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Embodied Cognition as a Concept of Educational Neuroscience and Phenomenology

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***Abstract*—**In this paper, we examine the connection between the human mind and body within the framework of Merleau-Ponty's phenomenology. We study the role of this connection in designing more efficient learning environments, alongside the findings in physical recognition and educational neuroscience. Our research shows the interplay between the mind and the body in the external world and discusses its implications. Based on these observations, we make suggestions as to how the educational system can benefit from taking into account the interaction between the mind and the body in educational affairs.

***Keywords*—**Educational neurosciences, embodied cognition, pedagogical neurosciences, phenomenology.

I. Introduction

SCIENTIFIC pedagogical neuroscience, whose main mission is to improve research on pedagogical activities, utilizes the combination of theories, methods, and techniques of neurosciences with pedagogical research and theory. The central question in this field revolves around the relationship between mind and learning.

Although pedagogical neurosciences study all kinds of learning and developmental environments, it seems that determining abnormal performances of students with specific needs (such as Attention Deficit Hyperactivity disorder, autism, dyslexia, and arithmetic disabilities) is of a specific importance in this field. However, in order to achieve the comprehensive understanding of these disabilities, the pedagogical neurosciences need to find ways to detect affected people and to present them with learning and pedagogic facilities and methods to be used in and out of school. Some claim that although pedagogical neurosciences promote our perception of how knowledge emerges, they will also improve our perception of learning and personal development [15, pp.297-298]. This paper deals with the implications of the theory of embodied cognition for education. The aim of the paper is to answer following research questions:

1. What setting/determination can be presented by embodied cognition?
2. What is the relationship between embodied cognition and cognitive neurosciences?
3. What are the implications of neuroscientific and phenomenological embodied cognition for the educational process?

In order to answer these questions, we use qualitative and quantitative methods.

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II. Embodied Cognition and Educational Neuroscience

The science of mind plays an essential role in our life nowadays. Over the past 50 years in the field of philosophy and over the past 15 years in artificial brain studies and related disciplines, there is a new wave in thinking and rethinking the nature of cognition. Perhaps the most striking change happening in the field is that instead of emphasizing formal operations in abstract symbols, the emphasis is put on the real world [9, p.274].

In the 17th century, Rene Descartes (1596-1650) followed Plato ideas about reflective methods in the study of mind. With Decartes' famous *cogito ergo sums* ("I think, therefore, I am"), Descartes created a new theory of philosophy which is based on "whatever the mind directly perceives": despite the fact that our senses play an essential role to know the world, our mind has the biggest role in epistemology [3, p.35]. Following this idea, Immanuel Kant (1724-1804), in 18th century, under David Hume guidance, used transcendental arguments to certify that both rationalism and empiricism are significant to the reality of mind [14, p.10]. Kant described the concept of mind using two fundamental capacities or powers, which Kant called "receptivity" and "spontaneity" [16, p.4]. Hegel, in the phenomenology of mind, discusses that knowledge starts with sensory experiences; however, it is not merely dependent on those experiences. Sensory experience, to Hegel, is the richest and most real form of knowledge. Merleau-Ponty believed that the body and the world are intertwined: sensory experiences and mental perceptions are interconnected [16, p.85].

While embodied cognition tries to make a connection between mind, body, and environment, cognitive neuroscience, employs electrophysiological tools and brain imaging techniques to understand how to process the knowledge, insight and experience in the mind and brain and the neural pathways involved in them. There are many reasons for explaining the relationship between cognitive neuroscience and learning, which makes it clear why there is a strong connection between embodied cognition, neuroscience and education [10, p.15].

In summary, in embodied cognition, the body plays an important role in shaping the mind. It shows that for various physical and intellectual activities, different regions of the brain show a variety of activities. And with the help of all interconnected cognitive sciences, many factors including memory, attention, sensation, modeling and its effects on learning are scrutinized [7, pp.200-212].

One more point to make is that recent studies with the help of various imaging techniques have shown that the brain is not steady, and in fact, it is constantly changing and adapting new ideas. Nerve flexibility can be defined as a chemical and structural variability of the brain's response to its surrounding environment. Neuroplastic flexibility is the ability to reorganize brain's neural networks in response to new experiences of life. The new information and skills acquired through learning or experience will result in continuous changes in the brain [5, pp.1-3].

III. The Relationship between Embodied Cognition and Cognition through Neuroscience and Educational Neuroscience

The brain uses the body to understand everything the human thinks or learns. For example, if you have this plan or decision to take a glass to drink water, first your mind sends this order to the body to do this act. In fact, the brain uses the body to do something. In short, we need physical experience in order to understand everything in the environment. Hence, embodied cognition theory claims that if you think about fear, you have some physical experience happening in your body [1, pp.91-130].

Educational neuropsychiatry is an emerging scientific field that creates a bridge between cognitive neuroscience, educational psychology, teaching technology and educational theory, and examines the interaction between educational processes and educational concepts. This science actually explores the mechanisms of learning related to nerves, such as reading and writing, and recognizing the important problems associated with them (i.e., reading and writing disorders [12, p.3-5].

IV. Reading and Writing as Embodiment Cognition

> "Writing is a manual sensory–motor skill, which requires the acquisition and storage of complex motor programs. For reading, its grounding in the sensory–motor systems is less obvious, because reading is typically considered to be purely perceptual" [11, p.16].

Embodiment and cognitive neuroscience believe that the motor programs and sensory experiences are influenced by writing when people start to read something. As a consequence, our habitual writing techniques should affect reading performance [9, p.16]. Improved writing skills have profound impacts on reading skills. The help children in primary schools receive from their teachers for improving writing skills will pay off once we see the impact on the progress these children make in reading. Of course, there is a difference between handwriting and typing: handwriting requires carefully reproducing the shape of each letter, whereas in typewriting, no such grapho-motor component is present. Hence, within the embodiment theory, excelling in handwriting plays an important role in getting better at reading [6, pp.297-288].

V. Educational Neuroscience and Learning

Some educational scientism claimed that the educational system does not need to be reformed, it needs to be transformed. It needs less standardization and more personalisation. There are three major components to this change:

1. Rote learning – instead of taking difficult exams, practice Space Repetition;
2. Active recall – instead of using passive learning, apply active recall techniques like using flash cards;
3. Integrative learning – learning that involves different aspects of life.

VI. The Role of Phenomenological Embodied Cognition in Educational Neuroscience

What is the relationship between mind and cognitive neuroscience? Consider the brains of humans, mammals and reptiles. There are big differences between them. Mammals try to survive with social bond; reptiles try to react to threats; and humans learn. Once we experience, our bodies release neurochemicals. We experience these chemicals as emotions [13, pp.350-352].

As shown in Fig. 1, the (light brown) part that captures the highest acumen to yourself demonstrates this point that human learning has a close relation to other areas such as emotion or feeling, as shown in red; thus, the human brain plays a crucial role in the emotional reactions. Furthermore, the other sections in the brain, referring to the blue and green parts in the image, show the role of social bound (mammals), and reptile in the (green) part that is connected to the threat emotional. So, although a huge valance in the brain belongs to human learning, the mind has a strong connection with other parts, as in social behavior and threat emotional. Moreover, all of this part has a profound effect on the learning process in the mind and brain.

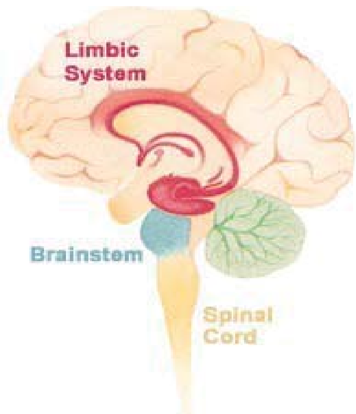

Fig. 1 Human, the (light brown) area with the largest mass has a close relationship with learning – emotion; while, Mammal, the (red) part at the center of the image, has close relation with the social bound; and Reptile, the (green) part is connected to reaction to threats, fear or emotions

In the past, it was a common method of education for the teacher to be the only voice in class and for students to be recipients of the information. This has changed over the decades, and most people nowadays believe that students should have interaction with the environment in order to learn.

Phenomenologists following Merleau-Ponty, among others, believe that we can learn via the interaction established between mind and body.

Merleau-Ponty believed that all perception is done through the body, and in the meantime, the body is not the intermediary of perception, but the "platform of experience", the basis of understanding and perception. A human being is part of the world through one's body. If we consider education as a means to promote humanity, then we should consider the peripheral and sensory platforms as "experiences" of the individual [8, pp.206-208].

Generally, phenomenology is used as a research method in various fields of knowledge. This method, specifically proffered by some scientism such as Willis mentioned that, is a piece of interpretive research focusing on human perception, especially the aesthetic qualities of one's experience [17, p.1]. To explain this method, Willis has used the metaphor of "visual process" against the metaphor of "auditory process", which is specific to other forms of interpretive research. That is because, in Willis' opinion, this kind of research looks at the question of what human beings see in their lives. In this way, the researcher is closely related to the phenomena under study and wants to know her/ himself in the process of experiencing these phenomena, presented a four-stage structure to explain how to implement this approach, which is summarized as follows:

1. Identify a topic of personal and social significance;
2. Choose the right attendees;
3. Interview with each participant; and,
4. Analyze the interview data.

The following piece is from Michael L. Anderson on the connection between the learning process at the environment within the embodied cognition theory:

> "The environment is part of the cognitive system. The information flow between mind and world is so dense and continuous that, for scientists studying the nature of cognitive activity, the mind alone is not a meaningful unit of analysis." This has been one of the more contentious claims to come out of the EC approach, and I'll not try to defend it in its strong form. What is right, or at least illuminating, about the claim flows from an analogy that can be made between mental and physical tools. When trying to analyze the actions of an organism, it can sometimes make sense to define the acting system in question as a whole including both the body and the tools of the organism. Turner (2000) argues for just such a "physiological" interpretation of the mole-cricket burrow (see the discussion, above). Likewise, it can be said that one does not understand the dynamics of spear throwing while using an atalatal without including the atalatl in the calculation of the system dynamics—the throw is performed not by the hunter, but by the hunter plus atalatl. Merleau-Ponty (1962) famously took this one step further by noting that the blind man can be said to feel, not with the hand holding the cane, but *with the cane*; there is a sense in which the cane becomes a part of the body, and the locus of sensation is extended to the tip of the cane. The claim is that the experience of the blind man is not one of feeling bumps in the hand and *inferring* from these the presence of certain textures or obstacles at the tip of the cane; rather, the cane as artifact recedes into the phenomenological background, and the signals transmitted by the motions of the cane are immediately interpreted in terms of—are felt as—the textures and obstacles in the world as present at the tip of the cane. In such cases, the actions, or the character of the perceptions, of the organism are best understood by including the tools with the body to form a single (acting, perceiving) system for analysis. The case is likewise when considering the cognitions of an organism as performed in the context of continual interactions with the environment, and/or with the help of the cognitive tools mentioned above. Here, too, it can make sense to treat the cognition as performed by an extended system including the actions, environmental changes, and external scaffolds employed by the thinking agent" [2, p.8].

What this piece shows is the role of environment and practical methods in the educational process. According to the principles of embodied cognition and cognitive neuroscience, brain development is way faster and far better in an enriched environment, and so learning in this situation is highly beneficial [4, p.462]. In this method, they recommended for education is that "learning at the environment". In fact, they suggested different kinds of ways. And example is learning by video gaming: since students are engaged with the program in action, their system of movement and imagination and exploration will improve [12, p.13], and learning will become a pleasure to them.

In sum, what we learn from this theory is that knowledge should be constructed at the environment, and people should get it through connecting mind processes with bodily experiences in the appropriate environment.

VII. Conclusion

Neuroscience, as the study of the function of the brain and its constituent elements, can provide educators with valuable information. We tried to show that the production of knowledge at the joint level of neuroscience and education is needed. When disciplines come into contact, each one brings a set of assumptions. The views of brain educators and the opinions of neuroscientists in education may have had a significant impact on the results of the collaboration. In other words, teachers need to know the basics of neuroscience and neuroscientists should learn about the basics of educational theories and their methodology in order to provide a desirable combination of approach. We want to propose adding the physical cognition approach inspired by Merleau-Ponty's phenomenology to this mixture, in order to improve theory, thinking and practice in the field of teaching and learning. It is also possible to offer curriculum planners with an appropriate curriculum design, taking into account the principles and criteria in these theories and the theories that have been raised under their influence. Other brain care suggestions for improving your learning include brain exercises. Proponents of the program believe that some physical movements cause the involvement of both brain hemispheres and thus enhance students' learning and progress. They claim that such exercises would enable learners to use all parts of their brain and thus improve their learning.

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