Journal of International Education and Development
2024, VOL. 8, NO. 12, 43-46
DOI: 10.47297/wspiedWSP2516-250006.20240812

Education and the body: embodied cognition and its Practice and Prospects of Educational Technology

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ABSTRACT
The learning paradigm of embodied cognition asserts that learning is based on the close connection of body, mind and environment. With the emergence of the theory of embodied cognition in recent years, education technology has been deeply influenced and gradually changed traditional education modes and teaching methods. This paper introduces the theory of embodied cognition and its three learning paradigms: kinesthetic learning, embodied learning and embodied interaction, and explores the practical application and future prospects of embodied cognition in education technology. However, the educational theory of embodied cognition lacks a clear teaching framework, and further research is needed to integrate embodied teaching methods into different learning environments and teaching designs. Reconsidering the role of the body in the teaching and learning process has a positive impact on educators and may also promote the development of education technology.

KEYWORDS
embodied cognition; educational technology; education; body

1 Introduction

Educational technology integrates the principles of science, technology, and engineering and utilizes a variety of tools and methods to enhance the efficiency and quality of the educational process[1]. It has had a significant impact on traditional education and has become an important driver of educational progress. Educational technology not only makes teaching and learning more scientific, systematic and innovative, but also significantly improves the quality and efficiency of teaching and learning. Moreover, it increases the flexibility of education and promotes students' independent learning. The theory of embodied cognition argues that cognition is based on bodily experience. Sensory and motor processes determine the type and nature of cognition and influence the structure and properties of the cognitive system[2][3]. This theory has become an important part of interdisciplinary field of study and had a profound impact on cognitive science and educational practice[4]. Embodied cognition emphasizes the central role of the body in cognitive processes[5], pushing education and teaching towards a greater focus on physical engagement, which is of great relevance to the research and practice of educational technology in the age of artificial intelligence.

2 Embodied Cognition Theory and its Learning Paradigm

2.1 Theoretical perspectives on embodied cognition

Embodied cognitive science is a new branch of cognitive science that emphasizes the critical role

of the body in the cognitive process.It argues that cognition is not merely a product of brain activity, but a result of the interaction of the body, cognition and the environment[6]. The theory of embodied cognition suggests that bodily experience is the basis for understanding the world and developing action strategies[7]. Bodily sensations, motor abilities and traits and the brain are inseparable in embodied cognition[8]. In addition, embodied cognition proposes that experiences in the physical world also have an impact on cognition. Dreyfus summarizes Maurice Merleau-Ponty's three dimensions of embodiment: physical embodiment, bodily abilities and situational responses, and the influence of the cultural world on the individual. [9] This theory challenges traditional cognitive doctrines, particularly the mind-body dichotomy, which has contributed to the "promotion of the mind over the body" in education and teaching,[10] while ignoring the importance of physical factors in education. It can be said that the development of embodied cognition promotes an emphasis on the physical element in education, advocating for the close connection between the body, mind and environment in the learning process[11].

2.2 Learning paradigm of embodied cognition

The learning paradigm of embodied cognition covers Kinematic Learning, Embodied Learning and Embodied Interaction. Of these, Kinematic Learning emphasizes cognition through bodily movement and perception, which involves perceiving the position and movement of body parts. This kind of learning is realized through bodily practices and external interactions, which help to gain in-depth and accurate knowledge[12]. For example, the Montessori pedagogy promotes learning through kinesthetic engagement. Kinesthetic learning contributes to a clear understanding of concepts and provides opportunities for action[13]. It is considered as an effective interactive learning style that enhances students' motivation and experience.

Embodied learning is a practice of exploring the integration of embodied cognition theory and education and teaching, and is a new type of learning mode based on embodied cognition theory. It integrates research results in the fields of learning science and human-computer interaction. And it focuses on the perception and interaction between individuals and the environment in the learning process. Its aim is to improve the efficiency and quality of learning[14]. In embodied learning environments, learners need to play multiple roles of sensory-motor roles of the body, reflective roles of the mind, and social presence[15].

The theory of embodied interaction was pioneered by Paul Dourish, a scholar in the field of human-computer interaction, and aims to explore the role of interaction between individuals and computer systems[16]. He argues that embodiment (physicality) is an attribute of our interaction with the world that can give meaning to things and create, manipulate and change meaning through interaction with products.

3 Embodied Cognition Theory in Practice of Educational Technology

Over the past two decades, a large number of empirical studies on learning and educational technology have shown that: body movements and motions can facilitate learning outcomes and enhance the learning experience. For example, a study based on the Microsoft kinect platform (a gesture-based device) found that embodied pedagogy can improve language comprehension among college students[17]. The study found that through the involvement of body movements, students were able to understand the language material more deeply during the learning process, thus significantly improving their language comprehension. Another Kinect-based study found that embodied pedagogy can improve students' understanding of action phrases and improve coding recall scores[18]. The study noted that when students learnt action phrases through body

movements, their coding recall scores were significantly improved. This means that body movements not only help students to better understand action phrases, but also enhance their recall of these phrases. And for non-English speaking college students, using Kinect to capture gestures such as raising, waving, and pointing, body movements involved in a designed situation can also improve speech comprehension scores[19]. This finding further emphasises the importance of body movements in language learning, especially in non-native language environments where the involvement of body movements can significantly enhance learning.

It is evident that physical experience and body movement have a positive effect on enhancing the effectiveness and quality of learning during cognitive processing of learning. Body movements help to engage students' attention, encode information competence, and facilitate interaction between learners, technology, and the environment. Therefore, applying embodied cognition theory to the field of education can create a more positive teaching and learning environment for physical experience, thus enhancing students' learning outcomes and experiences. At the same time, the theory of embodied cognition can be used in conjunction with different teaching techniques and devices for educational interventions, thus providing greater possibilities and effectiveness for future education and teaching.

4 Perspectives on Embodied Cognition Theory in Educational Technology

In the field of educational research on embodied cognition theory, it is necessary to further elucidate the link between bodily experience and abstract representational concepts. It ' s helpful to integrate embodied pedagogy with instructional activities, objects of study, and instructional content and deepen the learning and understanding of abstract concepts. Numerous studies have confirmed that bodily experience plays a key role in the learning process, but how to effectively integrate embodied cognition approaches into classroom teaching to achieve optimal learning outcomes still needs to be explored in depth. Therefore,future research could focus on how these innovative educational technology tools affect learners attention and collaboration skills. And it could pay attention to what promotes students ' academic performance and memory retention. In addition, there is a lack of research on the application of students ' cognitive learning strategies. At the same time, future research should also consider expanding device formats, such as studying the effects of embodied learning in game-based environments. Specific research directions may include the role of embedded devices in supporting learning and how embodied learning applications affect the interaction between learner characteristics and software features.

However, due to the lack of a clear pedagogical framework, the educational theory of embodied cognition is difficult to be applied by teachers in various learning environments. Therefore, more research is needed in the future to explore how to integrate pedagogical content into instructional design[20][21] so that it is educational, embodied, contextual, interactive, and generative. At the same time, there is a need to investigate effective methodologies. So teachers can master how to use embodied educational techniques to promote learners' physical engagement and movement in the learning environment. [22] Therefore, future research could be to promote embodied education methods and the develop educational guidelines , promoting the design, development and implementation of teaching systems[23].

In summary, the theory of embodied cognition and its related research clearly reveal the critical role of the body in the learning process of students.

Funding

2020 Guangdong Higher Education Teaching Reform Project: Research on Flipped Teaching Based on the Construction

of Online Open Courses - Taking Language Education for Preschool Children as an Example, Project No.: HS2020ZLGC47

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