challenges with resilience, critical thinking, and a deep sense of well-being.

Author contributions

OF-M: Investigation, Writing – original draft, Writing – review & editing. CG-M: Investigation, Writing – original draft, Writing – review & editing. MF-M: Investigation, Writing – original draft, Writing – review & editing. LP: Investigation, Writing – original draft, Writing – review & editing. SB-B: Investigation, Writing – original draft, Writing – review & editing. LL-G: Investigation, Writing – original draft, Writing – review & editing. MAÁ-M: Investigation, Writing – original draft, Writing – review & editing. TP: Investigation, Writing – original draft, Writing – review & editing. CC: Investigation, Writing – original draft, Writing – review & editing. MÁ-M: Investigation, Writing – original draft, Writing – review & editing. MS: Investigation, Writing – original draft, Writing – review & editing. RD: Investigation, Writing – original draft, Writing – review & editing. MO: Conceptualization, Investigation, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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