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Generative Artificial Intelligence-Driven In-Depth Classroom Responding: Value Implications, Risks and Mitigation Strategies

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Abstract

The rapid development of generative artificial intelligence has brought tremendous changes to the field of education, and is triggering a paradigm shift in classroom teaching. As one of the classroom practice forms of cognitive construction between teachers and students, the transformation of classroom responding is of great significance for realizing students' deep learning. Research shows that with its powerful natural language processing and classroom scenario generation capabilities, generative artificial intelligence has transformed into a deep dialogue scaffolding that promotes cognitive transfer, thinking advancement and meaning negotiation, as well as a collaboratively constructed dialogic community. Regrettably, the empowerment effect of digital-intelligent technology coexists with the risk of alienation. For example, the application of generative artificial intelligence empowerment in classroom teaching practice may induce a series of practical challenges, including the dissolution of dialogic authority and the narrowing of professional competence of teachers and students, students' cognitive outsourcing and the degradation of critical thinking, the solidification of algorithmic bias and hidden worries about educational equity. To stimulate the potential of technology and return to the fundamental mission of fostering talent, it is necessary to deepen teachers' professional literacy as dialogue designers and regulators; construct a human-machine collaborative responding model

centered on in-depth dialogue and thinking advancement; and optimize a technology support environment that guarantees equity and humanistic warmth, with a view to guiding classroom responding towards a new educational model of balanced and symbiotic development between intellectualization and instrumental rationality.

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Keywords

Generative artificial intelligence, classroom responding, deep learning, dialogic community, cognitive scaffolding, educational ethics, human-machine interaction, critical thinking.

Introduction

In May 2025, the White Paper on Smart Education in China issued by the Ministry of Education of the People's Republic of China presented a panoramic view of the development process of digital education in China, and systematically elaborated on its strategic value, implementation methods and long-term goals.[Ministry of Education of the People's Republic of China, 2025] In recent years, the rapid development of generative artificial intelligence centered on large language models has provided a new technical solution to break this dilemma. It can not only understand complex language and generate coherent and logical texts, but also conduct multi-round, contextualized dialogue interactions, showing a certain degree of "quasi-subjectivity" and "thinking-richness"[Zhao, Shen, 2025], which endows it with the potential to deeply intervene in classroom dialogue and play specific cognitive and communicative roles.

Classroom responding has been defined by scholars as "teachers' feedback and evaluation after students answer questions, which is an important carrier for enlightening students' learning ideas and evaluating learning effects, as well as a key grip for guiding students from shallow learning of knowledge transmission to deep learning including knowledge transfer and application, critical thinking training, and active emotional investment". In-depth classroom responding guides students' learning from surface memory to deep understanding, transfer application and higher-order thinking development, and is one of the key ways to promote the occurrence of deep learning. Unfortunately, under the multiple constraints of large class sizes in traditional classroom teaching and teachers' individual cognitive load, the ideal and personalized in-depth responding is often difficult to fully achieve. "Traditional classroom dialogue is highly closed, simplified into a one-way activity of teacher questioning and student answering, which weakens students' discourse power and the richness of the classroom, and restricts students' thinking and social development... It fails to reflect the demands of students' subjectivity and core literacy development", resulting in the insufficient release of the potential function of responding as a driver of deep learning.

In view of this, this study aims to systematically examine the profound implications of generative artificial intelligence-driven transformation of classroom responding, conduct an in-depth analysis of its potential educational risks, and put forward practical strategies for in-depth classroom responding. In short, this study is not only a theoretical response to the classroom teaching reform in the digital-intelligent era at the micro-teaching level, but also provides a theoretical basis and strategic support for front-line educators to rationally understand digital-intelligent technology tools and avoid potential educational risks.

Value Implications of Generative Artificial Intelligence-Driven Transformation of Classroom Responding

Embedded in classroom responding as an advanced cognitive and dialogue tool, generative artificial intelligence profoundly reconstructs the cognitive and dialogue methods of the classroom, and promotes the transformation of various forms of classroom responding practice.

(I) Functional Upgrade: From Diagnostic Feedback to In-Depth Classroom Dialogue

The intervention of generative artificial intelligence in classroom teaching has transformed the function of responding from diagnostic feedback to guiding students to complete cognitive and thinking tasks that they cannot accomplish independently, and ultimately improving students' own learning ability. Specifically, it provides students with a structured knowledge system and guides the direction of thinking. Based on students' real-time answers, generative artificial intelligence automatically identifies their cognitive "gaps", thinking "breakpoints" or weak links in argumentation, and dynamically generates serialized questions, cases and other content.

As Professor Guo Hua stated, deep learning is "a meaningful learning process in which students, under the guidance of teachers, fully and actively participate in, experience success, and achieve development around challenging learning themes. In this process, students...form a positive intrinsic learning motivation, advanced social emotions, positive attitudes, and correct values"[Guo, 2016], which echoes the requirements of the "vertical cross" structure in deep learning classroom dialogue, that is, guiding the in-depth development of thinking vertically through classroom questioning, and promoting the horizontal expansion of thinking by introducing multiple perspectives.

It facilitates the adaptive transfer and meaning negotiation of knowledge in new contexts. The key to deep learning lies in the structuring and transfer application of knowledge. Generative artificial intelligence can create diverse, real-world and cognitively conflicting problem scenarios in real time according to students' interest background, cognitive level and the context of classroom dialogue, driving students to apply the knowledge they have learned to solve problems, and conduct meaning negotiation in dialogues with generative artificial intelligence or peers.

In addition, generative artificial intelligence also promotes the development of students' critical thinking ability by enhancing their cognitive ability. "By improving the cognitive understanding ability of teaching agents, the efficient collaboration of multiple agents in the classroom environment is realized, thereby promoting the precise matching of educational scenario tasks and roles"[Lu, Tang, 2025]. To a certain extent, it shifts cognition from the problem itself to the process of examining, monitoring, evaluating and reflecting on the thinking process of oneself and others. Classroom responding becomes the carrier for transforming the cognitive ability of "learning to learn" into in-depth classroom dialogue, and ultimately promotes students' deep learning.

(II) From the Teacher-Student Dual Subject to the "Teacher (T)-Student (S)-Agent (A)" Tripartite Interactive and Collaborative Dialogic Community

Teaching is essentially an intersubjective dialogic practice. The intervention of generative artificial intelligence breaks the traditional dual closed system of "teacher-student", and forms a new dialogic form of "Teacher (T)-Student (S)-Agent (A)" tripartite interaction, which constitutes a dynamic "cognitive-dialogic community".

As an active dialogic subject, the agent participates in meaning negotiation. With its "quasi-subjectivity", it can actively initiate topic discussions, contribute viewpoints, question existing assumptions, and play specific roles (such as opponent, summarizer, interdisciplinary expert), becoming a quasi-dialogic subject. This makes "classroom dialogue under deep learning not a teacher's

'monologue' or 'message passing' between teachers and students, but a 'symphony' of multi-dimensional interaction and symbiotic integration"[Zhao, Qin, 2024].

On the other hand, the role of teachers has shifted, and their core tasks lie in: designing themes and frameworks that can trigger high-quality tripartite dialogue with digital technology; carrying out strategic intervention, reconciliation and value clarification when the interaction between the agent and students deviates, falls into a deadlock or is ambiguous in value; conducting theme sublimation, methodology summary and emotional connection during and at the end of the dialogue. Teachers' authority no longer stems from the monopoly of knowledge, but from their deeper understanding of education.

Notably, it promotes students' in-depth personalized interaction and equitable participation to a certain extent. The tripartite interactive ecosystem effectively alleviates the contradiction of teachers' attention resource constraints in traditional large-class teaching. As a "personalized dialogue agent", the agent can conduct parallel and continuous in-depth dialogues with multiple students at the same time, providing continuous cognitive companionship, personalized feedback and emotional support, basically making one-to-one in-depth responding possible. It provides a "safe space" for expression and thinking for every student, especially those who are silent or easily overlooked in traditional classrooms, and promotes the deepening of educational equity at the level of procedural participation.

(III) From a Single Responding Mode to Open, Vertically Crossed and Diversified Dialogues: Continuous Deepening of the Teaching Process

The intervention of generative artificial intelligence has profoundly changed the process and structure of classroom responding, and promoted a structural transformation from a simple cycle to a complex network.

It breaks the closed IRF structure and forms an open and diversified turn network. Traditional responding is often trapped in the closed cycle of "Teacher Initiation (I)-Student Response (R)-Teacher Feedback (F)", where students as "responders" are limited to narrow turns. The introduction of generative artificial intelligence decentralizes the right to initiate turns. Students can directly ask questions to digital technology (initiating a new turn), and this structure is closer to the "vertical cross" characteristic of classroom dialogue for deep learning, that is, spiraling upward in vertical deepening and horizontal connection. On the other hand, teachers can flexibly design responding activities integrating the two dialogue types according to teaching objectives and students' states, so that classroom thinking can maintain a dynamic balance between challenge and construction.

It realizes "multi-directional intercommunication" of dialogue information and co-construction of meaning. With the assistance of the agent, the information flow of classroom dialogue expands from the traditional "teacher→all/individual students" to a multi-directional, network flow among "teacher↔digital technology↔individual student↔student group". More importantly, the construction method of conclusions has truly shifted from teacher-led classroom dialogue to the co-construction of classroom dialogue collaboratively carried out by teachers, students and digital technology. The information and perspectives provided by the agent are jointly examined, criticized and integrated by teachers and students, and the final knowledge conclusions or problem solutions are dynamically generated in the continuous dialogue, negotiation and reflection of multiple subjects.

(IV) From Outcome-Based Evaluation to Caring Understanding: Realizing Emotional Interaction in the Classroom

Deep learning is "a meaningful learning process in which students, under the guidance of teachers, fully and actively participate in, experience success, and achieve development around challenging learning themes". The language generation capability of generative artificial intelligence in emotional

empathy enables it to participate in classroom emotional interaction more delicately, but also puts forward new requirements for classroom responding.

It realizes motivational feedback on growth mindset and process value. The agent can be designed to adopt growth mindset language. If students face setbacks, the agent can generate feedback such as "This imperfect attempt just reveals the real difficulty we need to overcome. Let's see how we can adjust from this step..." emotionally, framing learning difficulties as learning opportunities, protecting students' psychological safety and inquiry courage, which is consistent with the concept of focusing on the learning process advocated by deep learning.

It creates a safe and inclusive atmosphere for classroom dialogue. For example, by analyzing the voice rhythm and text emotional color of students when answering questions, the agent can initially identify students' confusion, excitement, anxiety or weariness, and adjust the dialogue strategy and tone accordingly, playing an initial role in emotional support and regulation. More importantly, the "virtual peer" role played by digital technology can also provide a safe trial-and-error space for students, allowing them to ask "naive" questions and make bold conjectures while discussing and communicating with peers, thus helping to create an open, fault-tolerant classroom atmosphere that encourages frank communication, which is also a prerequisite for in-depth dialogue.

In addition, even though generative artificial intelligence brings great convenience to in-depth classroom dialogue, teachers are still irreplaceable in emotional care and learning guidance. It is worth noting that the emotional feedback of digital technology is algorithmic simulation, lacking real understanding and empathy, which highlights the role of teachers as "caring presenters". Especially when digital technology provides rich information or even controversial viewpoints, teachers need to undertake the core responsibility of value clarification, ethical discrimination and meaning guidance, to prevent the potential danger of classroom dialogue falling into value relativism or the cold calculation of instrumental rationality.

Potential Risks of Generative Artificial Intelligence-Driven Classroom Responding

The transformation of classroom teaching brought by the intervention of digital technology also warns our education that any technology is both "unconcealing" and "concealing", and may bring new challenges and alienation while empowering. If the application of generative artificial intelligence in classroom responding lacks educational examination and value anchoring, the original intention of pursuing in-depth dialogue may slide to the opposite, leading to the following potential risks.

(I) Weakening of Teacher Subjectivity: The Risk of Classroom Dialogue Being Dominated by Instrumental Rationality

Excessive attention to "technical rationality" and neglect of teachers' "educational rationality" and "dialogue wisdom" generated in real situations are mainly manifested in the excessive pursuit of "efficiency", "richness" and "novelty" of digital technology in classroom teaching, which may lead to teaching being dominated by instrumental rationality. However, teachers' educational wit generated in real classroom situations, instant judgment based on context, and subtle grasp of complex teacher-student relationships may be marginalized because they are difficult to quantify and standardize due to excessive focus on tools.

Specifically, teachers may gradually be marginalized from in-depth participants in dialogue to "projectors" who simply execute scripts generated by digital technology or "technicians" who are busy operating technology, and their professional autonomy, creativity and ontological value in educational

communication are eroded. As some studies have pointed out, "Teachers also need to guide students to exercise reasonable empowerment, and help students understand that the participation of generative artificial intelligence in interaction is to broaden the horizon of problem solving and stimulate thinking collision, rather than letting generative artificial intelligence completely dominate collaboration and take its guidance as the template for dialogue"[Zhang et al., 2025].

On the other hand, mechanical human-machine collaboration leads to students' shallow understanding of classroom dialogue. If teachers lack a deep understanding of the behavioral logic behind the agent's dialogue, serious collaborative imbalance may occur, and the classroom is likely to fall into a disordered state dominated by technology, let alone the generation of in-depth classroom responding. In addition, "the algorithm black box further aggravates the ideological risk, bringing great obstacles to the subsequent supervision, review and correction work"[Guo, 2025], that is, the educational ethical responsibility and value judgment will be in a blurred state. If the responding content generated by digital technology may contain data bias, value conflicts or factual errors, and teachers directly adopt it without careful examination, in fact, part of the review responsibility of educational ethics, value judgment responsibility and cultural interpretation responsibility are directly transferred to the algorithm, which is not only irresponsible for students' spiritual growth, but also weakens teachers' role as the main body of moral and value guidance.

(II) Dwarfing of Students' Thinking and Dilution of Deep Learning Caused by the Convenience of "Instant Q&A"

The convenience of "instant Q&A" and seemingly "perfect" arguments provided by generative artificial intelligence can easily induce students' "cognitive outsourcing" and "thinking inertia". If students rely on digital technology, they may skip the arduous but crucial in-depth thinking process of information screening and independent thinking, and directly ask for or rely on the "standard answers" or "optimal arguments" generated by digital technology. In the long run, students' abilities of independent inquiry and critical thinking will tend to degenerate, and the "struggle", "trial and error" and "insight" experiences essential for deep learning will be replaced by efficient but shallow "answer acquisition".

Although digital technology can generate diverse texts, its underlying model is trained based on massive human data, and its output has inherent characteristics of tendency to stylization and preference for mainstream viewpoints. Long-term in-depth dialogue with a homogenized digital technology model may invisibly "standardize" and "flatten" students' questioning methods, existing viewpoints and even innovative ideas, and their thinking diversity may be technically narrowed, which is not conducive to the cultivation of real innovative thinking and critical thinking.

Notably, the weakening of emotional communication will also hinder students' cognitive development. Excessive reliance on in-depth classroom responding dominated by digital technology may lead to the compression of precious opportunities for in-depth emotional communication and collaborative problem solving between teachers and students, and between students. When classroom dialogue is overly mediated by machine language, the emotional temperature indispensable in education may be weakened.

(III) Implicit Educational Inequality Caused by Rigid Feedback of Digital Technology

When generative artificial intelligence is applied to classroom responding, it may be insufficiently sensitive to the expression methods and cognitive styles of students with special needs, producing seemingly "objective" but generalized classroom feedback, resulting in students being unable to obtain meaningful classroom feedback.

The dialogue data generated in the process of classroom responding empowered by digital technology is personal privacy that reflects students' thinking trajectory, emotional state, values and

even family background. "These data have the risk of being leaked, abused or attacked during collection, storage and use, which seriously threatens the security of educational privacy"[Guo, 2025]. If these data are collected without the full informed consent of students, and used for unauthorized learning situation analysis, behavior prediction or commercial utilization, it will constitute a serious data leakage, and attention needs to be paid to protecting students' basic rights as digital subjects.

It should be noted that high-quality classroom responding empowered by digital technology mainly relies on advanced computing power, stable high-speed network, and professional hardware. In economically underdeveloped areas, rural schools or schools with weak resources, equal application opportunities may not be available due to backward infrastructure, shortage of funds, and insufficient teachers' technical literacy. This may also lead to the widening gap in classroom teaching between regions, making the educational process equity that technology should promote instead aggravate the digital stratification between regions and schools in teaching quality and learning experience, resulting in the expansion of educational gaps.

Mitigation Strategies for the Sound Development of Generative Artificial Intelligence-Driven Classroom Responding

To guide generative artificial intelligence to play an important guiding role in classroom responding and avoid its potential alienation, it is necessary to transcend the "tool application" thinking, and cultivate a new ecosystem of classroom responding oriented towards human-machine collaboration and in-depth development.

(I) Transforming Teachers' Traditional Concepts and Improving Teachers' Professional Literacy in In-Depth Classroom Responding

Training and research activities on "generative artificial intelligence and in-depth classroom responding" should be carried out for teachers. "On the basis of continuously improving their understanding of the profound impact of generative artificial intelligence technology on education, schools and managers should grasp the close relationship between technology and classroom teaching, actively adapt to and assume responsibilities, so as to boost the high-quality development of classroom teaching empowered by technology"[Li, Zheng, 2024].

This requires education administrative departments and scientific research institutions to guide teachers to deeply understand the underlying logic, potential and limitations of the dialogue of generative artificial intelligence; master the strategies for designing themes, activity frameworks and specific teaching situations that can stimulate high-quality human-machine collaborative dialogue. By establishing interdisciplinary, cross-school and cross-regional practical research communities, we can share successful experiences, conduct in-depth analysis of the lessons learned from failed cases, and jointly create localized application models and discourse strategies adapted to different disciplines, school stages and cultural backgrounds, so that practical wisdom can be cyclically developed in dialogue and collision.

Notably, it is necessary to reform the existing traditional outcome-based teaching evaluation criteria, and take teachers' ability to design human-machine collaborative in-depth dialogue activities, the level of instant educational judgment in complex situations, and the practical reflection on the effect of technology application in promoting students' learning and thinking development as core indicators. Thus, we can guide teaching evaluation from only focusing on "technology use" to focusing on "the quality of classroom dialogue and the common growth of students' thinking empowered by digital technology", and enable the emergence of deep learning for students in the process of classroom responding.

(II) Optimizing Teaching Design, Clarifying Human-Machine Division of Labor, and Innovating a New Model of In-Depth Classroom Responding

To optimize teaching design, we should clarify the functional complementarity between digital technology and traditional classroom responding, and teachers need to integrate digital technology into teaching design in advance. Teaching design should also integrate the responding output of digital technology into the training process of critical thinking and dialogue ability, guiding students to not only review the content of digital technology, but also launch a new round of in-depth dialogue with digital technology, peers or teachers on the basis of review: questioning its presuppositions, challenging its conclusions, supplementing its arguments, and explaining its logic. An effective in-depth dialogue cycle of "digital technology generation→student criticism→new round of dialogue→meaning co-construction" is formed.

For example, we can deepen the "tripartite collaborative inquiry" model in project-based and inquiry-based learning. In projects solving real problems, digital technology is positioned as the "research collaborator" of the team, and a collaborative inquiry process of "teacher-machine-student" is constructed: teachers and digital technology collaboratively design the inquiry framework and driving questions (T-A); student teams conduct in-depth interaction with digital technology to obtain information, test schemes and simulate impacts (S-A); teachers and students conduct collective deliberation, value trade-off and decision-making on the basis of multiple evidence and perspectives provided by digital technology (T-S, with A as the resource). In this complete process, students can experience how to collaborate with human and machine intelligence, thereby improving the key ability to solve complex real-world problems.

(III) Providing Technical Support for Classroom Responding to Enable Technology to Better Serve the Achievement of In-Depth Classroom Responding

Providing a fair, safe and personalized environmental support for classroom teachers is the material basis to ensure the occurrence of in-depth classroom dialogue. Therefore, we should invest in digital technology in weak areas, provide strong guarantee in network, terminals and basic computing power, and carry out teaching ability improvement programs on classroom dialogue for teachers in rural and remote areas.

We should promote the research and development of special educational large models that meet the needs of in-depth classroom dialogue, that is, train special models for in-depth teaching dialogue, and use learning analysis technology to optimize the classroom responding system and the dialogue process itself. The collected data of digital technology application in the classroom should be used to improve the dialogue quality of digital technology and enhance the teaching effect on students' thinking development based on scientific data. By analyzing human-machine dialogue data, we can identify key nodes in the dialogue, continuously iterate the model and design intervention strategies, form a virtuous cycle of "application-evaluation-reflection-optimization", and enable technology to better serve the achievement of in-depth dialogue goals.

Conclusion

Generative artificial intelligence-driven in-depth classroom responding not only expands the cognitive boundary, subject structure and learning process of classroom dialogue, but also provides certain possibilities for upgrading responding from traditional simple feedback to a carrier of deep learning. Its value implication lies in that digital technology is promoting the transformation of classroom teaching interaction from the "teacher-student" system to a new educational model of "teacher-student-

machine". However, the application of technology in education also brings potential risks, such as the weakening of teacher subjectivity, students' thinking depth and critical ability. Therefore, this study hopes that the in-depth integration of generative artificial intelligence and classroom responding in the future will promote the emergence of an efficient new classroom teaching model. This requires primary and secondary schools, universities, education administrative departments, and technology research and development departments to continuously strengthen cooperation, reflect in continuous action, and continuously promote the generation of in-depth classroom responding.

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Генеративное искусственное интеллектуальное обеспечение углубленного ответного взаимодействия в классе: ценностные смыслы, риски и стратегии их смягчения

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Аннотация

Быстрое развитие генеративного искусственного интеллекта повлекло за собой огромные изменения в сфере образования и вызывает парадигмальный сдвиг в аудиторском преподавании. Как одна из форм аудиторской практики когнитивного построения между преподавателями и студентами, трансформация ответного взаимодействия в классе имеет большое значение для реализации глубокого обучения студентов. Исследования показывают, что благодаря своей мощной способности к обработке естественного языка и генерации аудиторских сценариев генеративный искусственный интеллект превратился в углубленный диалогический каркас, способствующий когнитивному переносу, развитию мышления и согласованию смыслов, а также в совместно построенное диалогическое сообщество. К сожалению, эффект упрощения цифрово-интеллектуальных технологий сочетается с риском отчуждения. Например, применение генеративного искусственного интеллекта для упрощения в практике аудиторского преподавания может вызвать ряд практических проблем, включая разрушение диалогической власти и сужение профессиональных компетенций преподавателей и студентов, когнитивный аутсорсинг студентов и упадок критического мышления, упрочнение алгоритмической предвзятости и скрытые опасения относительно образовательного равенства. Для раскрытия потенциала технологий и возвращения к основной миссии воспитания талантов необходимо углубить профессиональную грамотность преподавателей в качестве дизайнеров и регуляторов диалога; построить модель человеко-машинного совместного ответного взаимодействия, сосредоточенную на углубленном диалоге и развитии мышления; оптимизировать технологическое поддерживающее окружение, гарантирующее справедливость и гуманистическую теплоту, с целью направления ответного взаимодействия в классе к новой образовательной модели сбалансированного и симбиотического развития между интеллектуализацией и инструментальной рациональностью.

Для цитирования в научных исследованиях

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Генеративный искусственный интеллект, ответное взаимодействие в классе, глубокое обучение, диалогическое сообщество, когнитивный каркас, образовательная этика, человеко-машинное взаимодействие, критическое мышление.

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