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Embodied Cognition at school: enhancing fundamental motor skills through motor-expressive activities

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Abstract:
The pervasiveness of artificially intelligent machines has immersed the human being in a socio-cultural environment with liquefied and dematerialized boundaries where time seems to be marked by the productive and efficient logics of the anthropocene and by the algorithmic procedures fourth industrial revolution. In the school environment, the educational policy coordinates that emerge from national and international normative references are oriented to a profound transformation of the reference criteria of teaching action, centered on the assumption of an educational project capable of stimulating a virtuous attention to one's existence, based on the centrality of the inner work process and on the dimension of somatic memory, from which comes the ability to place one's own experiences meaningfully in the becoming of ever-changing identities. This study investigates the effectiveness of motor-expressive activities, designed to stimulate spatio-temporal and coordinative abilities, in enhancing basic motor skills in children of developing age. The research was carried out on 254 children (M=109; F=145) aged 8-9. The results confirm the value of motor-expressive practices in promoting a motor literacy based on the principles of Embodied Cognition, highlighting how movement, when integrated with expressive and creative components, can enhance motor adaptation, coordination and psycho-physical well-being.

Keywords: motor-expressive activities; embodied education; MOBAK 3-4; basic motor skills

1. Introduction

The interrelated dimensions of well-being, learning, and corporeality play a significant role in shaping cognitive processes, decision-making abilities, motivation, and autonomy (Oliverio, 2010). These dimensions are increasingly influenced by the effects of the Fourth Industrial Revolution (Schwab, 2016), which, through the emergence of a globalized market, the rise of digitalization, and the capacity for real-time, overlapping visualization of data, spaces, and individuals, has immersed human beings in the fluid and dematerialized boundaries of the so-called "society of digital plenitude" (Bolter, 2020). The rapid and widespread development of computational technologies, driven by intelligent and artificial systems, has shaped the production and commercialization of navigation and connectivity tools. These advances offer modern society indispensable benefits, significantly impacting sectors such as healthcare, public administration, infrastructure and industrial efficiency, energy consumption, and the enhancement of educational processes. At the same time, re-

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cent advances in biology, robotics, and neuroscience - while unquestionably expanding human capacities (Clark & Chalmers, 1998) - also underscore the importance of adopting a critical stance toward the ethical and philosophical implications of these developments. These transformations suggest that the Anthropocene (Crutzen, 2005) has not only fundamentally redefined notions of subjectivity and embodiment, (Braidotti, 2013) but has also challenged the educational community to play a central role in shaping an educational and training policy that is both existentially meaningful and socially empowering. The so-called *Alpha Generation* also known as the Screen Generation (Notte & Renzi, 2024) faces a significant reduction in bodily vitality (Milani, 2021), and experiences the paradox of inhabiting an *online* reality while living in *offline* mode (Floridi, 2014), thus relinquishing the body's irreducibility and complexity in favour of a model of humanity shaped by algorithmic and mechanistic logics (Benasayag, 2019). In the school context, the guiding principles of educational policy, as outlined in national and international regulatory frameworks, are increasingly oriented toward a profound transformation of the foundational criteria underlying educational practice: the construction of knowledge is both directed toward action and derived from it, centring on the student, fostering a holistic awareness of the complexity of learning processes, and promoting the planning of interventions that support educational action which is situated (Paloma, et al., 2015), embodied (Ceciliani, 2018), and primarily focused on educational prevention (Marchesano, Pallonetto, Minghelli & Palumbo, 2025). This perspective takes on significant tones both in the inclusive sphere where, according to the principles of individualisation and personalisation of the educational practices, the expansion of learning opportunities and participation becomes fundamental to foster the realisation of the educational success and the bio-psycho-social wellbeing (Nicolodi, 2015). L'educazione psicomotoria nell'infanzia. of the student with a view to a universal, transformative and ecological didactics (Canevaro & Ianes 2023), and in terms of sustainability. The National Strategy for Sustainable Development, following the guidance of the New European Recommendation on Key Competences for Lifelong Learning (Consiglio dell'Unione Europea, 2018), promotes the development of key individual competences to equip learners with the necessary tools for building a prosperous and resilient future. It also aims to help individuals navigate rapid socio-cultural changes by fostering a culture of sustainability across all educational contexts, in line with the principles of *lifelong learning*. Embracing this orientation supports the development of an educational project aimed at fostering a joyful and reflective inner dialogue. Such a project encourages mindful and constructive attention to one's own existence, grounded in the centrality of inner work, somatic memory, care, and self-understanding. These elements foster the ability to integrate one's experiences in a meaningful and coherent way, supporting the ongoing evolution of personal identity in a context of continuous transformation. The design of educational interventions focused on awareness and proprioception, inspired by the approach of motor-expressive activities, proves particularly effective in promoting the subject's integral and harmonious development. Aligned with the paradigm of *Embodied Education* (EE) and supported by neuroscientific research, it becomes essential to rediscover and enhance the role of the body as a foundational structure for learning. This perspective frames personal development from a holistic viewpoint, embracing the full spectrum of developmental domains (Caruana & Borghi, 2013). This perspective highlights the importance of considering the multiple implications for educational practices, where the active body plays a

central role in fostering holistic personality development. This occurs not only by enhancing perceived self-efficacy and intrinsic motivation (Brambilla, et al., 2011; Errisuriz, et al., 2018), but also by encouraging healthy and sustainable lifestyles (Hills, et al., 2015).
This highlights the crucial role of the qualitative dimension of physical activity in shaping a positive self-image and in developing perceived self-efficacy, particularly in relation to motor skills (*physical self-efficacy*). This study aims to investigate the effectiveness of implementing motor-expressive activities—designed to stimulate spatial-temporal awareness and coordination skills—in enhancing basic motor abilities in school-age children. Specifically, the investigation assessed how motor-expressive activities, in referring to a refined holistic potential located in the dimensions of trust and motivation, knowledge and understanding, promote motor literacy based on the principles of *Embodied Cognition*, highlighting how movement if integrated with expressive and creative components, can enhance motor adaptation, coordination and psychophysical well-being, while at the same time increasing levels of self-perception and belief in one's own abilities, as well as contributing to the construction of a balanced and harmonious sense of self.

2. Rediscovering the body at school: motor-expressive activity as a pedagogical key

Given these considerations, it is essential to reconsider the theme of corporeality in educational discourse, which has been a focal point of research in the human sciences and beyond (Damasio, 1994; 2003). This will help explore new pedagogical approaches that creatively address collaborative, critical thinking, while being mindful of the inalienable benefits of technology in daily life. Furthermore, it aims to reaffirm the role of the body at the heart of educational and teaching practices, allowing individuals to consciously reclaim their perceptive experience of both the self and others.

Since the 20th century, it is possible to speak of a genuine rediscovery of the body, thanks to the contributions of psychoanalytic thought (Freud, 1954) and, later, to phenomenological reflections (Merleau-Ponty, 1945 ; Husserl, 1988). The body has thus been established as a privileged site for a learning-teaching process that aims to become metacognitive (Flavell, 1999), embodied, and integrated (Lakoff, et al, 1999). Rooted in phenomenological philosophy and cognitive neuroscience, corporeality plays an active and fundamental role in the formation of cognition and learning processes.

The body is not merely a passive container inhabited by the individual, but an essential and profoundly expressive dimension that actively contributes to the development of their identity and uniqueness (Varela, et al., 1991).

However, to fully understand the impact and implications of corporeality in educational processes, however, it is necessary to consider how it is concretely translated into teaching methods and pedagogical practices.

In this regard, recent research in neuroscience and cognitive psychology highlights the profound significance of body pedagogy (Gamelli, 2006) within the learning-teaching processes.
It is increasingly recognised as a transversal formative approach—a new epistemological posture—characterised by discovery, sensory openness, and the active interplay of thought, body, and emotion.
Such an approach not only challenges the traditional dualism of body and mind,

embracing bodily intelligence and memory, but also transforms and integrates the ways in which learning occurs and the relationships between spaces and knowledge.

The educational challenge is both compelling and demanding, as it calls upon the teaching community to rethink traditional methodological practices.
This involves constructing a multidimensional bridge between physical experience and learning processes, guided by the paradigm of complexity (Morin, 1999).
The ultimate goal is to nurture forms of intelligence that, moving beyond the boundaries of fragmented and summative knowledge, are expressed as bio-psycho-social entities (Gibson, 1979), in which body, emotion, and cognition are intrinsically connected and mutually influential.

Motor-expressive activities emerge within this framework as a key tool for translating these pedagogical principles into concrete educational practice. They represent, in fact, a unique opportunity to harness the body's expressive potential, fostering educational approaches that are more adaptable and responsive to the diverse needs of each individual.

Through the practices of observation, mirroring, and empathic imitation—closely connected to the principles underlying the proposed workshop setting—the elementary school child can learn to recognize and express emotions using the full expressiveness of the body in motion, positioning themselves within the communicative relationship at a pre-verbal, expressive level. The preparation of the motor-expressive workshop *setting* involves seeking experiences that take the form of a shared learning process, based on the integration of skills that respect and acknowledge each individual's personality: Materials and objects are not used solely according to their formal or functional characteristics, as is often the case in traditional motor-sports lessons, but also in relation to their symbolic, imaginative, or projective dimensions. Through the significance attributed to the gesture within the motor act, a sense of the bodily self gradually takes form. As this bodily self develops, it contributes to the construction of an identity closely linked to the perception of one's own body (Le Boulch, 1966). When this perception is appropriately integrated and verbalised within a meaningful educational relationship, it fosters a virtuous expansion of sensory awareness (Alba & Naccari, 2006).

This enhanced body awareness aids in the development of cross-curricular competencies, including emotional self-regulation and social interaction skills, thereby promoting more integrated and meaningful learning. In an educational context increasingly shaped by technological acceleration and digitization, rediscovering the body as a generative structure of learning has become an essential necessity. Motor-expressive activities are precisely positioned in this direction, aligning with both the *Embodied Education* (EE) paradigm—which advocates for an innovative and inclusive educational approach—and the *Physical Literacy* paradigm (Whitehead, 2013), which highlights the importance of movement as a conscious experience and a decision-making process. These are essential components for the harmonious and balanced motor and cognitive development of the individual.

Motor-expressive activities, therefore, serve as a multidimensional educational opportunity to foster personal creativity and the development of skills such as listening, trust, empathy, and communication. These activities promote the exploration and definition of one's identity and role within the group, while teaching how to collaborate toward a shared goal.

In this way, the dimensions of *knowing* and *knowing how to do* (Ajello & Torti, 2019) are interwoven, while *knowing how to be* transitions into a framework that values the individual in their uniqueness and historical context, recognizing them as a subject capable of effectively engaging with others in the social environment.

3. Materials and Methods

In the contemporary educational context, characterized by the widespread and pervasive use of smart technologies, it is crucial to shift educational models away from deterministic approaches to development and learning, and instead adopt multifactorial and integrated models centered on the concepts of *Embodied Education* (EE) and *Physical Literacy*.

3.1 Objective

The present study explores the effectiveness of motor-expressive activities, aimed at stimulating spatial-temporal and coordination skills, in improving basic motor skills in typically developing children.

3.2 Sample

The study involved a convenience sample of 254 children aged 8-9 years (Tab. 1), with 109 boys (M) and 145 girls (F) (Tab. 2), selected using non-probability sampling. From the sample, general information on sports participation was collected, identifying how many children played sports and how many did not (Tab. 3).

Specifically, 149 children who did not engage in motor activities and 105 children who participated in motor activities in extracurricular settings were identified. Subsequently, the sample was expanded to include a group of 31 children who regularly practice motor-expressive activities in extracurricular settings, to further explore the rapid acquisition of motor skills observed in the tests administered.

Tab. 1 Sample divided by age

Age		Frequency	%
Valid	8,0	136	53,5
	9,0	118	46,5
	Total	254	100,0

Tab.2 Sample divided by gender

Gender		Frequency	%
Valid	Female	145	57,1
	Male	109	42,9
	Total	254	100,0

Tab.3 Sample divided by sports practice

Sports_practice	Frequency	%

Valid	No_sportspractice	149	58,7
	Yes_sportspractice	105	41,3
	Total	254	100,0

3.3 Tools

Experiential and laboratory pathways of motor-expressive activities were designed for the experimental group (n = 105) by an expert, following a non-linear sequence of experiences aimed at stimulating imagination and encouraging the use of diverse cognitive styles, while maintaining methodological rigor and an interdisciplinary approach, incorporating practices such as movement-expressive activities (Pallonetto, 2023), experiential anatomy (Olsen & Tolja, 1994), ideokinesis (Marchesano, 2023), yoga, and educational dance (Palumbo, 2024). The activities had a laboratory-like nature, where 'by laboratory we mean any teaching situation characterized by active learning, or learning by doing' (Baldacci, 2005), with an experiential and non-executive approach. The goal was to increase the child's awareness of their motor choices, combining gesture control with free expression."

The control group (n = 118) was assessed on basic motor skills, considering only the curricular hours of physical education conducted at school, without any additional interventions.

The results were analyzed by administering the MOBAK 3-4 (*Motorische Basis Kompetenzen*) test, designed for elementary school children, to assess the learning and development of basic motor skills (Herrmann, 2018; Scheuer, et al., 2019).

4. Results and discussions

The descriptive statistics of MOBAK 3-4 (Move Something and Move Around) made it possible to quantify in terms of mean values and standard deviations the differences of the variables through the analysis with comparison by level and gender, by level and age, both on whole sample and with inter-group comparison. In the two macro-areas of rile-vation, "Move Something and Move Around," the control group in the input test results (T0), in the skill areas of "Move Something" (74) has slightly higher values than the experimental group (67). In the exit detections (T1) in the skill area of "Moving something" the experimental group (1.14), thanks to the treatment activity managed to reach the levels of the con-trol group (1.18). In the skill area of "Moving something," in the in-gress test results (T0), there is an equal starting level between the control group (1.07) and the experimental group (1.06). In the outgoing detections (T1) in the compe-tency area of "Move", the experimental group (1.52) achieves a level that goes ul-teriorly better in the outgoing detection than the control group (1.47) although not showing a significant difference (p-value > 0.05) (tab.1).

Tab. 4 Descriptive Statistics mean comparison

		N	Mean	Std. Deviation
T0 Move Something	Control Group	108	,73	,53
	Experimental Group	146	,67	,47
	Total	254	,69	,49
T0 Move Around	Control Group	108	1,07	,47
	Experimental Group	146	1,06	,48
	Total	254	1,07	,48
T1 Move Something	Control Group	108	1,18	,44
	Experimental Group	146	1,13	,47
	Total	254	1,16	,45
T1 Move Around	Control Group	108	1,48	,39
	Experimental Group	146	1,52	,42
	Total	254	1,50	,41

An ANOVA was conducted to compare the differences between the control group and the experimental group across T0 and T1. The analysis revealed a significant change over time with respect to the time factor, with a statistically significant p-value ($p < 0.005$) between the input (T0) and output (T1) assessments. Both groups showed improvement in the test.

At T0, the experimental group had lower scores than the control group. However, at T1, the methodology implemented in the experimental group proved effective, resulting in slightly higher scores for the experimental group compared to the control group.

When comparing the three subgroups (control group, experimental school group, and experimental motor-expression group), a statistically significant p-value ($p < 0.005$) was found for both the time factor and the interaction effect. Post hoc analysis revealed a significant difference in the group engaged in motor-expressive activities ($p < 0.005$) when compared to both the control group and the experimental school group, irrespective of the time factor.

This result confirms that participants in the experimental motor-expression group responded particularly well to the treatment, showing significant improvements in the post-test compared to the pre-test, likely due to their favorable predisposition to the proposed stimuli (Tab.2). The data confirm that prior motor experiences, particularly those characterized by a variety of activities, significantly influence both pre-test and post-test performance. Children who engaged in activities such as free and expressive movement (Pallonetto, 2023), ideokinetic movement guidance (Marchesano, 2023), educational dance (Palumbo, 2024), and Educational Yoga showed greater readiness for motor control and a more effective ability to adapt to fundamental coordination tasks. This preparatory experience enhanced their ability to respond to motor stimuli with greater speed and accuracy. From an educational

perspective, individuals who engage in dance or body expression activities not only utilize their physical bodies but also cultivate a deeper awareness of their personal identity and the sociocultural context in which they are situated. In this context, motor action is no longer viewed purely as a technical skill, but rather as an expression of personality in interaction with the surrounding physical and social environment (Bortolotti, 2017). This shift in perspective echoes, on the one hand, the view of Parlebas (Parlebas, 1999), who argues that motor skills should not be interpreted in the traditional sense, but rather as a system of dynamic interactions activated by the individual within a specific contextual environment. On the other hand, it aligns with the principles of *Embodied Education* (EE), which situates learning within subjectivity, taking into account the spatial, temporal, and relational dimensions inherent to each educational *setting*. Thus, the core of this approach lies in embodied artistic experiences and in recognizing the interconnection between active engagement, multisensory perception, and cognitive processes—where the body, as a medium for developing motor, expressive, and communicative competencies, becomes central to the learning process. In light of these considerations, expressive motor practices may be seen as a stimulating and innovative alternative for enriching motor education programs, moving beyond a solely physiological-functional perspective. An analysis of major national and international policy documents reveals a growing interest in integrating such practices into educational programs. This approach reinforces the connection between pedagogy, movement, and creativity, broadening the educational framework and promoting the artistic-expressive dimension of the body within the school environment.

5. Conclusions

The data that emerged in the present research, indicate a significant advantage for children who participated in expressive movement activities compared to those who engaged solely in standardized motor education programs. This result aligns with existing literature that highlights the value of a nonlinear and creative motor approach in enhancing coordination and perceptual-motor skills. Motor learning, in fact, develops not solely through the mechanical repetition of motor patterns, but through ongoing processes of adaptation and sensory modulation (Shumway-Cook & Woollacott, 2001). The symbolic and projective dimensions of bodily activity enable children to explore new forms of communication and personal experience processing within a relational context that fosters social interaction and cooperation (Bruner, 1996). In light of these considerations, integrating motor-expressive practices into the school environment offers a valuable opportunity to promote inclusive education—one that acknowledges the complexity of learning and emphasizes the role of the body as a medium of knowledge and social connection. A key educational challenge for the future will likely involve moving beyond a vision of motor education focused solely on physical *performance* and training models, toward a more integrated perspective that fosters dialogue between body, mind, and emotions along a path of harmonious and sustainable development. Embracing the expressive potential of the body within traditional motor education practices could contribute to the development of a virtuous educational process—one capable of fostering transversal competencies, such as *life skills* and bio-psycho-social well-being, in line with the principle of *lifelong* learning. This approach shifts the focus away from result-oriented and

performance-based logics, emphasizing instead the dimensions of self-awareness, resilience, and human development.

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