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EMBODIED INTELLIGENCE AND LEARNING PROCESS

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Abstract: Artificial intelligence is becoming an integral part of the educational process. In order to be receptive to changes and exploit their potential, the School must be able to change the approach to artificial intelligence in order to facilitate teaching/learning processes and prepare students to face the challenges that contemporary society constantly poses. The virtual world allows a deep immersion of the students thanks to a multisensory involvement and the opportunity provided to the subject himself to build his own world, adapt it to his needs and make it live through the movement of his body. In the context of teaching/learning processes, in fact, research conducted on a neuroscientific and pedagogical level has highlighted the significance of corporeality in its action in movement. The present paper therefore intends to underline the importance of the relationship between body and learning and the need for a contextual review of the relationship between corporeality and cognitive processes, which are, in this sense, destined to change, contributing to a critical rethinking of the educational-training practices mainly adopted in the Italian School.

Keywords: education; new technologies, academic achievement; school; learning.

1. Introduction

The Body and its action through movement represent the fundamental focus of the evolutionary and formative process. They allow the growth and global maturation of the person, fostering awareness of the value of the body and the structuring of indispensable personality characteristics, such as the conquest of autonomy, the construction of personal identity and the acquisition of skills (Berthoz, 2009). Hence the need for an education of the body and movement aimed at developing motor skills that are fundamental for the growth of the person. The body, in fact, much more than a simple instrument at the service of the mind, is an expression in which the whole man manifests himself, representing the main way to express himself, communicate, understand and learn (Sibilio, 2002). The shift of the research paradigm towards cognitive sciences and neurosciences, which increasingly affirm the need for the importance of taking into account the bodily aspects of cognition, have animated the pedagogical, philosophical and sociological debate of recent decades (Gomez Paloma & Damiani, 2015).

The enhancement of the active role of the body within the cognitive experience

has significantly transformed the understanding of the complex relationship between emotions, behavior and knowledge and the ways in which these dimensions interact with each other, in the body and in relation to it. With the overcoming of the classical vision of cognitive sciences according to which the body was considered an executive accessory in relation to issues related to cognition, emotions and, more generally, mental processes, the new vision that takes into consideration the concept of embodiment by proposing the mind/body relationship according to an inseparable and integrated dimension, it claims the cognitive value of acting and being in the world (Damasio, 1995). The concept of embodiment, highlighting the idea of "knowledge as embodied action", makes it possible to overcome the vision of learning according to a mental representation of the reality experienced, recovering the theme of corporeality as an essential dimension of knowledge processes. This perspective allows us to put the emphasis on corporeality, so that every experience would become knowledge not only for our mind but, at the same time, also for our body, that is, the result of a circularity between perception and action that would outline a sort of reciprocal relationship between environment and subject. What research on embodied cognition has been able to offer is, in fact, scientific evidence about the deep mind-body interconnections. According to the embodied perspective, cognitive functions are strongly rooted in the sensorimotor system and for this reason, significantly connected with the process of perception and interaction of concretely lived experiences (Gomez Paloma, 2013). A cognition based, therefore, on bodily actions closely linked to the motor representations themselves. The motor system can no longer be seen as a "movement control system", but must be investigated in an evolutionary and adaptive perspective, in which cognition is rooted in action and in the sensorimotor system. The embodied mind gives life to a participatory construction with the environment in which the subject acts, supported by the sensorimotor contingencies between the body and the surrounding world. The mind-body system thus conceived does not respond deterministically to changes in the environment but, perceiving external stresses as perturbations that undermine its homeostatic balance, tries to make the necessary transformations to itself based on the relationships between environmental variations and the current state of its structures (autopoiesis). It is in this regard that Varela (1999) speaks of an action embodied in knowledge, in relation to which the motor reaction is an integral part of the perceptual process, inseparable from the sensory stimulus. The motor reaction is understood, therefore, as that motor program that is generated in the individual when sensory perception is activated by expressing embodied possibilities of interaction. Cognition, therefore, depends on being in a world and acting in it, arising from a mutual involvement of mind, body, and world (Varela et al., 2017). According to the enactive theory of embodied cognition, the individual is immersed in reality, he is not a spectator of the world but is in the world and knowledge is defined as the enation of a world that, starting from the experiences acted out in the world through the body, produces and elaborates meanings.

The growing interest in methods and tools to improve learning has brought to light new dimensions in the area of research in the educational field, in order to find advantageous pedagogical implications that are functional to the training of the student. In the context of teaching/learning processes, research carried out on a neuroscientific and pedagogical level has highlighted the significance of corporeality in its action in movement (Fugate et al., 2019). In contemporary educational discourse,

according to the perspective of Embodied Cognition, the human being is an indissoluble unity, constituted in its unity of mind and body and as such must be understood in its entirety, in order to build a participatory knowledge of the body itself that allows one to experience acting in the world through the perception of one's sensations and emotions (Shapiro, 2019). Cognition is, therefore, a phenomenon structurally inseparable from corporeality, so there can be no cognitive activity without a living body. This orientation of educational action in the field of education argues that mind and body are closely interconnected to the point that the bodily dimension plays a significantly important role in the way we learn and teach. As a result, the body takes on a central role in shaping the mind to the extent that we experience, understand, and act in the world through our bodies. In this way, cognitive functions are influenced by the person's experiences with respect to the environment in which he or she is inserted (Shapiro & Stolz, 2019).

From a pedagogical perspective, the learning process is to be considered in the context of the person's experience and overall existence, as the person learns in his totality, unity and integrality. This explains why we must strive for learning that is truly meaningful. It is precisely this that is aimed at with teaching that makes use of the body as a mediator and facilitator of learning. In the teaching/learning process it is possible to achieve what has been described so far by paying attention to the educational relationship between teacher and learner. This relationship becomes a regulator of behavior, in any context, school or extracurricular. In this way, the individual knows himself and the other, builds his own identity, which also becomes a regulator of behavior. An identity that is the result of learning processes that also pass through bodily experiences, the basis of all knowledge of oneself, of the world, of the surrounding environment, of the other. It is, therefore, in this way that it is possible to offer educational opportunities based on experience, an experience that also and above all passes through the body, from the body in action, from the body in movement. In this way, the need for an educational context and a didactic setting that allows experimenting, doing, discovering and interacting has become evident. A context of action that facilitates a participatory and reflective mental disposition (Kosmas & Zaphiris 2018).

The spread of new technologies has reopened a strong dialogue on the possibilities of embodiment, with the advent of virtual worlds, the body and the meanings associated with it, rediscover a profound process of interaction. In the reflection on the use of didactic mediators of a technological nature, this assumes relevance in the light of a learning that is substantiated in a way in which the student learns by participating in the process of knowledge related to doing and experimenting in the first person, extending the boundaries of his perceptive-motor work (Tran et al., 2017).

Within the school context, ICT is proposed as a critical model of learning/teaching towards didactic traditionalism that solicits and pushes towards new educational strategies, opening up to new interdisciplinary dialogues that emphasize and promote different integrated skills for the improvement of school processes (Pande & Chandrasekharan, 2017). In this perspective, the integration of new technologies in teaching participates in the creation of those Embodied-based learning environments in which the dialogic relationship between body-mind-virtual environment makes it possible to promote personalized teaching oriented towards the conquest of self-efficacy, autonomy, know-how and being of students (Adams & Aizawa, 2019).

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The provision of embodied-based learning environments, oriented towards the awareness of one's own body and the recognition of creative thinking in action and movement, can be a factor that significantly contributes not only to the improvement of motor mastery, but also to favor, through it, the development of other cognitive skills. The transferability of disciplinary contents, through bodily experience, opens up access to multiple knowledge, capable of anchoring itself simultaneously to the different cognitive and sensory-perceptual channels (Skulmowski & Rey, 2018). The body becomes an interacting subject for the solution of problems, for the re-elaboration of complementary or alternative strategies of knowledge, a real engine of support for teaching, a learning environment in which it is possible to follow a complex itinerary where spaces of "knowledge, know-how and know-how" can be opened through participatory teaching. It is in this way that it is possible to create, through technological tools, a learning environment in which disciplinary and transversal skills are enhanced which, starting from subjectivity, from the individual needs of the person, from his bodily-cognitive and emotional inseparability, leads to the construction of educational success. In this interpretation, physical education becomes a means of facilitation to modulate and promote privileged channels for access to knowledge (Ladouce et al.,2017).

The introduction of ICT into teaching also presupposes the reorganization of some established practices in schools. Specifically, it is a matter of reorganizing time, space and abandoning the rigidity and detachment that often characterize the relationship between teacher and students. It means, therefore, rethinking teaching time in a more flexible and less linear way, without precise boundaries between teaching time and learning time (Shin, 2017). A didactic approach supported by ICT makes it possible to facilitate and sustain experiences, involving the subject in interesting and motivating activities, which activate the awareness of acting thanks to the presence and awareness of oneself.

2. Application aspects of ICT

In recent years, ICT has become increasingly important in the field of education, so much so that it has become an integral part of teachers' daily work (Kocak, 2003; Liang et al., 2006). Harnessing the full potential of ICT requires teachers not only to have the skills to use these innovative tools to improve the quality of their teaching, but also to be trained to creatively integrate ICT into their lessons (Silverman, 1997).

Various ICT tools can be used by teachers to promote physically active lifestyles and improve pupils' learning. New emerging technologies, in fact, are increasingly used to promote motor activity and the physical and cognitive health of children (Sun et al., 2017). Unlike technologies such as computers and traditional video games, which have contributed significantly to the spread of sedentary behaviors, favoring, among others, the epidemic of pediatric obesity (Gao et al., 2017). This is especially critical in the modern world where technology has become an important part of every individual's daily life and health programs for prevention and safeguarding the health of the population are looking for new strategies to increase involvement in motor activities (Pasco et al., 2017). Often, however, the traditional exercises offered at school are not very motivating for some students, with respect to which alternative strategies are needed in order to stimulate their interest in the practice of motor activities (Gordon-Larsen et al., 2004). Children's physical activity depends on several

factors that can affect their motivation to learn and promote active lifestyles. They concern (Monacis & Colella, 2019):

1. Motivating and fun learning environments that enhance personal success;
2. Variability of practice;
3. Correct organization of the didactic-educational setting;
4. Selection, integration and use of the different digital tools;
5. Enrichment of currently available methodological knowledge.

In recent decades, the rapid evolution and large-scale diffusion of ICT has led to the development of new forms of teaching, to the point that they are increasingly used within schools as an innovative approach to promote enjoyment, physically active lifestyles among children and adolescents, and improve several psychosocial variables such as, for example, self-esteem and a sense of perceived self-efficacy.

ICT also makes it possible to systematically assess and compare the levels of learning and motor development achieved by students, allowing comparisons between groups with different backgrounds, through reliable and valid assessment protocols, necessary to ensure quality motor literacy processes. According to Momchilova and Gurnabova (2015), the use of modern technologies applied in teaching depends to a large extent on the way in which they are chosen and combined with traditional methods. The authors identify some key factors that every teacher should know and be able to contextualize in their practice in order to optimize the integration of ICT into mainstream teaching:

1. Clarify the learning objective to the students and scrupulously align the objective-teaching strategy-assessment;
2. Start from a problem that is relevant to the student, in order to stimulate their interest and motivation;
3. Explain and make clear the learning objective to be achieved and the direction to be taken;
4. Linking the new knowledge to that already possessed by the students;
5. Proceed gradually and in order of complexity in the presentation of new information, favoring a clear structuring;
6. Promote continuous teacher-student feedback, useful for the teacher to monitor the progress of the students and for the latter to become aware of their progress in the learning path and the best strategies to achieve the next goal (e.g. self-regulation strategies);
7. Stimulate reflection on the procedures followed (meta-cognitive strategies);
8. Vary forms and methods of application and recall knowledge at a distance of time (e.g. reinforcement strategies);
9. Use digital technologies with time-balanced interventions, keeping the risks of side effects under control;
10. Design integrated traditional/digital laboratory teaching for the achievement of objectives that go beyond the mere acquisition of knowledge.

If these principles apply to any didactic design, they play a role of fundamental importance when the teaching activity involves the mediation of digital technologies. On the other hand, the most recent MIUR programming policies for school education relaunch an overall strategy for technological innovation in Italian schools (MIUR, 2015). The very concept of school is rethought as an open space for learning, focusing not so much on the technologies themselves, but on the new application models of didactic interaction that use them.

There are several technological devices that find the right applicability at the service of the various disciplines in order to promote the acquisition of physically active behaviors. Among them, office applications can be used by teachers for the preparation of teaching materials and for the assessment of pupils (Silverman, 1997). Multimedia content creation software, such as video editing or animation software, is used in the production of video clips and educational animations (e.g. motor skills demonstrations). They appear to be particularly useful as they are able to motivate pupils to perform new tasks and can be used to demonstrate concepts and strategies, as well as to improve performance (Mohnsen, 2008). Specifically designed multimedia educational software is another valuable tool that can (Vernadakis et al. 2002):

1. Help students understand the theoretical concepts of the discipline;
2. Provide simulations and hands-on experiences that would otherwise be unavailable;
3. Support self-paced learning;
4. Provide immediate feedback;
5. Enable the teacher to adapt to various pupils' learning styles.

The new generation of physically interactive video games, such as the Nintendo Wii, can improve pupils' physical fitness, motor performance and motivation to exercise (Papastergiou, 2009), helping to maintain active lifestyles and improve certain health factors by stimulating motor skills and monitoring weight trends, body mass index (BMI) and body composition. According to Rudella and Buts (2015), the use of exergames makes it possible to meet certain standards on motor activity levels (SHAPE America – Society of Health and Physical Educators, 2014). Specifically, they are able to (Monacis & Colella, 2019):

1. Improve motor learning;
2. Enriching decision-making processes (tactical knowledge);
3. Develop sensory-perceptual and coordination skills;
4. Improve the acquisition of digital skills in relation to motor skills.

Last but not least, Internet and Web technologies offer unprecedented opportunities, as teachers can urge their pupils to seek information related to subject concepts to be studied on the Web (Bowman, 2003). Learners can participate in inquiry-based activities, such as webquests (Woods et al., 2004) and international collaborative learning projects (Cunningham et al., 1998). Therefore, it is evident that innovative technologies are a useful means to promote meaningful learning processes through the proposal of activities to be carried out in playful and fun situations (Staley, 2004; Campos & del Castillo Fernández, 2016).

3. The Importance of Pedagogy in the Context of AI-Enhanced Education

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Artificial intelligence (AI) is becoming an integral part of the educational process. AI is fundamentally transforming the educational landscape, introducing innovative tools and techniques that can enrich and personalize the learning experience (Wang, et al., 2023). This digital revolution is not only changing the way students acquire knowledge, but is also redefining the role of teachers and the very structure of the

learning environment. The education system sees schools and universities at the forefront, having introduced AI-based technologies into their curricula. Already during the pandemic, artificial intelligence accelerated its integration, allowing schools, universities, and other institutions to use technology to teach students remotely. The ability to offer information in an immediate way allows you to integrate the interactive approach necessary to make learning effective (Dekker et al., 2020). As a result, technological tools are slowly revolutionizing the way we perceive education today. By emphasizing the need for qualified professionalism, AI allows significant advantages to be obtained. However, a targeted approach is needed, which provides for adequate preparation of all the actors and elements involved, in order to achieve its objectives with maximum efficiency and effectiveness (Eguchi et al., 2021).

With the advent of AI in education, the role of the teacher does not lose dignity and importance at all. He remains a constant and indispensable figure, without whom teaching cannot take place. The teacher still retains a strategic importance, while his fundamental role remains. A real necessity. In this context, AI is configured as a crucial support, a sort of process assistant that can only facilitate the teacher's work, making it even more effective. But for all this to happen, it is essential to rethink the school and the role of the teacher (Kerres & Buntins, 2020).

But what exactly does it mean to implement AI in teaching and educational settings? And what benefits can it bring? AI, in simple terms, refers to systems that mimic or simulate human intelligence. In education, this can translate into a range of applications, from using chatbots to answer students' questions, to analyzing data to track students' progress and personalizing their learning journey. AI, in short, has enormous potential to improve education. However, to fully exploit this potential, we need to ensure that our teaching strategies and techniques are up to the challenge. Only in this way can we create more sustainable, diverse and accessible learning environments for all students (Holstein et al., 2019).

It is crucial to emphasize the crucial importance of pedagogy in the context of AI-enhanced education. Artificial intelligence, while a powerful tool, is nothing more than a means to an end. Its intrinsic value and positive impact on education depend largely on the way it is implemented and used, and this is where the irreplaceable role of pedagogy comes into play. Pedagogy, with its theories and practices, provides us with the fundamental guidelines for using AI effectively and responsibly in education (Papakostas et al., 2024). It helps us navigate the ever-changing landscape of digital education, ensuring that the use of AI is always aligned with pedagogical principles and students' needs. Moreover, pedagogy reminds us that the goal of education goes far beyond the simple transmission of information. Education aims to develop students' skills, form their values, and prepare them to face real-world challenges. AI can certainly enrich this process, but it is pedagogy that guides its orientation and ensures its quality.

5. Conclusions

To ensure that students acquire the skills and knowledge needed to succeed in today's world, education systems must move from traditional, regimented classrooms to environments where there is greater collaboration and meaningful projects that engage students, foster improvisation and creativity. By giving the highest priority to these teaching-learning processes, teachers can offer a learning experience tailored to

their students' interests, while helping them develop an open attitude towards innovation and problem-solving. Such learning experiences would help equip students with the tools they need to navigate our ever-changing global society. Ultimately, this restructuring would create individuals who are not only prepared to face the world, but also endowed with the ability to shape it. Now it's up to our teachers to be ready for this change.

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