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Artificial Intelligence and Embodiment: Conceptual borrowing and semantic drift

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Abstract: In special education, learning is closely tied to bodily experience. The body is seen as central to the perception-action process, and learning is understood as a social and embodied phenomenon (Merleau-Ponty, 1945; Vygotsky, 1934). Artificial Intelligence, by contrast, suggests that cognition can take place in digital systems without a physical body, implying a perspective that overlooks the role of embodiment. This tension stems from differing interpretations of the term "intelligence" and reveals a case of conceptual borrowing: the adoption of terms from neighboring fields to build the vocabulary of emerging disciplines. Conceptual borrowing is not a neutral act. Borrowed terms carry with them a "conceptual baggage" that can shape and sometimes distort understanding in the borrowing field (Floridi & Nobre, 2024). This paper examines these dynamics and explores their potential impact on educational practices and on the understanding of learning processes.

Keywords: Artificial Intelligence, Embodied Cognition, Digital Education, Conceptual Borrowing, Anthropomorphization.

1. Introduction

In the current complex historical moment, Artificial Intelligence (AI) appears to be at the center of nearly every domain—from technological innovation to philosophical inquiry. As AI becomes increasingly sophisticated, it invites comparisons with human intelligence, gradually blurring the boundaries between machine and mind.

In the field of special education, learning is deeply rooted in bodily experience. The body acts as a bridge between perception and action, shaping both cognition and learning itself (Merleau-Ponty, 1945). This perspective emphasizes the essential role of the body in interacting with the world, acquiring knowledge, and developing skills. Learning, therefore, is seen as a social and embodied process, shaped by interaction within one's environment (Vygotsky, 1934).

AI, by contrast, promotes a disembodied view of intelligence. It suggests that cognitive processes and problem-solving abilities can occur independently within

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digital systems, without any physical embodiment. This raises critical issues in education and the philosophy of mind, where intelligence is often considered fully intelligible without accounting for the role of the body.

Drawing from the classical cognitive paradigm, Fodor (1983) proposed that the mind is organized into function-specific modules. This idea has been transferred to AI models, often disregarding the profound differences between biological and computational cognition. The issue becomes especially relevant in the context of Large Language Models (LLMs), which — despite producing impressive outputs — rely on statistical correlations rather than genuine understanding (Bender & Koller, 2020). Brooks' (1991) position on situated and embodied AI reinforces the idea that artificial cognition should be grounded in direct interaction with the environment, rather than in abstract reasoning models.

These considerations have far-reaching implications, especially in educational contexts where embodied learning approaches are central to effective pedagogy (Johnson, 2007).

At the core of this tension lies the varied interpretation of the term "intelligence" across disciplines. This highlights the phenomenon of conceptual borrowing, where emerging fields adopt terminology from neighboring domains to build their own vocabulary. AI, in its rapid evolution, has borrowed extensively from cognitive psychology, pedagogy, and neuroscience — leading to anthropomorphic descriptions of computers as computational brains.

However, this borrowing is not unidirectional. Cognitive sciences have also drawn from information science, generating a complex web of interdisciplinary exchange (Floridi & Nobre, 2024). According to Floridi and Nobre, conceptual borrowing carries a conceptual baggage that can distort understanding within the borrowing discipline. The challenge lies in navigating this complexity without falling into confusion or reductionism in the use of key terms like "intelligence" and "learning."

A critical factor shaping our perception and interaction with AI is the human tendency toward anthropomorphism — attributing human-like traits to non-human entities. In this context, it is essential to take into account the ethical guidelines for the use of AI in education developed by the European Commission (European Union, 2022), which emphasize the importance of addressing ethical risks related to bias, lack of transparency, privacy, and the preservation of human agency.

2. The historical context of conceptual borrowing

Throughout the history of science, emerging disciplines have often relied on the terminology of related fields to describe and communicate new ideas (Boyd, 1979). This process is crucial for the rapid development of new areas of research, as it provides shared vocabulary that facilitates communication and collaboration. However, it also carries the risk of importing unintended connotations and assumptions from the original context, potentially leading to semantic drift and misunderstandings (Lakoff & Johnson, 1980).

Carl Schmitt's observation that modern political concepts have theological origins offers a compelling analogy for understanding conceptual borrowing in AI. Schmitt argued that concepts such as "sovereignty" and "legitimacy" were originally theological notions that had been secularized and repurposed for political use. This process of secularization did not eliminate the theological connotations, but rather recontextualized them within a secular framework (Schmitt, 2005).

Similarly, AI has extensively borrowed from cognitive psychology and neuroscience, adapting terms like "learning," "memory," and "attention" to describe artificial systems. These terms retain their original connotations from the human sciences, which can result in anthropomorphic interpretations of AI systems.

The term "artificial intelligence" itself is a clear example of conceptual borrowing. As McCarthy (1955) noted, the phrase was deliberately chosen to secure funding for a 1956 summer research project, with the explicit goal of achieving human-level intelligence. However, the word "intelligence" is inherently anthropomorphic, implying that AI systems possess the same cognitive capacities as humans. This has sparked an ongoing debate about whether AI systems can truly be considered intelligent or are merely sophisticated pattern-matching machines (Searle, 1980).

Epley, Waytz, and Cacioppo (2007) further explore this phenomenon, noting that anthropomorphism is surprisingly pervasive and significantly shapes how we perceive and interact with non-human agents.

3. The Role of embodiment in cognition

The concept of embodiment is central to understanding the differences between human and artificial intelligence. Embodied cognition is a theoretical framework that emphasizes the role of the body in shaping cognitive processes (Gallagher, 2005). From this perspective, cognition is not merely the abstract processing of information but is deeply intertwined with bodily experience and interaction with the environment. The body provides a structure for interpreting and engaging with the world (Lakoff & Johnson, 1999).

In special education, embodied learning approaches are commonly employed to support students with disabilities in developing cognitive and motor skills (Hannaford, 2005). The theory of the extended mind, introduced by Andy Clark and David Chalmers (1998), argues that cognitive processes are not confined to the brain but extend into the tools and environments we interact with. According to Clark (2008), digital devices, analog tools, and cultural artifacts can function as extensions of the mind, enhancing memory, perception, and problem-solving abilities. The key idea is that the mind is not an isolated entity but a distributed system that uses external elements to expand its cognitive capabilities.

In parallel, Alain Berthoz (2009) developed the concept of vicariance, which refers to the brain's ability to compensate for functional deficiencies and improve efficiency through substitution and adaptation. Vicariance describes the cognitive system's capacity to activate alternative strategies when a familiar path is unavailable, leading to more flexible and adaptive behavior. This principle is especially relevant in motor learning and neurocognitive rehabilitation, where the brain engages alternative neural pathways to restore impaired functions.

Despite their different origins, the extended mind and vicariance theories share a view of cognition as dynamic and distributed. Both challenge the idea of the mind as strictly localized in the brain and emphasize the role of the environment in enhancing and compensating for cognitive functions.

These perspectives converge in the concept of embodied cognition, which recognizes the importance of both body and environment in shaping cognitive experience. Gallagher (2005), in How the Body Shapes the Mind, highlights the "body schema" as a key component in cognitive development, showing how the extended mind and vicariance can be understood as complementary strategies for cognitive adaptation.

These approaches support the use of physical activity and sensory experiences to enhance learning and cognitive development. For example, students may use manipulatives to understand mathematical concepts or engage in movement-based activities to improve reading comprehension. Embodied learning approaches acknowledge the body as an active participant in the learning process.

In contrast, AI systems are typically disembodied, existing as abstract algorithms and data structures within computational environments. While some AI systems can interact with the physical world through sensors and actuators, they lack the kind of embodied experience that humans possess. This absence of embodiment has significant implications for the capabilities and limitations of AI. For instance, AI systems may struggle with tasks that require common-sense reasoning or social intelligence, as these abilities are deeply rooted in embodied experience (Dreyfus, 1979).

This fundamental difference between embodied human cognition and disembodied AI further highlights the risks of direct comparison and the potential for semantic drift.

4. Semantic drift in Artificial Intelligence

As AI has borrowed terminology from cognitive psychology and neuroscience, the meanings of these terms have often shifted from their original contexts. This semantic drift can lead to confusion and misinterpretations regarding the actual capabilities of AI systems. For example, the term learning in AI refers to the process by which a machine learning algorithm adjusts its parameters to improve performance on a given task. However, this differs significantly from human learning, which involves a complex interplay of cognitive, emotional, and social processes (Schank, 1982).

The term hallucination is another clear example of semantic drift in AI. In cognitive psychology, a hallucination refers to a perceptual experience occurring in the absence of external stimuli. In AI, hallucination is used to describe instances where a model produces outputs that deviate from accurate or grounded representations of the input data (Floridi & Nobre, 2024). While both uses involve a divergence from reality, the underlying mechanisms are fundamentally different. Human hallucinations are typically caused by neurological or psychological disorders, whereas AI hallucinations usually result from flaws in training data or model architecture (Goodfellow et al., 2014).

This semantic drift can be problematic because it may lead to overestimations of AI's cognitive abilities. When people hear that an AI system is learning or hallucinating, they might assume it engages in the same types of cognitive processes as humans. This can create a false sense of confidence and obscure the limitations of these systems.

It is therefore essential to be aware of the semantic drift that occurs when terms are borrowed across disciplines and to carefully consider the context in which such terms are applied.

5. Anthropomorphization and the conceptualization of AI

Understanding why AI-related terms are anthropomorphized can offer a more comprehensive framework for interpreting artificial systems. Referring to AI using terminology borrowed from psychology and neuroscience—such as learning, perception, and decision-making — inevitably leads to anthropomorphization (Epley, Waytz & Cacioppo, 2007).

According to the Three-Factor Theory proposed by Epley and colleagues, anthropomorphism is driven by three key psychological factors: the accessibility of anthropocentric knowledge, the motivation for effectance, and the motivation for social connection.

This theory helps explain the underlying psychological processes that lead individuals to attribute human-like traits to AI systems:

Elicited Agent Knowledge:

This factor refers to the accessibility and applicability of human-centered knowledge when making inferences about non-human agents. Humans have immediate and intuitive access to knowledge about themselves and others, and they often apply this understanding to interpret unfamiliar entities, including AI systems. The easier it is to apply human-based knowledge to a system, the more likely people are to attribute human-like characteristics to it. For example, if an AI chatbot is designed to mimic human conversation, it may activate accessible schemas about human communication, leading users to perceive the chatbot as more human-like.

Effectance Motivation:

This refers to the desire to understand and predict the behavior of agents in order to interact effectively with the environment. Anthropomorphism becomes a cognitive strategy to reduce uncertainty and increase predictability. By assigning human-like motives and intentions to AI systems, people can more easily make sense of their actions. As suggested by Epley et al., higher levels of uncertainty about an agent increase the likelihood that it will be anthropomorphized.

Sociality Motivation:

This factor reflects the human need and desire for social connection. In the absence of sufficient social interaction, individuals may turn to non-human agents, including AI systems, to meet their social needs. Anthropomorphizing AI can create a sense of social presence and companionship, even if the system lacks genuine emotional or relational capacities. In situations of isolation, users may attribute human-like qualities to AI companions, thereby simulating a form of social interaction.

These three factors interact in complex ways to shape the degree to which individuals anthropomorphize AI systems. They help explain why users often perceive chatbots or virtual assistants as intentional beings, even though such systems function solely through algorithmic processes.

6. Implications for education

The debate surrounding artificial intelligence and embodied cognition carries important implications for the field of education. As emphasized by the European Union (2022), diversity, non-discrimination, and equity — including accessibility, universal design, bias prevention, and stakeholder participation — are essential to ensuring inclusive use of AI, regardless of age, ability, or background, with particular attention to students with special educational needs.

With the growing use of AI systems in education, it is crucial to assess both the potential benefits and the risks of these technologies. AI can be used to personalize learning, provide feedback to students, and automate administrative tasks (Holmes et al., 2019). However, it is equally important to consider how AI might reinforce existing biases, limit students' creativity, or undermine the value of human interaction in the learning process (Williamson, 2020).

A key challenge is ensuring that AI systems are used in ways that support and enhance human teaching rather than replace it. Teachers play a vital role in fostering creativity, critical thinking, and socio-emotional development — skills that are difficult to replicate through AI. Preserving the human element in education is essential (Darling-Hammond, 2010).

The tendency to anthropomorphize AI systems should be approached with caution, to ensure that students understand both the advantages and limitations of the tools they are engaging with.

It is also necessary to consider the ethical implications of AI use in education. AI systems often collect and analyze large amounts of student data, raising concerns about privacy and security. It is critical to ensure that student data is handled responsibly and ethically, and that learners are not subjected to discrimination based on their data profiles (O'Neil, 2016).

Furthermore, data confidentiality and governance must be safeguarded, including respect for privacy, data quality and integrity, and access control (European Union, 2022, p. 18). Technical robustness and security — including resilience to attacks, general safety and protection, accuracy, reliability, and reproducibility — are essential to ensure the trustworthiness of AI systems used in educational contexts (European Union, 2022, p. 19).

7. Conclusions

The tension between artificial intelligence (AI) and embodiment represents one of the most significant challenges in the fields of cognitive science and education. While embodiment emphasizes the role of the body in learning and cognition, AI promotes a view of intelligence as a disembodied phenomenon. This conflict raises fundamental questions for education and the philosophy of mind, and it highlights the phenomenon of conceptual borrowing, in which emerging disciplines adopt terms and concepts from neighboring fields.

The anthropomorphization of artificial systems and the use of terms borrowed from cognitive sciences have led to overlapping meanings that may result in misinterpretations of AI's capabilities and functions. Recognizing the human tendency to anthropomorphize such systems is not a question of if, but of when and why. As described by Epley, Waytz, and Cacioppo (2007), the Three-Factor Theory of anthropomorphism offers a valuable framework for understanding why people tend to attribute human-like qualities to AI systems.

It is also crucial to recognize the importance of embodiment in human cognition and learning. Embodied learning approaches have proven effective across various educational contexts, and maintaining the human element in education remains essential. AI systems should be employed to support and enhance human teaching, rather than to replace it. The psychological motivations behind the anthropomorphization of these systems must be carefully considered in future educational implementations.

By critically examining the language used to describe AI systems and acknowledging the role of embodiment in human cognition, we can foster a more accurate understanding of the strengths and limitations of artificial intelligence in comparison to human intelligence. As Alain Berthoz (2011) pointed out, the human mind does not merely process large volumes of data in a mechanical way; rather, it operates with remarkable efficiency and elegance by using small amounts of information to produce original and novel responses. This ability exemplifies simplexity — a unique form of decipherable complexity based on simple yet rich rules — which allows living beings to adapt and navigate the world with creativity and intelligence, rather than through rigid mathematical or abstract logic.

Approaching these technologies requires clarity, precision, ethical responsibility, and a deep appreciation for the distinctive qualities of human intelligence. In this context, the transparency of AI systems — including traceability, explainability, and effective communication — is essential to ensure that decisions made by such systems are understandable and verifiable (European Union, 2022). Therefore, human agency and oversight are key elements for ensuring the responsible and informed use of AI in educational settings.

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