International Journal of Emerging Issues in Social Science, Arts, and Humanities



https://ejournal.lucp.net/index.php/ijeissa

Original Article

IJEISSAH

Vol. 4(4), October 2026, pp. 01-17
Published on 26 October 2026

ISSN Online: 2976-310X

How Generative AI Reshapes Classroom Dialogue in Chinese Higher Education: A Mixed-Method Study of AI-Enhanced Dialogic Teaching

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DOI: *doi.org/10.60072/ijeissah.2026.v4i04.001*

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***Received:** 28 Jul 2026*
***Revised:** 08 Oct 2026*
***Accepted:** 23 Oct 2026*

ABSTRACT

This study examines how generative artificial intelligence (GenAI) changes classroom dialogue in Chinese higher education, using a mixed-method design informed by dialogic teaching theory. Whereas earlier research has concentrated on AI adoption and user perceptions, this study treats GenAI as a structural mediator of classroom dialogue, one that shapes instructional design, interaction processes, and student engagement. Data were gathered at two Chinese universities and include 12 undergraduate courses, 10 teacher interviews, 24 classroom observations, and 221 student questionnaires. The quantitative results show significant increases in classroom participation (+22.2%), contribution frequency ($p < 0.001$), and higher-order cognitive responses, although overall learning engagement stays relatively stable. The qualitative findings point to four interrelated mechanisms by which GenAI supports dialogic teaching: AI-assisted lesson design, AI-supported questioning sequences, AI-driven personalized learning support, and AI-facilitated collaboration. These mechanisms correspond to, and extend, Alexander's principles of dialogic teaching, enhancing purposefulness, reciprocity, supportiveness, cumulativeness, and collectivity. The study proposes a GenAI-Enhanced Classroom Dialogue Framework, which shows that GenAI does not affect learning outcomes directly but reshapes them by restructuring classroom dialogue. The findings suggest that GenAI mainly strengthens teachers' pedagogical design capacity and allows classroom interaction to become more structured, inclusive, and cognitively demanding.

Keywords: Classroom Interaction; Dialogic Teaching; Generative AI; GenAI; Higher Education Teaching

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Background

Generative Artificial Intelligence (GenAI), represented by large language models such as ChatGPT, is rapidly changing teaching and learning practices in higher education. Traditional educational AI has concentrated mainly on grading, recommendation systems, and learning analytics. GenAI differs in its capacity for natural language generation and context-aware interaction, which allows it to take part directly in curriculum design, classroom interaction, and learning support processes (Kasneci *et al.*, 2023; Tlili *et al.*, 2023). Both UNESCO (2023) and the OECD (2019) point out that GenAI is transforming knowledge production and reshaping teacher roles, as well as the organizational logic of teaching.

China continues to internationalize its higher education and is pursuing a national strategy for educational digitalization, and against this backdrop the use of GenAI in university teaching has grown quickly. In recent years Chinese universities have actively explored generative AI tools such as ChatGPT, ERNIE Bot (Wenxin Yiyan), Tongyi Qianwen, and iFlytek Spark in their teaching, gradually bringing them into curriculum design, learning support, and instructional management. Whether in developing curriculum resources or providing personalized learning support, in structuring classroom discussions or guiding collaborative projects, teachers increasingly treat GenAI as an important instructional aid (Cotton *et al.*, 2023).

Research on GenAI in higher education falls mainly into several strands. The first addresses teachers' and students' acceptance of GenAI, their behavioral intentions, and the factors that influence them, often drawing on the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT) (Sallam, 2023). The second looks at the development of AI literacy, asking how teachers and students understand, evaluate, and use AI technologies (Ng *et al.*, 2021). The third deals with the ethical risks that generative AI poses, among them academic integrity, data privacy, algorithmic bias, and students' overreliance on AI (Dwivedi *et al.*, 2023; UNESCO, 2023).

Objectives

These studies lay an important foundation for understanding how GenAI has entered higher education. Even so, the literature is still concerned mostly with "AI adoption" and "AI perception," and has not yet turned fully to examining "how AI reshapes pedagogical processes" (Cui & Teo, 2021). In response to this gap, this study draws on Alexander's (2008) theory of dialogic teaching to explore how GenAI reshapes the mechanisms of classroom dialogue and how it influences student participation and learning processes. In particular, it investigates how teachers use GenAI to support instructional design, classroom questioning, personalized learning, and collaborative learning, and it addresses the following research questions:

RQ1: How do teachers use GenAI to implement dialogic teaching?

RQ2: Through what mechanisms does GenAI influence classroom dialogue and student participation?

RQ3: What are the opportunities and challenges of its application?

Literature Review

Generative AI in Higher Education

The use of artificial intelligence in higher education has progressed from rule-based systems to generative models. Early research centered mainly on intelligent tutoring systems, automated grading, and learning

analytics, and its core aim was to improve teaching efficiency and offer personalized support (Holmes *et al.*, 2019). As large language models developed, GenAI gradually gained the ability to generate content, design questions, and produce feedback, and it moved from being an assistive tool to acting as a collaborative participant in the teaching process (Zawacki-Richter, *et al.*, 2024 ; Kasneci *et al.*, 2023). Studies to date indicate that GenAI can support curriculum design, formative assessment, and the creation of learning resources, and that it can also give students immediate feedback and support for self-directed learning (Cotton *et al.*, 2023). Researchers have also raised ethical concerns, including academic integrity, bias, and the risk of overreliance (Dwivedi *et al.*, 2023; UNESCO, 2023). With regard to teacher development, GenAI is changing the structure of teaching competencies, especially in prompt engineering, AI-based evaluation, and ethical judgment (Benyahia, 2025). On the whole, work in this area still concentrates on the functional dimension of "AI as a tool," and pays limited attention to how it structurally affects classroom interaction processes.

Dialogic Teaching and Classroom Dialogue

Dialogic teaching theory, proposed by Alexander (2008), holds that knowledge is co-constructed through sustained interaction. Classroom dialogue is more than a process of exchanging information; it is a core mechanism for promoting reasoning, reflection, and meaning-making (Mercer *et al.*, 2019). Alexander sets out five principles of dialogic teaching: collectivity, reciprocity, supportiveness, cumulativeness, and purposefulness.

In recent years, dialogic teaching theory has been further extended from primary and secondary education to higher education contexts. Research shows that high-quality classroom dialogue can promote students' critical thinking, metacognitive abilities, and deeper disciplinary understanding (Mercer *et al.*, 2019; Asterhan *et al.*, 2015). From a sociocultural theory perspective, classroom dialogue is not only a medium for knowledge transmission but also a key mechanism through which learners co-construct meaning and develop cognitive capacities.

With the development of online learning platforms, collaborative tools, and artificial intelligence technologies, researchers have increasingly examined the impact of digital technologies on classroom dialogue. For example, digital collaborative platforms and intelligent learning environments can expand opportunities for interaction, increase feedback frequency, and support more equitable classroom participation (Firer *et al.*, 2021; Luckin & Cukurova, 2019). The widespread adoption of hybrid learning in the post-pandemic era has further advanced research on technology-supported classroom dialogue. However, discussions on how generative AI intervenes in classroom dialogue mechanisms remain at an early stage.

Towards GenAI-Supported Dialogic Teaching

Recent studies suggest that large language models are inherently dialogic systems, and their generative mechanisms are structurally similar to processes of meaning negotiation in classroom interaction (McMurry, 2025). Therefore, GenAI is increasingly considered a potential cognitive tool for supporting classroom dialogue. Existing research indicates that GenAI can support teaching processes in four main ways: curriculum design optimization, question generation, personalized feedback, and facilitation of collaborative learning. Theoretically, these functions may enhance both the depth and frequency of classroom interaction.

Although emerging studies have begun to explore the impact of GenAI on learning engagement and feedback processes, research on how GenAI specifically supports classroom dialogue, transforms interaction structures, and facilitates knowledge co-construction remains limited (Cui & Teo, 2021). In particular, within Chinese higher education contexts, there is still a lack of systematic empirical evidence on how teachers integrate GenAI into dialogic teaching practices and how such integration shapes student

participation and learning processes.

Synthesis and Research Gap

Taken together, the existing literature shows three structural limitations. First, GenAI research has mostly concentrated on technological adoption and competency development, treating AI as an external tool and not as a structural variable embedded in pedagogical processes. Second, dialogic teaching research stresses the importance of classroom interaction, yet it implicitly assumes that teachers design the dialogue and lacks theoretical engagement with intervention by external intelligent systems. Third, studies of the educational value of GenAI tend to concentrate on learning outcomes and overlook classroom interaction as a key mediating mechanism. A central question has therefore received too little attention: how does generative AI systematically reconstruct classroom dialogue structures by influencing instructional design and the organization of interaction?

Responding to this gap, this study reconceptualizes GenAI as a "structural mediator of classroom dialogue," and asks how it reshapes the generative logic of classroom dialogue through instructional design, questioning structures, personalized support, and collaborative mechanisms, instead of asking only whether it improves teaching efficiency or learning outcomes. This perspective addresses the theoretical disconnect between "AI-teaching process-dialogue mechanism" and offers a new analytical lens for understanding classroom interaction in the age of AI.

Conceptual Framework

The study draws on Alexander's (2008) theory of dialogic teaching and on existing research into the application of Generative Artificial Intelligence (GenAI) in higher education to build an initial conceptual framework. This framework is intended to examine how GenAI influences classroom dialogue practices and students' learning engagement.

Alexander (2008) argues that dialogic teaching places emphasis on the co-construction of knowledge through high-quality classroom interaction. Its core features are collectivity, reciprocity, supportiveness, cumulativeness, and purposefulness. The theory rejects the view of learning as one-way transmission of knowledge and treats it instead as meaning-making that takes place through sustained teacher–student interaction. The quality of dialogue thus becomes a key determinant of students' learning engagement and cognitive development.

On this theoretical basis, the study posits that GenAI does not influence student learning outcomes directly. It first shapes teachers' teaching practices; these practices then affect classroom dialogic processes, which ultimately influence student engagement outcomes. Following this logic, an initial conceptual framework is developed (Figure 1).

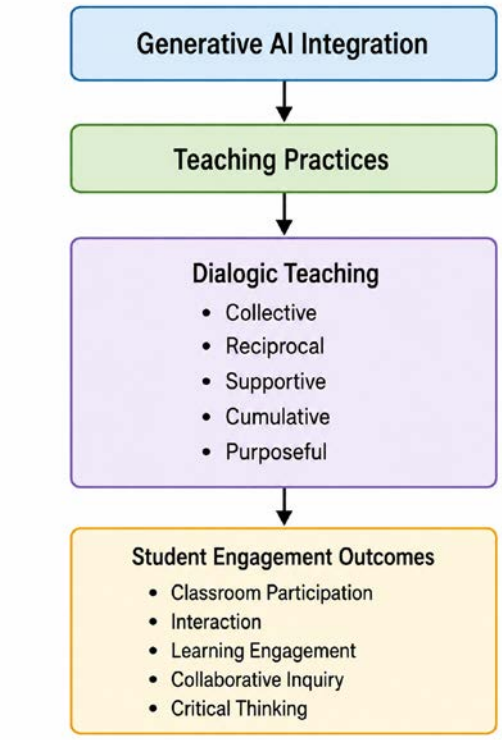


Figure 1. *Initial Conceptual Framework*

Figure 1 sets out the initial conceptual framework of the study. The framework assumes that GenAI influences classroom dialogue processes indirectly by shaping teaching practices, which in turn affect student learning engagement. More specifically, GenAI is conceptualized as a pedagogical enabler that helps teachers with instructional design, the organization of classroom interaction, and learning support activities. These practices then shape how classroom dialogue is organized and how good it is, and through dialogic teaching processes they influence student engagement.

There is still insufficient evidence, however, on the specific mechanisms by which GenAI affects classroom dialogic practices. To address this gap, the study uses a convergent mixed methods design that combines classroom observations, teacher interviews, and student questionnaires to explore how GenAI supports dialogic teaching in practice.

Methods

Research Design

The study uses a convergent parallel mixed methods design: qualitative and quantitative data are collected at the same time and brought together during analysis to produce a multi-layered interpretation (Creswell & Plano Clark, 2018). The qualitative data serve to uncover the mechanisms through which GenAI operates in classroom dialogue practices, and the quantitative data to examine its effects on student participation and learning engagement. Such a design is especially well suited to research at the intersection of educational technology and teaching processes, because it allows both an understanding of the complexity of pedagogical practice and the empirical verification of outcomes (Creswell & Plano Clark, 2018; Tashakkori & Teddlie, 2010). It also supports methodological complementarity and triangulation (Poth, 2023), which adds to the explanatory power and rigor of the study.

Research Sites and Participants

The study takes two representative universities in China as its research sites, one public and one private (non-state). Including different institutional types is meant to enhance the external validity of the study (Creswell & Poth, 2018) and to allow comparison of how generative AI is applied in teaching practice under different institutional contexts and resource conditions (Merriam & Tisdell, 2016; Yin, 2018), as shown in Table 1. At both universities, GenAI tools have been built into multiple courses to support the design of classroom discussion, learning feedback, and project-based instruction.

Table 1. *Research Context and Participants Overview*

Component	***Description***
Research sites	Two higher education institutions in China: one public university and one private university
Course scope	12 undergraduate courses in total, covering business, social sciences, and natural sciences
Student participants	221 undergraduate students with varying levels of academic ability and classroom participation
Teacher participants	10 university teachers integrating GenAI into teaching, with 3–18 years of teaching experience across disciplines (e.g., marketing, education, mathematics)
Sampling strategy	Purposive sampling (selecting courses where GenAI is actively used in classroom practice)
Ethical considerations	All participants signed informed consent forms, and all data were anonymized

Data Collection

To obtain diverse and complementary data (Creswell & Plano Clark, 2018; Flick, 2023), the study draws on three data sources, summarized in Table 2: classroom observation, teacher interviews, and student questionnaires.

Table 2. *Overview of Data Collection Methods*

Data type	***Source and scale***	***Key details (duration / method / purpose)***
Qualitative data	Classroom observation (24 sessions across 12 courses)	90–120 minutes per session, totaling approximately 48 hours; records instructional design, questioning strategies, student interaction, group collaboration, and GenAI usage
	Teacher interviews (10 teachers)	Semi-structured interviews, 45–75 minutes each; conducted both online and offline; all audio-recorded and transcribed verbatim to analyze teachers' AI pedagogical practices and perceptions
Quantitative data	Student questionnaire (221 students)	Five-point Likert scale; measures classroom participation, learning engagement, and perceived AI support; used for statistical analysis and group comparisons
Research design integration	Convergent parallel mixed methods design	Qualitative and quantitative data collected simultaneously; integrated through triangulation for comprehensive analysis and interpretation

Data Analysis

Qualitative analysis follows Braun and Clarke's (2006) approach to thematic analysis, which involves familiarization with the data, initial coding, generation of themes, and review of themes. Coding centers on four categories of AI-supported teaching practices: curriculum design support, questioning structure optimization, personalized learning support, and collaborative learning facilitation. The themes that emerge are then mapped onto Alexander's (2008) five principles of dialogic teaching so that the analysis is integrated with theory.

Quantitative analysis combines descriptive and inferential statistical methods. Mean comparisons and paired-samples t-tests are carried out, with classroom participation rate, interaction frequency, and learning engagement scores as the key indicators. Changes in these indicators before and after GenAI was introduced are tested at a significance level of $p < .05$ (Field, 2018).

Results and Discussion

Based on classroom observations, teacher interviews, and student questionnaire data, this study analyzes teaching practices and learning outcomes of GenAI-supported dialogic classroom interaction. The findings are presented in two parts: quantitative findings and qualitative findings.

Quantitative Findings

This study adopts a within-subject pre-post design to examine changes in learning behaviors and learning engagement among 221 students before and after the introduction of GenAI-supported classroom dialogue. Data analysis includes descriptive statistics and paired-samples t-tests, with the significance level set at $p < 0.05$.

Descriptive Statistics Results

Table 3 presents the descriptive statistical results of changes in classroom participation behaviors and learning engagement among 221 students before and after the introduction of GenAI. Overall, most behavioral indicators show an upward trend in the post-test stage, while changes in learning engagement are relatively small.

Table 3. *Student Classroom Participation and Learning Engagement (n = 221)*

Indicator	***Pre-test (M)***	***Post-test (M)***	***SD (Pre/Post)***	***Change***
Classroom participation rate (%)	56.2	78.4	14.6 / 18.3	+22.2
Number of classroom contributions (times/class)	3.1	5.2	1.8 / 2.7	+2.1
Student speaking confidence (1–5)	3.4	3.9	0.74 / 0.81	+0.5
Learning engagement score (1–5)	3.52	3.47	0.68 / 0.79	−0.05

Paired-Samples t-Test Results

Table 4 reports the results of the paired-samples t-tests. The findings show that both classroom participation rate and number of contributions reach statistical significance ($p < 0.001$). Speaking confidence shows a small but significant increase, while learning engagement does not reach statistical significance ($p = 0.063$).

Table 4. *Differences in Student Performance under Different Classroom Conditions*

Variable	***t-value***	***df***	***p-value***	***Cohen's d***	***Direction***
Classroom participation rate	7.18	220	< 0.001	0.63	Significant increase
Number of contributions	6.02	220	< 0.001	0.51	Significant increase
Speaking confidence	4.11	220	< 0.001	0.29	Slight increase
Learning engagement	-1.87	220	0.063	0.13	Non-significant decreasing trend

Observational Behavioral Data

Table 5 presents changes in classroom behavioral observation data. The results show that total student contributions increased from 214 to 356. The proportion of teacher-led talk decreased from 71% to 58%, while student-led interaction increased from 29% to 42%. The proportion of higher-order cognitive responses increased from 31% to 46%.

Table 5. *Changes in Classroom Interaction Behaviors (Observation Data)*

Behavioral indicator	***Early stage***	***Later stage***	***Change***
Total student contributions	214	356	+142
Teacher-led talk (%)	71%	58%	−13%
Student-led interaction (%)	29%	42%	+13%

Higher-order cognitive responses (%)	31%	46%	+15%

Polarization in Learning Engagement

In the dimension of learning engagement, further subgroup analysis reveals clear differences. Table 6 shows changes in engagement among students with different participation levels. The results indicate that high- and low-participation students show slight increases, while medium-participation students show a decline.

Table 6. *Changes in Learning Engagement by Group (Polarization Effect)*

Student type	***Pre-test***	***Post-test***	***Change***
High-participation students (Top 30%)	4.01	4.18	+0.17
Medium-participation students (Middle 40%)	3.52	3.41	−0.11
Low-participation students (Bottom 30%)	2.91	3.05	+0.14

Summary of Quantitative Results

Based on paired-samples t-tests and classroom behavioral statistics, student classroom participation significantly increased in the post-test stage ($p < 0.001$), and the proportion of higher-order cognitive responses also rose. However, learning engagement did not show statistically significant change ($p = 0.063$) and exhibited heterogeneous patterns across different student groups.

Qualitative Findings

Theme 1: AI-Assisted Lesson Planning

This theme addresses Research Question RQ1, focusing on how teachers use generative AI to design lessons in ways that enhance the purposefulness of classroom dialogue.

The findings show that teachers commonly treat GenAI as a "cognitive external brain" in the early stage of instructional design. They use it to generate teaching cases, design discussion topics, anticipate how students might respond, and build the structure of classroom activities. This process significantly strengthens the goal orientation and structuring of classroom discussions. One teacher remarked in the interview:

> *"In the past, designing discussion questions took a lot of time because I had to imagine how students might respond. Now I can use AI to simulate students' thinking first and then refine my questions accordingly."*

Classroom observations also indicate that in courses using AI-assisted design, teachers' questions tend to be more layered, and discussions dwell less on factual recall and more on explanation and evaluation. In terms of Alexander's (2008) dialogic teaching theory, this mechanism mainly strengthens the principle of "Purposeful," moving classroom dialogue away from spontaneous interaction and toward a goal-directed learning process.

Specific manifestations include:

- Teaching cases are more closely aligned with real-world contexts
- Discussion questions are more open-ended and challenging
- Student discussions are more aligned with learning objectives
- Teachers are able to anticipate and guide discussion trajectories

What GenAI contributes at the lesson planning stage, therefore, is essentially greater structural organization and cognitive depth in classroom dialogue.

Theme 2: AI-Supported Questioning

This theme responds to RQ1 and RQ2. It concentrates on how GenAI reshapes the structure of classroom questioning and, in doing so, promotes student participation and deeper dialogue. According to the findings, teachers make extensive use of GenAI to generate three types of key questions:

- Open-ended questions
- Probing questions
- Higher-order cognitive questions

Teachers usually arrange these questions as "questioning sequences," which give classroom discussion a progressively layered structure. On this basis, the study proposes an AI-supported dialogic questioning sequence model (Figure 2).

Knowledge → Understanding → Application → Evaluation → Reflection

Figure 2*. AI-Supported Dialogic Questioning Sequence Model*

The model shows how teachers use GenAI to produce progressive questioning sequences. Classroom observations show that teachers typically start with factual questions that activate prior knowledge (Knowledge), then lead students to explain concepts (Understanding), to apply knowledge in solving problems (Application), to evaluate different perspectives (Evaluation), and finally to engage in reflection and metacognitive discussion (Reflection).

This progression helps move classroom dialogue from information exchange toward knowledge co-construction, and it strengthens the principles of Reciprocity and Cumulativeness that Alexander (2008) emphasizes. The observation data also show that in classrooms with AI-supported questioning, discussion no longer follows a "single-turn Q&A" pattern but develops into a continuous trajectory of knowledge building. One teacher said:

> *"AI helps me turn a simple question into a five-level progressive sequence, so students don't finish discussing quickly—they keep going deeper."*

From Alexander's theoretical perspective, this mechanism strengthens:

- Reciprocity: students respond more frequently and in more diverse ways
- Cumulativeness: discussion continuously builds on prior contributions

Theme 3: AI-Guided Personalization

This theme relates to RQ2 and concentrates on how GenAI, through personalized support, improves student engagement and psychological safety.

According to the findings, teachers use GenAI to produce differentiated learning suggestions, personalized feedback, and guidance on learning pathways, which makes classroom dialogue more supportive. The key manifestations include:

- Providing differentiated explanations for students of different ability levels
- Adjusting classroom tasks based on AI-generated learning suggestions
- Offering real-time feedback and supplementary learning resources
- Reducing students' anxiety about speaking in public discussions

A student wrote in the open-ended questionnaire:

"I used to be afraid to speak in class because I was worried about being wrong. But after the teacher used AI to organize our ideas, I feel more confident expressing my thoughts."

Classroom observations also show that low-participation students speak noticeably more often in AI-supported personalized learning environments.

Within Alexander's framework, this mechanism strengthens the principle of Supportiveness: it creates a safe and inclusive dialogic environment in which students at different levels can take part in knowledge construction. GenAI, then, does more than "provide information"; it lowers the threshold for participation and so makes classroom engagement more equitable.

Theme 4: AI-Facilitated Collaboration

This theme relates to RQ1 and looks at how GenAI supports classroom collaboration and the collective construction of knowledge.

The findings show that GenAI is widely used by teachers to support the following instructional activities:

- Group brainstorming
- Collaborative inquiry tasks
- Project-based learning design

In these activities GenAI frequently serves as a "shared cognitive tool," helping students to generate initial ideas or structure their discussions, or supplying informational support. Classroom observations indicate that in AI-supported collaborative classrooms:

- Group discussions are more structured
- Task division is clearer
- Students more frequently reference AI-generated content in discussions
- Discussions are more likely to reach shared conclusions

Seen from Alexander's perspective, this mechanism strengthens the principle of Collectivity, under which learning is understood as a social process of group participation. As one teacher put it:

> *"AI makes group discussion no longer a situation of 'having nothing to say,' but gives students a starting point."*

In collaborative learning, therefore, GenAI acts as cognitive scaffolding for collective dialogue and in this way makes group collaboration more efficient.

Theme 5: Opportunities and Challenges

This theme relates to RQ3 and systematically examines both the potential benefits and the practical limitations of GenAI-supported dialogic teaching.

Key Opportunities

The findings suggest that GenAI brings several major advantages to classroom dialogue:

1. **Efficiency improvement**: Teachers can produce teaching materials and discussion questions faster, which cuts preparation time significantly.
2. **Enhanced inclusiveness**: Low-participation students are more easily engaged in classroom

discussion.

3. **Improved accessibility of learning resources**: Students have quicker access to explanations and learning support.

Key Challenges

Despite its positive effects, several challenges were identified:

1. **Ethical concerns**: Some teachers are concerned that students may come to depend too heavily on AI-generated content.
2. **Teacher competence gaps**: Teachers differ significantly in their ability to use AI, which affects how consistent teaching outcomes are.
3. **Student over-reliance on AI**: Some students do less independent thinking and tend to take AI-generated answers directly.

Theme 6: An Emergent GenAI-Enhanced Classroom Dialogue Framework

Four core mechanisms through which GenAI supports classroom dialogue are identified in this study:

- AI-assisted curriculum design (Purposeful Dialogue)
- AI-supported questioning structures (Reciprocal & Cumulative Dialogue)
- AI-guided personalized learning (Supportive Dialogue)
- AI-facilitated collaborative learning (Collective Dialogue)

Together, these mechanisms improve the quality of classroom dialogue and student engagement, forming an integrated theoretical model: the GenAI-Enhanced Classroom Dialogue Framework (Figure 3). This model illustrates how generative AI influences classroom dialogue practices through four pedagogical mechanisms, ultimately promoting student participation and learning engagement.

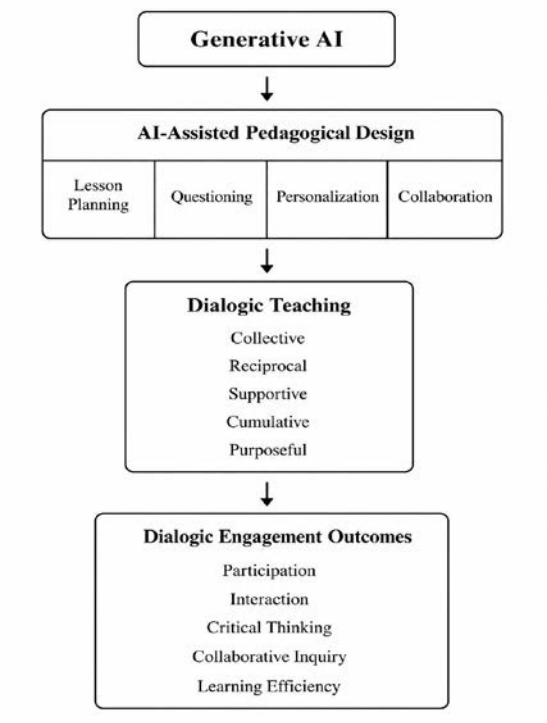


***Figure 3**. GenAI-Enhanced Classroom Dialogue Framework*

This framework indicates that GenAI does not directly influence student learning outcomes. Instead, it first enhances teachers' pedagogical design capacity through AI-assisted instructional design, which in turn activates four key teaching mechanisms: curriculum design, questioning design, personalized support, and collaborative learning.

These mechanisms jointly shape classroom dialogic practices and correspond to Alexander's (2008) five principles of dialogic teaching (Collective, Reciprocal, Supportive, Cumulative, Purposeful). Ultimately, dialogic teaching practices further promote multiple dimensions of student learning outcomes, including participation, interaction, critical thinking, collaborative inquiry, and learning efficiency.

Therefore, this study argues that the core value of GenAI in higher education classrooms is not to replace teachers, but to enhance teachers' instructional design capacity, thereby indirectly facilitating the generation of high-quality classroom dialogue.

Drawing on the theoretical perspective of dialogic teaching (Alexander, 2008; Mercer *et al.*, 2019), this study examines how Generative Artificial Intelligence (GenAI) reshapes the structure of teaching interactions and learning processes in Chinese higher education classrooms. Unlike traditional research that conceptualizes AI as a tool for instruction or an efficiency-enhancing technology (Holmes *et al.*, 2019; Kasneci *et al.*, 2023), this study positions GenAI as a "structural mediator" of classroom dialogue and proposes a GenAI-Enhanced Classroom Dialogue Framework. This section discusses the findings at three theoretical levels and further explores implications for teacher professional development.

GenAI as a Structural Mediator of Dialogic Teaching

The main theoretical contribution of this study is that it redefines the functional position of generative AI in classroom teaching. Existing literature typically frames AI as a tool for generating content or as a technology for supporting learning (Dwivedi *et al.*, 2023; Kasneci *et al.*, 2023). The empirical findings here, however, demonstrate that GenAI is deeply embedded in instructional design and classroom interaction processes, where it functions as a "pedagogical cognitive mediator" that directly influences the structure, rhythm, and depth of classroom dialogue.

Several empirical findings support this interpretation. First, the quantitative results show that once GenAI was introduced, classroom participation increased significantly (+22.2%, $p < 0.001$), the number of contributions per class rose significantly (+2.1, $p < 0.001$), and the proportion of higher-order cognitive responses grew from 31% to 46%. This indicates that GenAI does more than raise the frequency of interaction: it improves the cognitive quality structure of interaction.

Second, classroom observations reveal a systematic change in how teachers question, from factual Q&A to multi-level cognitive sequences (Knowledge → Reflection), which indicates a substantial restructuring of dialogic architecture. On the basis of these findings, the study argues that GenAI expands teachers' cognitive boundaries along three pathways:

- Question generation capacity
- Anticipatory pedagogical reasoning in classroom interaction
- Dialogic structuring capability

Importantly, GenAI does not replace teacher judgment but expands the teacher's "design space," enabling the construction of more complex dialogic structures at lower cognitive cost. Therefore, this study proposes a revision of the traditional teaching model:

- Traditional model: Teacher → Dialogue → Learning

- Revised model: Teacher → GenAI → Dialogue → Learning

This shift suggests that GenAI is no longer an external tool but a structural generative mechanism embedded within classroom teaching, one that fundamentally changes how classroom dialogue is produced.

Four Pedagogical Mechanisms of AI-Enhanced Classroom Dialogue
Drawing on the integrated analysis of the qualitative and quantitative data, the study identifies four core mechanisms by which GenAI supports classroom dialogue and maps them onto Alexander's (2008) five principles of dialogic teaching.

Mechanism 1: AI-Assisted Lesson Design → Purposeful Dialogue
Teachers make wide use of GenAI to generate cases, predict questions, and structure activities, moving classroom teaching from experience-driven to structure-driven design. This change improves goal alignment and cognitive focus in classroom dialogue.

Observations show fewer factual exchanges in AI-assisted classes and more explanation, evaluation, and reflection, which is consistent with the significant increase in higher-order responses (+15%). This mechanism strengthens Alexander's principle of Purposefulness: dialogue becomes a structured cognitive pathway instead of spontaneous interaction.

Mechanism 2: AI-Supported Question Design → Reciprocal & Cumulative Dialogue
GenAI is a key contributor to the generation of "questioning sequences," turning classroom interaction from isolated Q&A into structured, progressive dialogue. Interviews indicate that AI expands single questions into multi-layered sequences and so lengthens chains of discussion.

Quantitative findings support this mechanism, showing more student contributions (+2.1) and a greater proportion of student-led interaction (+13%). The mechanism strengthens:

- Reciprocity (increased interaction frequency and response diversity)
- Cumulativeness (knowledge construction through continuous dialogue)

More importantly, it transforms the temporal structure of classroom dialogue from linear Q&A into a cyclic generative cognitive process.

Mechanism 3: AI-Driven Personalized Support → Supportive Dialogue
Personalized feedback enabled by GenAI significantly reduces students' anxiety about speaking and raises participation among low-engagement students. The subgroup findings are consistent with this: learning engagement among low-engagement students rose from 2.91 to 3.05, whereas that of medium-engagement students fell (-0.11), which indicates a redistribution effect.

This mechanism strengthens the Supportive principle. Through cognitive scaffolding it lowers barriers to participation and so reshapes the psychological accessibility of classroom dialogue.

Mechanism 4: AI-Facilitated Collaboration → Collective Dialogue
In group learning contexts, GenAI acts as a shared cognitive tool that gives knowledge construction a structured starting point. Classroom observations show group discussions that are more structured, a clearer division of tasks, and more frequent use of AI-generated content as anchors for discussion.

This mechanism extends the Collective principle. In GenAI-supported environments, collectivity means not only participating together but also sharing an intelligent cognitive system as the basis for interaction, which produces a socio-technical mode of collaboration.

Extending Dialogic Teaching Theory in the Age of GenAI

The study also extends Alexander's model of dialogic teaching. In its original form, dialogic teaching can be reduced to Teacher → Dialogue → Learning, a structure that assumes teachers alone design classroom dialogue.

The key finding here is that, when GenAI is present, this structure is fundamentally reconfigured as Teacher → GenAI → Dialogue → Learning. The change has three theoretical implications. First, GenAI becomes a generative mediator of classroom dialogue: it takes part in pre-structuring interaction and reduces reliance on the capacity of individual teachers. Second, the way dialogue is generated shifts from teacher-centered design to human–AI co-design, which widens the reach and scalability of dialogic teaching. Third, Alexander's five principles (Collective, Reciprocal, Supportive, Cumulative, Purposeful) are reinterpreted as operational logics of a human-AI co-constructed system, and not solely as pedagogical norms.

The GenAI-Enhanced Classroom Dialogue Framework therefore shows that GenAI does not affect learning outcomes directly. It reshapes classroom dialogue, which acts as a mediating mechanism and in turn influences student participation, critical thinking, and collaborative ability. This finding goes beyond the prevailing "technology-outcome" paradigm and points instead to a "technology–dialogue structure–learning outcome" mediation pathway.

Implications for Teacher Professional Development

The findings suggest that using GenAI effectively depends on teachers' digital pedagogical competence as well as on the technology itself. Teacher professional development should therefore move away from traditional ICT training toward the systematic development of AI-enhanced teaching competencies. Specifically, four key dimensions are proposed:

1. **Prompt design literacy**: the ability to produce high-quality instructional materials through prompts, including questions, cases, and learning tasks.
2. **AI pedagogical literacy**: understanding how AI can be built into instructional structures, not merely used as an auxiliary tool.
3. **AI ethics awareness**: recognizing and handling issues such as data privacy, academic integrity, and student dependency.
4. **Dialogic facilitation competence**: keeping classroom dialogue deep, open, and critical when AI is present, so that AI does not weaken student thinking processes.

Future teacher training systems should accordingly shift from "technology use training" to "human–AI co-design capacity building" in order to support the sustainable and responsible integration of GenAI in classrooms.

Conclusion

Drawing on dialogic teaching theory and mixed-method evidence from two Chinese universities, this study systematically examines how Generative Artificial Intelligence (GenAI) reshapes the mechanisms of classroom dialogue and affects teaching processes and student engagement. It proposes and validates a GenAI-Enhanced Classroom Dialogue Framework, showing that GenAI does not directly affect learning outcomes. GenAI works instead by embedding itself in instructional design processes, which forms a

human-AI co-generative pathway: Teacher → GenAI → Dialogue → Learning. More specifically, GenAI improves classroom dialogue through four core mechanisms: instructional design optimization, questioning structure reconstruction, personalized learning support, and collaborative learning facilitation. Together, these mechanisms raise classroom participation, interaction frequency, and higher-order cognitive responses, and they partly improve how learning engagement is distributed.

Theoretically, the study redefines GenAI, moving it from a "teaching tool" to a "structural mediator of classroom dialogue" and extending Alexander's (2008) framework toward a human-AI co-constructed dialogic model. In practical terms, it offers actionable pathways for integrating GenAI in higher education and stresses that what matters is not the technology itself but how it is used to rebuild high-quality classroom dialogue structures. The study is, however, limited by the scope of its sample. Future research could examine the robustness and long-term effects of the framework in cross-disciplinary and longitudinal contexts, deepening understanding of how AI-driven pedagogical transformation works.

Declarations

Ethics Approval and Consent to Participate: Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and all information provided was treated with strict confidentiality throughout the study

AI Assistance: The authors utilized Paperpal during the preparation of this manuscript to improve its language quality and overall readability.

Conflicts of Interest: The authors declare no conflicts of interest.

Funding: This research received no external funding.

Authors' contributions: Cuiyun Wang and Lei Miao jointly contributed to the study conception and design, data collection, data analysis, manuscript preparation, and revision. Both authors read and approved the final manuscript.

Acknowledgement: Sincere appreciation is extended to all participants for their valuable contributions to this research.

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