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Embodied Digital Learning: New Educational Scenarios Between Artificial Intelligence And The Rediscovery Of Corporeality

Santolo Ciccarelli[1]*, Maria Giovanna Tafuri[2]

[1] Università degli studi di Napoli Parthenope;
santolo.ciccarelli001@studenti.uniparthenope.it
[2] Pegaso University; mariagiovanna.tafuri@unipegaso.it
* Correspondence: santolo.ciccarelli001@studenti.uniparthenope.it

Abstract: Artificial intelligence is rapidly transforming the educational landscape, with tools like Chat GPT attracting the interest of students and teachers. However, the trend towards digitized learning risks further distancing students from the bodily and sensory experience, which is critical for effective learning. In this presentation, we analyze the opportunities offered by AI for the personalization of learning, but also the risks of over-reliance on such tools. Through the presentation of an immersive teaching method, characterized by the use of game design techniques in a structured context such as school and based on embodied cognition theory, i.e. the body's ability to foster the learning process, the importance of integrating corporeality, perception and emotions into AI-enhanced learning is emphasized. It concludes by highlighting the key role of teachers in guiding students towards a conscious and profitable use of AI, without sacrificing the centrality of bodily experience in the construction of knowledge.

Keywords: Embodied Pedagogy; Social Science; Artificial Intelligence; Gamification; Social science

1. Introduction

The advent of artificial intelligence (AI) and systems based on this technology, such as Chat GPT, a chatbot that through an apparatus of neural networks trained on huge amounts of textual data, is able to learn and replicate the structures of human language (Leunard et al., 2023) . It is raising concerns within school environments due to limitations in the quality of responses, which can contain inaccurate, fabricated and distorted information, as well as highlight the lack of critical thinking and in-depth understanding of the topics covered (Zhu et al., 2023). However, despite its imperfections, AI is still seen by internet users as a great opportunity, and its ability to increase productivity fuels its rise (Czarnitzki et al., 2023).

As far as teaching is concerned, AI still seems to be able to offer countless benefits, as despite its typos it still seems to be able to promote the acquisition of concepts and knowledge (Gibson et al., 2023), even managing to be a valuable support in pursuing ambitious educational goals such as learning a foreign language (Rugaiyah, 2023). This is made possible by the fact that these systems, in addition to allowing personalized feedback, greater accessibility to educational content, and a

great capacity for interaction, offer teachers the opportunity to quickly prepare lessons and propose new ways to nimbly teach complex concepts (Adeshola & Adepoju, 2023).

The ability of artificial intelligence to support foreign language learning is comparable to that of other teaching approaches, which use physical movement. These protocols, which are increasingly integrated with gamification, which involves the introduction of playful elements in structured contexts such as educational ones in order to increase motivation and involvement (Seiffert-Brockmann & Neureiter 2023), have proven to be equally effective in facilitating the acquisition of new idioms through motor play (Kosmas, 2021).

Although learning through the use of the body (Gomez Paloma et al., 2016) and AI may seem like two opposing elements, as one involves experiential learning (Nardiello, 2023) and the other only computational ability (Thompson et al., 2020), these 2 variables could coexist.

The integration of AI with the principles of embodied cognition theory, according to which knowledge is not limited to mere mental representations, but extends to bodily states and environmental resources (Tanton, 2023), was theorized as early as the 80s by Rodney Brooks (1991), who argued that in order to create truly intelligent systems, an interaction between them and the real world through technologies that can reproduce perception and action, thus avoiding relying on abstract representations.

In light of these considerations, there is a need to investigate the role that the body can play within a gamified teaching approach, supported by AI and aimed at learning foreign languages, as in the era of post-teaching and a social and cultural life increasingly permeated by technologies (Tafuri & Priore, 2020), an approach that can reconcile embodied theories with new technologies, could represent an important space for innovative educational research.

2. Embodied Cognition and the Cognitive Shift

In 1916, Margaret Floy Washburn, the first woman to earn a doctorate in psychology, advocated the need to link the events of mental life with those of bodily movement. This attention to the body and action (Sibilio, 2002), already present at the beginning of the 20th century, has long been opposed by classical cognitive psychology, whose predominance of scientists considers action (and the body) secondary to knowledge. As the decades go by, the reason why cognition depends on the body becomes clearer and clearer: we perceive in order to act, and what we perceive depends on how we intend to act (Glenberg et al., 2013). The consequence of these considerations is that any research program that does not consider the body is, in itself, incomplete, and we can imagine the extent of all this by taking into account the cultural climate in which all this is questioned, that is, the cognitivist approach from the 1950s to the mid-1980s. Cognitivism attempted to analyze the processes that occur in the "black box", considered unknowable and in some ways irrelevant to its behaviorist predecessors, placing for the first time the focus on the active subject who lives and moves in the world, a subject who acts by virtue of his mental capacities.

The central element of cognitivism is that the main functions of the mind can be represented in terms of manipulating symbols in accordance with explicit rules (Gallagher & Zahavi, 2009). In the 1960s, Miller, Galanter and Pribram (1960) developed a model called the "TOTE unit", where TOTE stands for: text (check, I am

verifying), operate (making changes and getting a further change), text (verifying the changes that have occurred), exit (when the test is successful, you can exit the TOTE model and implement the changes in terms of behavior and reaction). This is how man's planning activity was described. The TOTE model is the process that we put in place every time we carry out an action and is expressed through a continuous comparison between what the body knows and expects from one side, and what the environment offers it with respect to the objectives of the plan. In other words, every action is directed to a goal, and every time an individual wants to perform an action, he formulates a plan of behavior to achieve the intended goal.

Hence the mind-computer analogy in which the organic substrate of cognitive activity corresponds to hardware and cognitive activity itself, to software. This approach was supported in the 1950s by the proponents of Artificial Intelligence (computers, problem solving...) and probably today few scholars would adopt this position and therefore the idea that cognitive processes can be separated from the body or the social environment within which these processes occur. One attempt at an answer stems from constructivism.

Trying to explain what is called the "Nightmarish landscape" (Phillips, 2000), or the tangled paradigm of constructivism, is quite complex, since it is characterized by a marked transdisciplinarity and the difficulty of the many disciplines to embrace it. It should be noted that the literature on this subject is really extensive; suffice it to say that in 1993 the AERA (Annual Meeting Program) contained more than twenty explicit references on this subject. In addition, there are many theoretical references of various origins (anthropological, philosophical, ethnological, sociological, mathematical, psychological, etc.), but the element on which we will focus concerns the pedagogical variable and how this is intertwined with a didactic based on the concept of Embodied Cognition.

The possibility of "objective" knowledge was seriously questioned during the 1980s, and it was argued that individuals did not come into the world with a pre-established and pre-incorporated "database" (Phillips, 1995). At that time, thinkers in linguistics, philosophy, artificial intelligence, biology, and psychology had formulated the idea that manifest behavior itself depended on the specifics of the body in action, so that cognition depended on the body (Berthoz, 1998).

The nascent exploratory direction rejects the image of an abstract knowledge, devoid of emotional veins and independent of action, also eliminating the vision of a cognitive apparatus dislocated from the structures in which it is incorporated (Boella, 2006).

The first theories that can be traced back to the model of embodied cognition concern the ecological apparatus of perception by James Gibson, who attributes primary importance to perceptual systems, for their ability to directly grasp objects as a function of the motor possibilities associated with them (Michaels & Carello, 1981).

The psychological concept on which Gibsonian pragmatism is based is called "affordance" (Gibson, 1979). Affordance is the physical appearance of an object that allows the user to deduce its functionality or functioning mechanisms.

The affordances that a subject is able to perceive in a given object depend on his previous experiences, on his current needs, on his awareness of what the given object can make available. According to this principle, the individual does not perceive a copy of what the external world sends back to him but captures a series of high-order

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information useful for his action. This is the consequence of three fundamental points:

1. Perception is direct, i.e. it does not require mental representations;
2. Perception is there to guide action and not to gather information;
3. If perception is direct and functional to action, then the environment must offer sufficient and adequate information to guide action (Gomez Paloma, 2013).

The concept of Embodied Cognition is placed in this direction, highlighting that knowledge requires the participation of the brain, body and environment, reinforcing the idea that thought is not "divorced" from the body; but how we think, it depends on the type of body we have.

In the last twenty years this view has been explored by different authors: Edgar Morin (1989), for example, asserts that the relationship between mind and brain cannot be seen in terms of product and producer, effect and cause, since the product is able to react on its producer and the effect on the cause. "Everything points to a reciprocal relationship, a mutual effect, a circular causality". The conclusions reached by Lakoff and Johnson (1999) are basically two: the first is that the bodily component assumes a fundamental aspect in the organization of our conceptual system. The second is related to the fact that the use of metaphors related to our bodily experience is more effective than those that are not. From this theoretical line develops the "corporate" cognitive psychology, Embodied Cognition, which defines the mind not as a set of brain circuits, but as a distributed phenomenon that resides not only in the head since corporeality (embodiment) is the necessary condition for the development of cognitive processes. Others, on the other hand, prefer to speak of diffuse body and Extended Mind to emphasize the impossibility of limiting the boundaries within which cognitive processes take place to the mind or body.

In this sense, we recall Alve Nöe (2009). He argues that the mind is not the brain or a part of it, since it must be understood in terms of its interaction with the organism and the external environment. For him, brain, behaviour and world represent the basis of consciousness. As Nöe himself states (Jeannerod, 2007): "[…] Consciousness is not something that happens inside us. It is something we do or make. Better: it is something we achieve. Consciousness is more like dancing than it is like digestion…. The idea that the only genuinely scientific study of consciousness would be one that identifies consciousness with events in the nervous system is a bit of outdated reductionism […]".

Admittedly, this is an astonishing concept. To think that we are not our brain is a bit like being told that the brain is not that thing inside us that makes us conscious, because in reality it would not exist, like a piece of our body. However, it is only in recent years that the new perspective of embodied has emerged, which emphasizes that organisms are endowed with a body as well as a brain, that the mind is not something separate but that cognitive processes are based on sensory-motor processes. It is now a question of seeing whether it is sufficient to consider the body as a situated device of action or whether it is necessary, as we believe, to configure this vision according to a constructivist perspective in the educational and didactic sphere, an even more complex element (Farina, 2021). In this direction, educational research can feed a Neurodidactics, paying attention both to the complexity of the dimension of the human system as a bio-dynamic entity in formation, and to the consider-

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ation of the problems involved in the unfolding of living reality, adopting a heuristic and synergistic approach that does not predefine its objectives, but regulates them from time to time to the complexity and uniqueness of the individual.

3. Theoretical-methodological orientations towards a didactic system that integrates body, learning and technologies

Embodied theories encompass the conceptual framework that postulates the idea that the body facilitates the learning process by accompanying actions that would otherwise be exclusively mental representations (Giacobo & Souza, 2023). On the other hand, gamification involves the transfer of game dynamics within educational contexts (Macedonia, 2019). These theoretical constructs serve as a scientific basis for educational research investigations that have explored the relationship between corporeality and learning (Tomar, & Verma, 2021), clarifying the importance of motor activities in enhancing curriculum-based learning.

The advent of AI, in addition to representing a crossroads between the devaluation of educational institutions and the great opportunity to increase the learning process and the quality of teaching within them (Behzad et al., 2022), could also play a supporting role in terms of experiential learning hybridized with technologies (Garcés et al., 2022).

Therefore, the proposal of didactic-motor protocols supported by an AI system capable of supporting the work of teachers without claiming to replace them, could be a valid expedient to be integrated with curricular study hours. Such an approach implies a pedagogical vision that approaches the training of students in a holistic way (Ogunseiju et al., 2021), thus revitalizing the operational principles of experiential learning, bringing it to a new level that can predict human-machine interaction (Wilson, 2002).

3.1 TRIP a-Bike

The TRIP a-Bike educational device, an AI-based system that through the principles of embodied cognition theory (Iavarone et al., 2017), provides an immersive gamified learning experience (Gomez Paloma, 2014). It was created with the intention of providing educational support, capable of promoting the teaching of languages to students of lower and upper secondary schools.

From a technical point of view, TRIP a-Bike consists of an AI-based apparatus that involves the development of a game-based educational app. This technology will be interconnected, through a smartphone that through a switch will be able to interact with a physical support consisting of a bicycle fixed to the ground and an LCD screen, which will in turn be hooked to a fixed support. The entire system will also include a technology that, thanks to the use of a support of stabilized suspension rollers interconnected to a sensor capable of detecting movements.

Once the APP is launched, the screen will project 3D paths, and through a series of didactic expedients it will be possible to undertake the study of foreign languages.

This technology provides a student interface and a teacher interface with the possibility of being able to digitize classrooms with an attached virtual register.

The student interface will be characterized by a game activity that includes multiple choice questions, the possibility of composing sentences in another language, the

opportunity to carry out activities of coupling between the words in the mother tongue and those in a foreign language, the possibility of training pronunciation through the help of a headset connected to the device, which will allow interaction with the system. Each learner, once they have reached a fixed number of correct answers, will be able to earn points that will allow them to access intangible prizes such as upgrades and skills for their avatar, as well as the possibility of overcoming game levels and being able to earn training credits that can be spent on their course of study.

In the event that any student gets into difficulty and fails to achieve certain goals, support is provided by the AI, which will give small suggestions to the students at the bottom of the ranking, in order to avoid episodes of frustration and therefore abandonment.

The teacher interface will give the latter the opportunity to use a system also based on AI, which, once a prompt has been entered relevant to the desired educational objective, will return to the students the tasks and teaching activities consistent with the training objective, while they enjoy the gaming experience. In addition, the teacher will have a virtual register where, through a traffic light coloring, he will be able to keep the progress of the entire class group under control, so as to be able to intervene on the specific criticalities of each student, since the same system, through the analysis of data and through the use of generative AI, will develop an evaluation form for each student, highlighting their weaknesses and suggesting possible strategies to remedy the critical issues that have emerged. In this way, the teacher will be able to design a personalized recovery intervention that can be carried out, either through a conventional teaching method or, if desired, through the same system, thanks to the insertion of a prompt addressed to the specific student, through which personalized game experiences will be created.

4. Discussion

The recognition of the centrality of the body in cognition is considered as a complex process that changes in relation to the interactions of the system and action. The paradigm of generative reciprocity between knowledge and experience, long supported by phenomenological pedagogy, integrates the theory of embodied cognition according to the concrete repercussions that it seems to reveal in educational practice (Gallese, 2005).

The construct of embodied education is oriented towards the self-perception and identity of the subject, i.e. the centrality of the relationship through which people mediate their presence in the world. Embodiment seems to highlight two souls, one of a perceptual matrix and one of a motor matrix which, integrated into self-awareness, allow cognitive functions to experience emotions, decisions, and one's own representation, thanks to interactions with people, objects and spaces (Caruana & Borghi, 2013).

Intelligent motor behavior, therefore, manifests itself in the interaction with reality, in cognition agitated at the very production of experience, even in determining the experience of which it is a part. The bodily experience, in the present moment, in the here and now, manifests itself as a vital form of the mind, as cognition resulting from the continuous integration between body – environment – situation, as a personal story that recalls previous experiences to open up to change (Cappuccio, 2006). Several evidence point to the important role of body-movement in children's cogni-

tive development. The ontogeny of human development does not originate in abstract, centralized and context-separated cognition, but is intrinsically anchored in a cognition centered on perceptual-motor processing, sensory-motor or kinesthetic-bodily intelligence. The theory of the dynamic system and embodied cognition have emphasized the contribution that the child's body and actions provide to learning and cognitive development, considering sensorimotor processes to be fundamental in the complex body-mind-environment interaction for the formation of cognitive representations (Zhao & Zhang 2021).

Motor experiences, due to their intrinsic characteristics, integrate body-mind-environment into the construct of enactive practice, based on participation in concrete and situated situations, far from a centralized mental action detached from bodily and sensory-motor aspects.

Research in the field of neuroscience therefore highlights a profound interdependence between movement and cognitive processes. This interdependence is primarily related to changes that occur in brain function and structure as a consequence of motor activity.

In this scenario, it is evident how a *pedagogy of corporeality*, oriented towards an education and training in which there is an indissoluble unity between body and mind, can enhance the role of movement in the construction of knowledge. This is the motivation that drives neuroscience to offer, through recent contributions in the pedagogical and didactic field, a vision of the body considered as an integral part of learning.

In light of what has been discussed so far, it is clear that the advent of AI has drastically changed the teacher-learner balance (Zhao & Zhang 2021), once again relegating the body to a marginal role in learning.

Therefore, we intend to propose TRIP a-Bike, an educational device designed for middle and high school students, which integrates physical activity with AI through the gamification methodology. Through this integrated system, the aim is to promote the learning of foreign languages. This competence, in accordance with European directives, is essential for achieving professional success once one's training is completed (Vasilachi, 2022).

In the literature there is already evidence regarding the potential of aerobic training carried out using a bicycle for learning, for example, in a study conducted at the University of Brescia (Italy) and published in *Nature* by Perini (2016), it was shown that in a single session of moderate aerobic exercise both visual and motor learning significantly improves and that the effects persist for at least 30 minutes after the end of exercise, suggesting that this kind of physical activity may promote brain plasticity.

Therefore, through TRIP a-Bike, in addition to pursuing the goal of promoting the process of learning foreign languages, we want to "teach" AI, conveying it within a closed system that allows its management by teachers, who through a resilient sprint can continue to guide their students towards a conscious and profitable use of this technology, sanctioning the centrality of bodily experience in the construction of knowledge.

5. Conclusions

The present work stems from a strong dialogue between Pedagogy, Neuroscience and Exercise Science in the educational field, united by the enhancement of the multi-perspective scientific paradigm of Embodied Cognition. Some peculiar opera-

tional applications of this approach highlight the relationship between physical movement and the enhancement of learning and memory, as well as the ability of the brain to generate new neurons until old age and its modifiability (concept of plasticity). Starting from the analysis of the body as a scientific mediator of the learning process at a neurobiological and neurophenomenological level, a fertile field of study focuses on the scientific evidence that Embodied Cognition, with its embodied acts, can offer to the world of teaching and on how to build methodologies that respond effectively to the educational needs, including special ones, of students. In this direction, the aim of the present work was to outline and validate an "Embodied Based" model, in order to enhance corporeality as a learning and contextualization environment (setting). All this starting from the assumption that the key principles of Embodied Cognition offer unprecedented opportunities to enhance the differences in learning processes, proving to be extremely functional in creating innovative teaching methodologies. In this context, it is clear that the TRIP a-Bike device can be an expedient capable of representing an educational innovation. However, given the risks associated with AI and the lack of scientific evidence focused on similar tools, empirical studies are needed to demonstrate their effectiveness.

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