

Physical Education and Sport Essential as transversality and body integration in the Learning Process: A Systematic Review

La Educación Física y el Deporte como Elementos Esenciales de la Transversalidad y la Integración Corporal en el Proceso de Aprendizaje: Una revisión sistemática

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Abstract. Superior cognitive function and the sensorimotor system are interconnected in interesting ways, according to recent research primarily related to neuroscience. Some empirical evidence suggests that the state of the body is the foundation of information processing and the idea that incarnations influence different facets of mental events. It disproves the conventional theories in cognitive science and philosophy of mind. Using this theoretical foundation as a starting point, the objective of this contribution is to elaborate the cognitive importance manifested as a new perspective that takes into account the mental processes that are based in how the body interacts with the environment. Following a thorough selection and analysis of research on neuroscience in education, the study concentrated on educators. The method used is to find articles that are relevant to the topic. In order to potentially include them in the study, all headings and abstracts were reviewed. The research title, abstract, and full text found are then read and analyzed. Relevant studies are obtained after a thorough review, provided they meet the inclusion criteria. This analysis shows the strength and key points of research conducted in recent decades focusing on the body's transversality and integration in education. This study sought to determine whether a learning environment that takes into account all facets of personality could enhance learners' perception, comprehension, and deliberate action. The results showed that a significant outcome of the analysis is that theory has the possibility to be applied in various educational contexts and scientific fields. The conclusion is that, the current theoretical framework shows how important physical education and sports are as important components in the learning process. Meanwhile, they also stress the importance of trying and spreading new teaching methods and perspectives.

Keywords: Physical Education, Sports, Learning Methods

Resumen. La función cognitiva superior y el sistema sensoriomotor están interconectados de maneras interesantes, según investigaciones recientes relacionadas principalmente con la neurociencia. Alguna evidencia empírica sugiere que el estado del cuerpo es la base del procesamiento de la información y la idea de que las encarnaciones influyen en diferentes facetas de los eventos mentales. Refuta las teorías convencionales de la ciencia cognitiva y la filosofía de la mente. Tomando como punto de partida esta fundamentación teórica, el objetivo de esta contribución es elaborar la importancia cognitiva manifestada como una nueva perspectiva que toma en cuenta los procesos mentales que se basan en cómo el cuerpo interactúa con el entorno. Tras una minuciosa selección y análisis de la investigación sobre neurociencia en educación, el estudio se centró en los educadores. El método utilizado es encontrar artículos que sean relevantes para el tema. Con el fin de incluirlos potencialmente en el estudio, se revisaron todos los títulos y resúmenes. A continuación, se leen y analizan el título de la investigación, el resumen y el texto completo encontrado. Los estudios relevantes se obtienen después de una revisión exhaustiva, siempre que cumplan con los criterios de inclusión. Este análisis muestra la fortaleza y los puntos clave de las investigaciones realizadas en las últimas décadas centradas en la transversalidad e integración del cuerpo en la educación. Este estudio buscó determinar si un entorno de aprendizaje que tenga en cuenta todas las facetas de la personalidad podría mejorar la percepción, la comprensión y la acción deliberada de los alumnos. Los resultados mostraron que un resultado significativo del análisis es que la teoría tiene la posibilidad de ser aplicada en diversos contextos educativos y campos científicos. La conclusión es que, el marco teórico actual muestra la importancia de la educación física y el deporte como componentes importantes en el proceso de aprendizaje. Al mismo tiempo, también destacan la importancia de probar y difundir nuevos métodos y perspectivas de enseñanza.

Palabras clave: Educación Física, Deportes, Métodos de Aprendizaje

Fecha recepción: 06-04-24. Fecha de aceptación: 02-06-24

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Introduction

Today, body dimensions are very important in learning (Huang et al., 2019). It demonstrates its potential for education, social, and inclusiveness, and bears the significance of considering how body movement and learning relate to each other regarding effectiveness and caliber. The body can convey information that can be learned and understood to enhance our understanding of the dynamics of the decision-making process, both in social and individual contexts (Nguyen & Crossan, 2022). The study is based on embodied learning, a theoretical framework focused on the state of the body and the sensorimotor interaction it generates with the outside world (Ferreira, 2021). This theoretical frame-

work aids in our comprehension of the connections between various cognitive states and effects and the environment (P. Zhang, 2013). Therefore, cognitive embodied learning is one of the most cutting-edge scientific theories in the field of educational neuroscience. This is mutually supportive of earlier cognitive learning theories such as Peaget's cognitive theory (Tudge & Rogoff, 2014). The foundation of this field's research is knowledge of the new body vision.

Cognitive science was embodied, also known as embedded cognitive science. By manifesting, The mind is now written in the body, not something apart from it (Varela et al., 2017). The embodiment approach is gaining popularity in today's world, and its definition is incarnation. Research

in the field of educational science might spark a new neurodidactic that focuses on the body's complexity as a bio-dynamic entity that is developed and takes into account the mechanisms that underlie our perception of reality (Borghini & Cimatti, 2010). Global goals cannot be defined using synergistic strategies and heuristics alone.

Nevertheless, they possess the capacity to design and develop effective research instruments that enhance comprehension of the complexity and individuality of every individual. According to embodied cognition, human cognition is basically based on sensory-motor and morphological processes of our body and internal state (Dodig-Crnkovic, 2022). Specifically, it is critical to take into account the significant impact that children's bodily motions can have on obtaining a high-quality education (Chandler & Tricot, 2015). Several research studies have demonstrated the significant benefits that physical activity can have on children's learning, academic performance, and cognitive development (Pacheco et al., 2022). Tomporowski concluded that exercise is an easy and promising way to improve aspects of children's mental functioning. This plays a crucial role in their cognitive growth. (Tomporowski et al., 2008).

Children must act, experiment, and actively participate in the classroom for effective skills teaching (Marheni et al., 2024). Even in childhood, scientific evidence suggests that movement and the body are essential for cognitive development (Corcoran et al., 2023). Embodied research on co-cognition has changed our understanding of how cognition, perception, and action interact with each other. During development, The interplay between sensory and cognitive capacities becomes more delicate (Goncalves & Monteiro, 2023). This opens a new window to the appearance of age-related variations and entrenched cognitive consequences (Akbar et al., 2024). In the context of incarnation, the body showing the basic source of information, comprehension, and cognition of the movements that children and adults make when speaking indicates a process of cognitive change (Markowitsch & Staniloiu, 2023). Very significant, especially in individual and personal teaching, neuroscience focuses on the study of mind and body (Y. Zhang et al., 2024). This type of learning requires the involvement of body and mind, as well as biological and psychological components.

The representation of one's own body is the basis of feelings and thoughts, and is essential for subjectivity (González-Sánchez et al., 2024). The motor system allows people to understand thoroughly. Movement and the physical body are essential for cognition processes in school (Saputra et al., 2024), such as logical-mathematical and language learning, as well as for cultivating emotional and interpersonal skills (Ow et al., 2023). In addition, The program's foundation should be embodied learning in physical education (Forte et al., 2023). This is because motor activity in the classroom is not only done physically but also cognitively, which helps children develop important cognitive skills, especially executive function (Kolovelonis et al., 2022). The purpose of this paper is demonstrates the value

of physical education and sports are as important components in the learning process. This study has been chosen because of the experimental element of the embodiment-based teaching approach used in the school environment, It makes use of corporeality and movement in interaction and action to support transversal learning. Assuming that the main principles of embodied cognition offer unprecedented opportunities to take advantage of changes in the learning process, the creation of innovative teaching methodologies is required.

Material and Method

The scientific literature has been examined using the following keywords: physical education, corporeality, learning, education, cognitive embodied, neuroscience, and cognitive embodied approaches. Specifically, research has been examined that demonstrates the significance of corporeality in the learning process and the planning of instructional programs that emphasize the use of the body and movement as knowledge mediators.

The first step in writing a paper is to collect relevant research according to the topic of the review. The following databases were used in the paper search: Google Scholar, PubMed, Medline, Mendeley, Scopus in the period 2009 to 2024. The selection of the period is based on the purpose of the analysis to see the development of learning theory and physical education in the last 15 years. The search was performed using the following keywords and their combinations: physical activity, physical activity barriers, physical learning, and sports. In order to potentially include them in the study, all headings and abstracts were reviewed. The research title, abstract, and full text found are then read and analyzed. Relevant studies are obtained after a thorough review, provided they meet the inclusion criteria. Pencarian basis data berdasarkan kata kunci menghasilkan 1760 penelitian. From 1760 studies, further filtering was carried out according to the theme of the analyzed title and produced 360 eligible articles for deeper analysis. Through analysis and in accordance with the criteria set, in line with the objectives of this study, so that as many as 50 manuscripts were included for analysis because they were appropriate and fulfilled the topic to be discussed.

Result and Discussion

In embodiment theory, the body aids learning through perception and action. Therefore, he went beyond the conventional scientific paradigm that considered him as a single object of evaluation used to improve the status of the subject of cognition. The post-constructivist hypothesis (Gefei, 2023) studies the relationship between cognition, environment, and body and how these relationships shape embodied cognition. The role of the body in cognitive implementation is the focus of this theory. Consequently, he believed that knowledge and cognition were dynamic processes with their roots in the body and its biological component.

(Kersting et al., 2023). The neuroscience of cognition is strongly influenced by the reformulation of this body as a central conceptualization of information as well as a means of interaction with others, oneself, and the surroundings (Dodig-Crnkovic, 2022). Every kind of cognition and knowledge is "embodied" through bodily experience, according to this argument.

We will go over the most recent theoretical and experimental research that has been done to understand the role of embodiment in classroom learning in this review. After that, we'll go over developments in cognitive neuroscience research that provide light on how brain-body interactions work and how learning occurs.

Theoretical concepts

In addition, new research in neuroscience recognizes that An essential element of brain learning is the body (Saleem & Hamid, 2023). This concept suggests that in the body there is impaired exchange, processing and storage activity. The study of neuroscience revisits the theories and methodologies that underpin teaching and research approaches in which education can transfer these interactions between emotions, mind, and body (Chang et al., 2021). The new approach to education places a strong emphasis on the body and views mobility as an active part of cognitive processes. (Best, 2010). According to this embodied perspective of cognition, the basis of cognition is the body's interaction with culture and environment. Additionally, this viewpoint claims that abstract ideas are connected to the body's motor and sensory systems.

Because the principles of embodiment assert that the brain is but one component of a more intricate system that includes the body and the external world, the cartesian perspective is contradicted. In addition, the body is responsible for the integration and creation of cognitive processes (Marilyn & Astrid, 2023). It is therefore an interactive "tool" that uses sensory networks to enable observation, analysis, and information collection from outside sources. In addition, through communication with external cues, they can help in behavioral and cognitive adaptations (Alves et al., 2023).

The body helps learn with cognition. In situations like these, the environment is where transformation happens (Javier Romero-Naranjo et al., 2023). Meaning is created from external elements and representations, and the body interacts with its environment through its sensorimotor networks (Shimada, 2022). This is where the mind begins, and this is where extremely intricate neurofunctional networks and paradigms give rise to cognitive processes. Neurodiversity and bio-psycho-social cues, for instance, depend on a comprehensive strategy. A holistic approach combines biological, psychological, and social aspects by considering the interaction between living systems and their environment (Talan et al., 2020). Numerous theoretical philosophies have examined the connection between movement and body cognition from various perspectives have recognized that the kinesthetic dimension of the body is essential

in the process of knowledge construction.

This allows us to reconsider the expressive, communicative, and learning potential of the body in learning practice. In particular, Embodied Cognitive Science (ECS) research has revealed that instruction has developed further reflections on embodied vicarious processes and simulations (Damiani & Gomez Paloma, 2021). This can aid in a deeper comprehension of the complexity of each person and the actors participating in the teaching-learning process as a whole.

Experimental studies of classroom learning

Neuroscience research has flourished in recent years, especially with regard to the relationship between brain, cognitive, and motor activity (Umar et al., 2023). The study was clearer in younger subjects. The movements of babies early in life are influenced by the development of cognitive processes and their representation Adolescents who possess kinesthetic bodily intelligence demonstrate their capacity for reasoning in specific situations and through their exploratory behavior (Şinik, 2017).

This is the first example of learning to learn (life skills), a transversal competency anticipated in European citizen training. Neuroscience, the theory of embodied cognition and the consequences of embodied education have supported this intelligence, is a growing emphasis on the role that motor activity has in mental development. The importance of encouraging children to exercise is increasingly emphasized by research on executive function and early metacognition, or children's understanding of what they know and how they might utilize it (Marulis et al., 2020). Motor activities and sports increase a person's awareness and emotions, as well as the body and surrounding environment (Ascione et al., 2019). As a result, the subject has the ability to regulate his movements through this balance. Therefore, cognition controls the emotions of the subject, which allows him to choose which actions to perform. As a result, the subject moves from input information to action.

Numerous studies indicate that the body is crucial to the learning process (Tombak, 2014). Studies of mathematics education show that students are faced with difficult situations, which hinder their ability to make decisions and solve problems. This increases the daily responsibilities of teachers, administrative responsibilities, and the risk of failure. Motor skills develop along with mathematical knowledge, which includes oral counting, enumeration, and numerical representation (Reikerås et al., 2017).

The latter appears to affect comprehension and impede the degree of mastery of the taught mathematical ideas. Perceptual motor should be a major focus in mathematics learning, especially in elementary school. Through active observation, teachers may consistently grasp the subtleties and various characteristics of different classroom circumstances, and students can contextualize their learning based on their surroundings (Kinshuk et al., 2016). Combining juggling exercises with multiplication tables produces good learning outcomes, according to other studies (Kraeutner

et al., 2023).

Additional research suggests that movement affects the understanding of mathematical concepts (Chan et al., 2023). In other fields, such as science and foreign language education, it has been shown that the use of these learning gestures is beneficial. demonstrates how play and play-related elements boost kids' motivation and focus and aid in the development of their own learning processes. In addition, studies have shown that better learning outcomes are associated with motor activities performed outside of school and that the amount of time spent on physical education in school is associated with better academic outcomes (Álvarez-Bueno et al., 2017). Both modes of physical activity affect children's cognitive and academic abilities, but it is generally recognized that they help children acquire better and healthier motor skills.

In a different classroom research, teaching math was aided by physical activity (Astuti & Erianti, 2024). The study looked at how these interventions affected a person's body mass index, aerobic fitness, and physical activity level (Lubans et al., 2018). The study showed that participating in physical activity improved math academic achievement. This strategy also helps students adopt a healthy lifestyle. Gestures help children create theoretical concepts and write mathematical symbolics. In the body-centered learning approach, some of the tools used to communicate include touching objects, pointing at them, and using fingers to count (Tajadura-Jiménez et al., 2018). This phenomenon shows how physical actions make ideas better.

Children learn to count "one, two, three, etc. simultaneously after recognizing external objects. It seems that this body-environment interaction is essential for learning. Linear nerves connect arithmetic functions and sensorimotor physical functions (Moustafa et al., 2021). Additionally, fundamental cognitive skills and spatial thinking—both of which are critical for mathematics—can be enhanced through embedded spatial instruction. If these abilities are developed in elementary school, there appears to be a trickle-down impact that increases student engagement and success in science and technology across the curriculum

In addition, we count with our fingers to help cognitive processes. We help children understand basic math operations, such as adding, subtracting, dividing, and multiplication, by putting together, cutting, and so on. All this is done with our body. By referring tasks to real-world objects, Even those who are illiterate and unable to read or write numbers can do operations. Children aged five to nine years were asked to complete the calculation tasks of one target, two targets, and addition in two experiments conducted by. While doing this, participants had no obstacles or obstructions that interfered with hand or foot movements that had to be addressed.

The number of impaired hand movements is greater than the foot movements. These results show how our fingers and counting relate to each other. These results are not surprising given the fact that finger counting in childhood is

closely associated with improved numerical skills. Peel presented only adult numbers from 1 to 9 visually in an fMRI study as they lay still in a scanner (Peel & Chouinard, 2022). Hemodynamic activity in the contralateral motor cortex is seen when figures are displayed. This varies depending on whether participants use the left or right starter when counting. The embodied view of mathematical knowledge is supported by this neuroscience evidence. The mechanism of learning Hebrew is related to the relationship between the motor activity of the brain and counting with fingers. They apply during the learning process and have a relationship between finger movements performed when counting and cognitive mathematical operations (Tschentscher et al., 2012).

Research on cognitive neuroscience has advanced, providing insight into the connection between the body and brain as well as the process of learning.

Recent studies in psychology and neuroscience have demonstrated that experience is necessary for cognitive function because it depends on action and perception (Kiefer & Trumpp, 2012). The body and its movements can be internalized through senses such as hearing, sight, and touch. It can also aid learning, intelligent behavior, and memory and emotional intelligence.

Emotional intelligence is a person's ability to recognize, understand, and manage one's own emotions as well as the emotions of others (Nazari & Emami, 2012). This concept includes several important aspects, such as: self-awareness, self-regulation, motivation, empathy and social skills. High emotional intelligence obtained from physical education learning tends to have better relationships and abilities in dealing with stress and pressure. From this point of view, embodied cognitive research can be of great benefit to education as it emphasizes learning approaches that utilize whole-body involvement (Kosmas & Zaphiris, 2018).

As research on learning through play shows, sensorimotor drives are essential for improving learning (Makino et al., 2016). Through the instinctive and innate representation they have with the world and their environment, motricity helps children learn (Pugliese et al., 2023). These representations are combined by their senses, and the idea changes according to the moving elements in its constantly changing environment. It can explain how the body interacts with different objects found in the environment, like musical instruments, balls, sticks, and blocks, can be used to display numbers, letters, and geometric shapes. In addition, body-centered teaching methods can improve students' ability to complete arithmetic tasks (Cea, 2023). When cognition takes the form of modality, it can help pupils learn more and assess their academic progress. Embedded learning is intended to be a successful teaching approach that can keep all participants interested (Borge et al., 2020).

The central function of experience, the significance of the body's involvement in mathematical cognition, and the multiplicity of options and modes connected to experience

are three crucial components. All of this has pushed individuals and researchers toward real mathematical cognition. There is little research on how physical exercise affects learning. Several studies have linked physical play to math and geometry education and found that both help students understand geometry better, including right angles, rectangles, and squares (Shoufan, 2021). These findings imply that the nervous system's motor and cognitive components interact to affect and mold behavior. Learning is not just memorization and thinking, It was a broader process (Mukherjee & Chang, 2023). To direct and enhance our interactions with the environment and society, real learning necessitates coordination, cognitive, emotional, perceptual, and motor skills. Students can acquire the cognitive skills required for academic topics focused on conceptualization and critical thinking with the support of body-centered instruction.

The study emphasizes that motor activity education should start early and school curricula should be designed with a body-centered approach. According to recent studies, Children's motor function and mathematics understanding are positively correlated in those aged three to ten. This association is justified by decision-making theory. (Hedges, 2012). According to this theory, forward action and analysis-oriented decision-making reasoning are necessary to utilize motor skills. As statistical analysis shows, learning motor skills and mathematical concepts has a positive relationship with developmental teaching. It also suggests that the connection between the body and the outside world is at the core of cognitive processes.

Future direction

Researchers in cognitive and developmental neuroscience, educational psychology, educational theory, and other related disciplines are gathering in this new field to study the relationship between biology and education. It is a recognized field of research that uses transdisciplinary episteme as its hallmark. It usually blends ecological paradigms, including classroom settings where teachers and students interact, with accepted standards of scientific rigor and research data (Fraser, 2014).

Because motor activity and cognitive processes are closely related, engaging in motor exercise on a daily basis can improve executive functioning, including attention, perception, decision-making, and problem-solving, as well as overall health (Tao & Yu, 2024). In physical education, it is necessary to use a dual approach qualitative and quantitative to teach children. To avoid a variety of health problems, the qualitative approach encourages kids to be more active and form healthy eating habits. The quantitative method backs up the notion that exercise is vital for good health (Silva et al., 2017).

Nevertheless, future studies ought to uncover proof of the connection between sensorimotor assessments and cognitive abilities in learning exercises. The main focus of this research should be on ways to enhance academic abilities

including math, scientific reasoning, and language understanding. Further studies should look into how sensory-motor skills affect language comprehension and acquisition. Research should focus on instruction and learning, as well as how to better understand how mathematical cognition is embodied in learning environments for designers.

The development of cognitive function can benefit from the practical didactic application of the embodied theory of cognition to motor activity and movement, particularly when aerobic exercise involving intense coordination and mental dedication is involved (Forte et al., 2023). This method should be applied both inside and outside of school because it can help children get closer to sports through cognitive engagement and motivation.

Conclusions

This paper shows that how important physical education and sports are as important components in the learning process. Meanwhile, they also stress the importance of trying and spreading new teaching methods and perspectives. Not only cognitive functions must be considered while learning, but also the part that potential, body involvement, and experience play. Participatory experience and learning also lead to better learning outcomes. Because school design is body-centered and excludes the interaction of the social environment, the idea that closed schools should be created to promote effective learning must be overcome by motion learning such as physical education in children.

For successful learning, students must engage in activities that produce the same mental and physical stimulation seems that a new educational culture that prioritizes students as a source of knowledge and encourages them to actively participate in the curriculum is necessary. By combining theoretical knowledge with motor skills, embedded learning theory can be applied in educational research. Experience helps research body-centered learning. In addition, it can generate thought processes and cognitions that help explain individual differences in interaction with their environment. Action in learning is an important innovative component. An action is not just a simple gesture, but it is an articulated interaction with the surrounding world that allows it to gather as much information as possible. Some things that become weaknesses in the presentation of a study are how to reveal a truth theory that has different sources so that it becomes a difficulty in concluding a fact on an existing theory.

Conflict of interest

No conflict of interest with any person, company, or institution.

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