

Opportunities, Challenges, and Practical Paths of Empowering Educational Innovation and Development with Generative Artificial Intelligence

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Abstract

Education is an ancient yet young science. With the advent of generative artificial intelligence, education should also become vibrant. However, it also poses a huge challenge to the original logic of the education field. Currently, we should be courageous to enrich educational content, innovate educational methods and make the teaching process intelligent, seizing these opportunities; at the same time, we also need to deeply reflect on the challenges that arise in this process, such as “blurring content information ethics and data bias”, “affecting teachers’ emotional interaction and technological cognition”, and “inhibiting students’ independent thinking and critical thinking”. In conclusion, we should conceive and construct an educational resource governance system of “human-machine collaboration and teacher dominance”, implement a teacher professional development plan of “two-way empowerment and role evolution”, and design a new hybrid teaching paradigm of “thinking-oriented and technology-utilized”, so as to adapt to the new educational ecosystem characterized by the era of generative intelligence.

Keywords

Generative artificial intelligence; opportunities; challenges; practical paths

1. Opportunities Faced by the Empowerment of Education Innovation and Development through Generative Artificial Intelligence

1.1 The educational content is rich, enhancing both breadth and depth

Generative artificial intelligence is an intelligent system that generates new data with similar features to the training data by training generative models on large-scale data. The shift from governing generative artificial intelligence to using it to govern the education sector is not only a product of technological innovation but also a key force driving the transformation of the education governance model from traditional to modern (Shen et al., 2024).

Content generated by generative artificial intelligence plays a significant role across various domains such as text, imagery, education, and video, particularly in educational contexts. Firstly, within the learning environment of the generative AI era, educational resources are enriched, infusing vitality into experiential learning and empowering educators with a more extensive repository of teaching materials. Secondly, generative AI facilitates, to a certain extent, the promotion of educational equity across different regions. Furthermore, it enables the visualization of educational resources, leading to transformative advancements in both the breadth and depth of educational content. In terms of breadth, it fundamentally transcends the spatiotemporal constraints inherent in traditional textbooks and

the knowledge base of individual instructors. Regarding depth, it achieves a critical transition from mere “knowledge presentation” to “cognitive deepening.” Generative artificial intelligence not only delivers conclusions but also constructs multi-layered, interpretable knowledge frameworks, thereby driving pivotal transformations in contemporary education.

1.2 Innovate educational approaches and respect individuality and diversity

The function of generative artificial intelligence is to help people solve problems. Students can use generative artificial intelligence to build a comprehensive knowledge system and enhance their learning ability with its empowerment, greatly improving the efficiency of learning ability cultivation (Zhu & Yang, 2023).

The distinctive attributes of generative artificial intelligence (AI) in the realm of education indicate its potential to enrich educational content and foster the intellectualization of pedagogical processes. First, it enhances interdisciplinary teaching. Constructing personalized autonomous learning platforms for students, it enables diagnostic assessment of learning progression and facilitates summative evaluation of academic outcomes. Second, through approaches such as resolving learners’ inquiries and engaging in interactive dialogue, it provides tailored evaluation, feedback, and guidance. Third, generative AI fundamentally differs from earlier intelligent educational tools. Prior to its emergence, mainstream preference favored intelligent learning devices that allowed students to click for answers when encountering difficulties, yet such mechanisms did little to expand knowledge comprehension. In contrast, generative AI supports innovative pedagogical development by delivering expanded knowledge points and the most suitable answers tailored to individual learners. It respects students’ unique characteristics and diversity, translating abstract ideas into tangible understanding.

1.3 Intelligent education process, achieving data integration

Thanks to multiple technological breakthroughs, generative artificial intelligence can utilize various techniques. The entire process only requires learners to input instructions, and a highly perfect text can be produced.

Generative artificial intelligence aggregates high-quality learning resources, providing students with multi-level and multi-dimensional reading, expression, and communication experiences. First, the educational process consists of three main stages: lesson preparation, classroom instruction, and after-class follow-up. During lesson preparation, educators can leverage generative AI to access high-quality educational resources and develop situational and targeted teaching designs that optimally facilitate students’ proximal development zones. Second, in the classroom teaching phase, teachers can utilize tools such as PowerPoint presentations and the increasingly popular text-to-image generation technology to help students vividly experience real-life scenarios. Through progressively detailed descriptions, students enrich the contextualization of these scenarios, thereby deepening their understanding of knowledge. Finally, in the after-class stage, educators can employ generative AI for self-reflection to identify areas for improvement, while students can use it to resolve doubts, document questions and insights, and systematize notes. This ensures a coherent and structured educational process, enabling seamless data integration throughout.

2. Challenges Faced by the Empowerment of Education Innovation and Development with Generative Artificial Intelligence

2.1 Ethics of Fuzzy Content Information and Data Bias

Sometimes, after generating text, you may find that the content is not correct. Therefore, the quality of the output from generative AI is related to the quality of the content asked for.

Within the educational process, this is not the first instance where generative artificial intelligence has posed such challenges. For example, in a university English course I attended, the instructor assigned students to process a segment of English text using six different software tools simultaneously. Upon concluding the exercise, the instructor found that among over one hundred students, at least ten produced highly similar outputs—all generated within a three-day period. This illustrates that generative AI is not an authoritative source; rather, it exhibits instances of content inaccuracy and data bias. Moreover, when conducting searches within generative AI platforms, the references provided are often fabricated and cannot be located in authoritative databases such as CNKI. Additionally, the development of generative AI models relies on large-scale data training. Variations in output largely

stem from discrepancies at the data level—such as insufficient data volume or quality—which may result in performance falling short of expectations. Crucially, these systems lack human value judgments and ethical accountability. Therefore, when utilizing generative AI, it is essential to critically evaluate the content and maintain independent perspectives and stances.

2.2 Impact on teachers' emotional interaction and technological cognition

Despite possessing substantial knowledge reserves, logical reasoning capabilities, and linguistic proficiency, generative artificial intelligence ultimately remains incapable of supplanting the central role of educators when addressing open-ended challenges such as emotional communication

Existing research indicates that the information literacy of primary and secondary school teachers in China is still not ideal, especially in terms of information discrimination awareness, the application level of information technology, and the innovative level of information-based teaching (Wu et al., 2020). Firstly, Teachers need to avoid simplifying the educational process, which is originally characterized by the integration of wisdom, the collision of ideas, and the interweaving of emotions, into a fixed routine, simple form, and dull content of “procedural dialogue”, and avoid confining classroom teaching to the level of “questioning → answering” formal communication (Liu & Tan, 2022). Furthermore, the lack of interaction between teachers and students undermines effective emotional communication between educators and learners. Secondly, the proliferation of generative artificial intelligence has led to uncritical adoption among many educators, who increasingly equate the use of such technology with teaching quality—often substituting slide presentations for traditional blackboard instruction without contextual introduction or pedagogical innovation. In summary, the widespread application of generative AI exerts both emotional and technical impacts on educators. Educators must not only master the operational aspects of generative AI but also comprehend its underlying mechanisms, critically evaluate its outputs, and thoughtfully integrate it into instructional design.

2.3 Inhibiting students' independent thinking and critical thinking

Generative artificial intelligence, leveraging its robust data processing capabilities, offers precise solutions for innovating curriculum concepts. However, while it enhances efficiency and convenience, it inadvertently diminishes the space for independent thinking among participants.

Firstly, generative artificial intelligence is gradually replacing a large number of repetitive and procedural jobs, with the focus of talent cultivation on the exploration and cultivation of students' individualized advantages (Ding & Gu, 2024). If students overly rely on generative artificial intelligence during the learning process, it may have a negative impact on the development of their critical thinking and their ability to solve problems independently, and even lead to an inaccurate understanding and mastery of the essence of knowledge. Secondly, generated answers are not the product of students' critical thinking but rather the outcome of provided instructions, which may hinder the development of students' critical thinking skills and impede their personalized growth. To foster comprehensive and free individual development, educators must adopt corresponding measures to guide students in using generative artificial intelligence correctly and healthily. For instance, course tasks that require creative problem-solving can be appropriately incorporated to encourage independent exploration and practice. Simultaneously, the educational process should adhere to the principle of student-centered learning with teacher guidance. Educators can demonstrate relevant examples to help students recognize the limitations of artificial intelligence, enabling them to utilize it as an effective auxiliary tool rather than a shortcut to avoid independent thinking.

3. Practical Paths for Empowering Educational Innovation and Development with Generative Artificial Intelligence

3.1 Build an educational resource governance system featuring “human-machine collaboration and teacher leadership”

Education is a social activity that purposefully nurtures people. Human-machine collaboration, as a process of competition and cooperation between humans and machines, refers to a dynamic process in which humans and machines unanimously aim towards an ideal goal and develop in an orderly direction (Cai et al., 2023). According to this

definition, human-machine collaborative teaching can be defined as a new model in which educators and generative AI help each other as an organic whole in a contextualized setting, and through the integration of their strengths and resources, educational goals are achieved and teaching quality is improved (Huang et al., 2023).

Educator-led inquiry, human-AI collaborative deep learning, and teacher-centered approaches can provide learners with comprehensive intelligent support via generative artificial intelligence. First, a problem-oriented approach serves as the primary entry point. This process entails learners collaborating with generative AI in a human-computer synergy to accomplish tasks. Guided by students' capabilities and aided by generative AI, iterative questioning subsequently facilitates continuous improvement, fostering advanced cognition through progressive guided responses. Second, in the educational creation phase, human-computer collaboration substantially elevates the caliber or quality of the outputs. During the dissemination stage of the educational process, learners engage in classroom critiques and exchanges, leading to the further refinement of their accomplishments. Third, generative AI can deliver customized support, offering video resources and task sheets aligned with expected deliverables such as video-based projects. In conclusion, to establish a robust governance framework for educational resource management predicated on "human-computer collaboration and teacher leadership," educators must harness the potential of generative AI judiciously, guarding against the detrimental effects of data bias and ambiguity to maintain alignment with educational objectives.

3.2 Implement a teacher professional development plan featuring "mutual empowerment and role evolution"

With the deepening integration of generative artificial intelligence and higher education, academic institutions, educators, and policymakers must collaborate to remain vigilant regarding the latent risks and emergent challenges posed by this technology in university curriculum development.

Generative artificial intelligence, with its extensive knowledge repository and on-demand retrieval capability, enables educators to comprehensively enhance instructional efficiency. First, with the support of generative artificial intelligence, teachers can collaborate with it to deeply explore the differences in student experiences and diverse teaching possibilities inherent in various teaching methods, thus creatively conducting human-machine collaborative teaching (Zhang, 2023). Secondly, generative artificial intelligence can not only provide multi-disciplinary and multi-level teaching services for teachers but also effectively promote the growth of their professional abilities. The application of this technology also places corresponding demands on teachers' teaching qualities and professional capabilities. By leveraging its powerful information retrieval and screening capabilities, it can provide teachers with precise feedback, thereby enhancing their teaching abilities. Thirdly, teachers can guide students to engage in deep interaction with generative artificial intelligence during the teaching process, enabling personalized learning for students and achieving a dual improvement in their learning abilities and teaching quality.

3.3 Design a new paradigm of blended teaching that is "mind-oriented and technology-enabled"

Within the context of the generative artificial intelligence era, educators ought to revamp classroom systems by shifting curricular focus from the known to the unknown, thereby fostering learners' capacity for independent problem-solving.

Firstly, educators must effectively implement interdisciplinary teaching methods in classroom instruction to facilitate students' integration of knowledge across diverse domains. This approach enables learners to construct knowledge and enhance competencies within authentic contexts. Secondly, throughout the educational process, learners should adhere to the principle of "thought as the foundation and technology as the tool," while educators must ensure that students utilize generative artificial intelligence in a targeted manner. Furthermore, during instruction, educators should consistently design thought-provoking questions that foster imaginative thinking and cultivate cognitive skills. Such practices encourage continuous reflection among learners, allowing them to recognize distinctions between their own capabilities and those of generative AI, identify personal limitations, and thereby achieve continuous adaptation and mutual progress.

In conclusion, generative artificial intelligence is a powerful enabling tool. During the learning process, the development of students' thinking is the most important. Education should always promote students' critical thinking, help them solve complex problems, and enable them to have creative imagination and ethical judgment.

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