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Generative artificial intelligence: the 'more knowledgeable other' in a social constructivist framework of medical education

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Generative artificial intelligence can fulfil the criteria to be the 'more knowledgeable other' in a social constructivist framework. By scaffolding learning and providing a unique and augmented zone of proximal development for learners, it can simulate social interactions and contribute to the human-AI co-construction of knowledge. The presence of generative artificial intelligence in medical education prompts a re-imagining and re-interpretation of traditional roles within established pedagogy.

Generative artificial intelligence (GenAI) including large language models (LLM) have the potential to transform medical education and assessment. The pace of development is rapid and there is a need for learners and educators to consider the potential opportunities and challenges that will arise from these technologies in creating competent and empathetic doctors. In the review article *Situating governance and regulatory concerns for generative artificial intelligence and large language models in medical education*[1] we outline the broad positive impacts, and challenges facing learners and educators, pedagogical considerations and explore whether there is a need for more regulation.

In this paper we argue that a carefully designed pedagogical approach is critical to ensure that the quality of learning is truly augmented, and not diminished, by the use of AI-based systems. We explore social constructivist and experiential learning theories and how they need to be reconceptualised within the emerging context. Some have argued that GenAI and LLMs are unlikely to successfully fulfil the remit of these accepted pedagogies in medical education because the context in which learning is experienced, and knowledge acquired, relies on exposure, cultivation of interpersonal interactions and participation in communities of practice. We propose that GenAI could successfully adopt the role of the 'more knowledgeable other' within a social constructivist framework of learning. Challenging our accepted epistemological notions will be necessary in deciding what role GenAI will have in the future of medical education.

Social Constructivism

The constructivist model of learning posits that learning is an active process where learners question information, navigate any resulting cognitive dissonance and construct knowledge by linking new information to their prior knowledge and experiences[2–4]. Social constructivism emphasises that social interactions and collaboration are important for effective learning, not only through a process of experimentation and active reflection[5] but also through the sharing of ideas[4]. Learning is thus both collaborative and individual and subjective, with experiences being interpreted differently by each learner depending on their preconceptions[6]. The 'zone of proximal development' (ZPD) proposed by Lev Vygotsky describes the skills a learner can perform under guidance, but not yet by themselves[4]. Assistance is provided through a 'more knowledgeable other' (MKO) who possesses skills and knowledge beyond that of the learner, or through 'scaffolding' where a leaner is guided by a tutor or peers through their ZPD, enabling greater performance than on their own[7]. With good scaffolding and collaboration, learners achieve self-reliance[6] in categorising experiences as fitting within existing schemas or causing (and prompting resolution of) cognitive dissonance[8].

GenAI as the more knowledgeable other

The acquisition of knowledge and understanding is more complex than the simply transmitting facts from the external world to the learner. A social, collective notion of knowledge recognises that learners establish a dialogue to stimulate knowledge transformation into complex relational structures[9]. While GenAI and LLM technologies do not have any inherent conceptual knowledge or conscious understanding, the ability to generate natural, human-like, language can support argumentative dialogue with humans and in so doing, contribute to the process of 'joint' knowledge construction[9], thus increasing the development of deep expertise. GenAI and LLMs would not necessarily be jointly 'learning' with humans, but rather would be a conduit for knowledge creation between a group of humans collaborating in learning as digital participants.

One assumption of the constructivist philosophy is that the ZPD is a desirable point of difference between educator and learner. The nature of this gap is variable, depending on both the educator's and learner's respective unique contexts and experiences. The sense-making process of learning in navigating this gap is not necessarily fruitful if the gap, scaffolding, learning style, degree of social collaboration and reflective capacity are excessively variable (as may occur amongst a community of learners) and of low quality[10]. Learners with 'inadequate' prior knowledge and intolerance of uncertainty may feel embarrassed exposing this in a collaborative setting, which is a requirement of this style of learning[11].

GenAI has the ability to support personalised learning, and this has the potential to address variability in learning gaps and accommodate diverse learning styles[10]. GenAI differs from human scaffolding and facilitation of

Table 1 | The role of generative AI in a social constructivist pedagogical framework

Constructivist principle	Principle defined	The role of GenAI
Learning is an active process	Learners actively construct understanding and knowledge by questioning information.	GenAI can facilitate active engagement if a dialogue beyond simple question-answer is established, to provoke thought, demand exploration or stimulate argument.
Prior knowledge influences learning	Learners link new information to their prior knowledge and experiences. This background influences how new information is interpreted and assimilated.	A learner's prior knowledge will influence GenAI model outputs. GenAI can also 'learn' from past interactions and develop context-aware prompting to individualise output to learner's knowledge.
Learning is contextualised	Knowledge is connected to the situation in which it is acquired.	GenAI can account for user context, location, and previous interactions to foster more meaningful, relevant, and effective engagement.
Learning is collaborative	Learners consolidate their understanding more effectively when working with others and sharing ideas.	Learners and GenAI work collaboratively to iteratively refine prompts and construct a conversation. GenAI output is based on user input and ongoing prompting generates discourse and facilitators knowledge co-construction.
Reflection enhances learning	Learners reflect on their experiences and understanding to contemplate how they can apply new knowledge in the future.	The co-construction of knowledge in the human-AI interaction promotes reflection of both learners and GenAI systems. Learners assess whether the responses received meet their needs and promote deeper thinking to consider how insights gained can be applied to new scenarios.
Learning involves problem-solving	Learners actively confront challenges and participate in the learning process.	GenAI can produce outputs from prompts as problems or challenges to be solved. GenAI can act as a facilitator to guide learners through problem-solving stages, facilitating active learning.

(Adapted from Robertson et al. 2024[15]).

learning in that it can draw on information far-exceeding that of any individual educator and potentially prevent groupthink and knowledge gaps amongst groups of learners limited by their own experiences[12]. The ZPD presented to learners by the GenAI facilitator would be contextually relevant, being specific to the information it has been trained on. Technological advances including retrieval-augmented language models such as RAPTOR (Recursive Abstractive Processing for Tree-Organized Retrieval) present a solution to adapt to changes in knowledge and reduce the possibility of inaccurate information being presented to learners[13].

The output of GenAI is customisable, with agents tailored to individual preferences, and can thus adapt to learning and reflective styles that are individual to learners. This would avoid the exclusion of learners with diverse learning preferences and needs.

When users interact with GenAI, they engage in a form of social constructivism with AI acting as the MKO[14]. This relationship promotes human-AI co-construction of knowledge using GenAI[15]. With iterative refinement of provided prompts, learners create a dialogic environment where the AI, acting as the MKO, scaffolds the learning and knowledge-building experience[16]. In so doing, learners can progress into their ZPD and perform increasingly more advanced tasks under the support of the AI[17], before doing so independently. Engaging learners to co-construct knowledge and refine the prompts provided to GenAI technologies can improve the results of human-AI interactions and increase the effectiveness of this relationship[2,15].

There are concerns that GenAI's rapid information processing capacities do now allow for critical thinking skills to develop. Its rapidity in output generation may override the opportunity to develop the nuanced understanding, creativity, and adaptability to learn from mistakes that are inherent in human learning[18]. One possible way to encourage this element of human learning is to tune GenAI output to a Socratic approach, fostering the argumentative dialogue between human and AI which in turn leads to the creation of more refined prompts through an iterative process. GenAI models can also adopt social processes to learn from feedback and user experiences[18], using reinforcement learning algorithms to refine its output and foster dialogue and engagement with users and learners in this human-AI ecosystem. As a tool for learning, GenAI may be particularly effective for assisting in generating the complex memory structures within the human learner that are required for rapid accurate decision making under uncertainty. Their utility is less clear in the development of other components of skill that require embodied cognition[19].

Concerns raised about GenAI and LLMs in medical education more broadly include ensuring the accuracy and contemporaneousness of information, reducing bias[20], ensuring accountability[21], minimising learner over-reliance, preventing patient privacy exposure and safeguarding data security, enhancing the cultivation of empathy, being aware of the environmental impact of upscaling technology[22], and maintaining academic integrity[23]. This apprehension assumes that human peers, educators, clinicians and even patients as the MKO are immune to these issues, which is untrue. One benefit in being aware of these limitations for GenAI and LLMs is that they can be more readily and pro-actively addressed, than in their human counterparts.

Broadly, GenAI could facilitate learning in a social constructivist framework. Its roles within the key tenets of this pedagogical theory[15] outlined in Table 1.

Conclusions

'Any teacher who can be replaced by a machine should be'[24]. This proclamation, and our proposal, are not necessarily advocating for an asocial dystopia, but suggest that any technological challenge to established pedagogy should prompt a reflection on our understanding and the evolution of teaching and assessment methods and communities of practice. There is no consensus on the optimal way in which learning and teaching occur[8]. Constructivism unifies many learning theories and explains many facets of learning in medical education[8]. GenAI can fulfil many of the social roles external to the learner, including that of peers, facilitators and the 'more knowledgeable other,' and can potentially simulate the benefits of social interaction in social constructivism. GenAI cannot replicate true human interaction and purists will decry this fact as an automatic exclusion of this technology from social constructivist conversations. It should be remembered however that social constructivism does not guarantee that students

are constructing knowledge, especially when any of a priori knowledge, quality of social interaction and facilitation, and appropriateness of the ZPD are not ideal. GenAI deserves a place within the conversation of medical education and presents an opportunity to reduce educational inequality and inequity, level the playing field, and reduce the impact of the heterogeneity of educational variables.

Data availability

No datasets were generated or analysed during the current study.

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Competing interests

The authors declare no competing interests.

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