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Research on the Model and Effect of Generative AI Empowering Classroom Interaction in Basic Education

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Abstract: **This research systematically analyzes recent Chinese and English literature to clarify the core patterns, multidimensional effects, and key challenges of generative AI in empowering classroom interactions within basic education. Findings reveal that generative AI primarily reconstructs the "teacher-student-machine" triadic interaction structure by assuming three roles: "context co-creator," "thinking coach," and "personalized tutor." Its enabling effects are significantly supported by empirical evidence across three dimensions-cognitive deepening, behavioral engagement, and emotional investment-though effect intensity is moderated by factors such as subject domain, application methods, and teaching scale. Nevertheless, inherent technological issues like "hallucinations" and "black-box" problems, potential risks of "over-empowerment," and insufficient teacher adaptability constitute major barriers to its deep application. Therefore, this research concludes that future practice must transcend technological instrumentalism and shift toward building a new "human-machine symbiosis" educational ecosystem. This ecosystem should center on teachers' design wisdom and humanistic guidance, aiming to foster students' higher-order thinking and responsible human-machine collaboration. This approach will achieve a qualitative transformation in classroom interaction and a return to the essence of education.**

Keywords: **Generative AI; Classroom Interaction; Empowerment Model; Learning Effectiveness; Human-Machine Collaboration.**

1. INTRODUCTION

With the rapid advancement of generative AI technologies exemplified by ChatGPT, the education sector is undergoing a profound digital transformation. This shift not only provides new tools for resource delivery and personalized learning but also holds the potential to reshape classroom interaction-the core element of teaching. Traditional classroom interaction models face inherent limitations in depth, breadth, and personalization. Generative AI, with its powerful content generation and contextual dialogue capabilities, is evolving from an "auxiliary tool" to an "active participant," giving rise to new forms of human-machine collaborative interaction. However, current practical explorations remain fragmented, and academia lacks comprehensive systematization and dialectical analysis regarding how generative AI can systematically empower classroom interaction in basic education, along with its actual effects and potential risks.

To this end, this research aims to conduct a systematic literature review, integrating recent Chinese and English literature through comprehensive analysis. The core focus is on exploring typical interactive empowerment models of generative AI in basic education classrooms and their multidimensional effects (cognitive, behavioral, and affective). The research seeks to clarify current progress, discern key controversies, and subsequently construct an understanding framework of "technology application-interaction reconstruction-learning effects" to address the lack of systematic research in this field. This review not only offers fresh perspectives on classroom interaction theory within intelligent educational environments

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but also provides robust academic foundations and practical guidance for frontline teachers designing human-machine collaborative instruction, reforming teacher education systems, and evidence-based development of educational technology products.

2. THEORETICAL EVOLUTION AND CONCEPTUAL FRAMEWORK

Theoretical research on classroom interaction has always been closely intertwined with the evolution of technological environments. From the era of Computer-Assisted Instruction (CAI) to the present, the role of technology has undergone a profound transformation from “tool” to ‘medium’ to “actor,” driving the continuous evolution of theoretical perspectives on classroom interaction. Within the early CAI framework, technology was primarily viewed as an auxiliary tool for conveying information or training skills. Its theoretical foundations stemmed from behaviorism and cognitivism, focusing on stimulus-response reinforcement and information processing efficiency[1]. At this stage, classroom interaction research centered on how technology could “enhance” established interpersonal interaction processes. The value of technology itself was considered neutral, entirely determined by the teacher's intended use. With the rise of network technologies and collaborative learning concepts, constructivism and sociocultural theories gained prominence, highlighting technology as a “social medium.” Research shifted to how technology supports meaning negotiation, knowledge co-construction, and distributed cognition within learner communities, viewing interaction as a sociocultural practice. Theories from this period began examining the mutual embedding of technology and social systems, arguing that technological applications and meanings are jointly shaped by specific educational theories, institutions, and cultures[2].

The rise of generative artificial intelligence marks the beginning of the “Generative Intelligence Education Era,” where technology begins to possess subject-like capabilities of understanding, generating, and evolving. This fundamental shift has catalyzed the third migration in classroom interaction theory: shifting focus from “human-to-human interaction mediated by technology” to exploring “collaborative interaction between human and machine agents.” This new perspective integrates and transcends existing theoretical frameworks: it draws upon distributed cognition theory, acknowledging AI as an active, formal node within cognitive systems; simultaneously, it is inspired by activity theory and “post-anthropocentrism,” advocating for moving beyond the human-machine dichotomy. It examines the symbiotic relationship between teachers and technology from an ecological perspective, viewing AI as a “non-human actor” with a mediating role in teaching activities. This implies that generative AI is no longer merely a channel for interaction or a repository of resources, but an active participant capable of initiating, sustaining, and transforming the interactive process. Theoretically, this expands classroom interaction into a dynamic network of meaning-making among the triadic subjects: teacher-student-artificial intelligence. Some scholars further categorize this triadic structure into collaborative models such as “teacher-led, AI-assisted” or “human-AI parallelism.” The core principle is that human agents must remain within the technological processing “loop” to monitor, adjust, and make final decisions[3].

Based on this theoretical evolution, this research defines the core concepts as follows:

• Generative AI in Education: Refers to artificial intelligence technologies capable of autonomously generating novel multimodal content-including text, images, and code-based on algorithms, rules, and pre-trained databases in response to human prompts. Within educational contexts, it is frequently discussed as “AI-generated content” (AIGC), with its core value lying in serving as a cognitive tool to support personalized learning, resource generation, and instant feedback[4].

• Classroom Interaction: In this research, specifically denotes the symbolic exchange and negotiation of meaning occurring within classroom teaching scenarios among teachers, students, and AI agents to achieve instructional objectives. Empowered by generative AI, the interactive subjects expand from a “teacher-student” dyad to a “teacher-student-machine” triad[5], encompassing three interwoven dimensions: cognitive, social, and emotional.

• Empowerment: Here, generative AI leverages its generative, interactive, and quasi-agent capabilities to provide new possibilities, resources, and scaffolding for classroom interactions. This process expands the boundaries of interaction, deepens its levels, and reconstructs its patterns. At its core, AI intervenes as a new agent, collaborating with teachers and students to jointly shape novel forms of interaction.

To systematically analyze how generative AI empowers this complex interactive system, this research constructs an integrated analytical framework, as shown in Figure1. This framework comprises three interconnected and bidirectionally interacting dimensions:

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(1) Technology-Role Layer (Enabling Foundation): Analyzes the roles generative AI assumes in specific classroom activities (e.g., tutor, learning partner, debate opponent, resource generator) and the technical pathways through which these roles are realized. This serves as the logical starting point for AI-enabled interaction, where distinct role positioning directly determines the manner and depth of AI engagement.

(2) Interaction-Process Layer (Core Reconstruction): Focuses on structural changes in classroom interaction processes following AI intervention. This encompasses the evolution of interaction patterns (e.g., shifting from one-way lectures to student-AI dialogues or teacher-student-AI collaborative inquiry), adjustments to interaction rules (e.g., turn-taking allocation and meaning negotiation mechanisms), and the generation and circulation of multimodal resources within interactions (such as text, images, and solutions generated by AI or collaboratively produced by teachers and students).

(3) Learning-Effect Layer (Value Objectives): Assess the impact of the aforementioned restructuring on learners' multidimensional development. effects manifest not only at the cognitive level (e.g., higher-order thinking, problem-solving abilities) but also at the affective-behavioral level (e.g., learning interest, engagement, self-efficacy) and the metacognitive level[6] (monitoring and regulating one's own and AI cognitive processes)

This framework emphasizes that the relationship between the three layers is not linear but involves a bidirectional dynamic construction: the definition of technological roles aims to trigger specific interactive processes, while the practice of these processes retroactively generates new demands for technological roles, collectively steering learning effects. Simultaneously, feedback on learning effects prompts teachers and students to readjust their technological usage strategies and interactive designs. The diagram positions “teachers' design wisdom and ethical considerations” at the center, underscoring educators' decisive role in navigating technological roles, guiding interactive processes, and safeguarding pedagogical values. This is crucial for ensuring technology empowers for good and avoids alienation. The following sections will systematically review and critically synthesize existing literature within this framework.

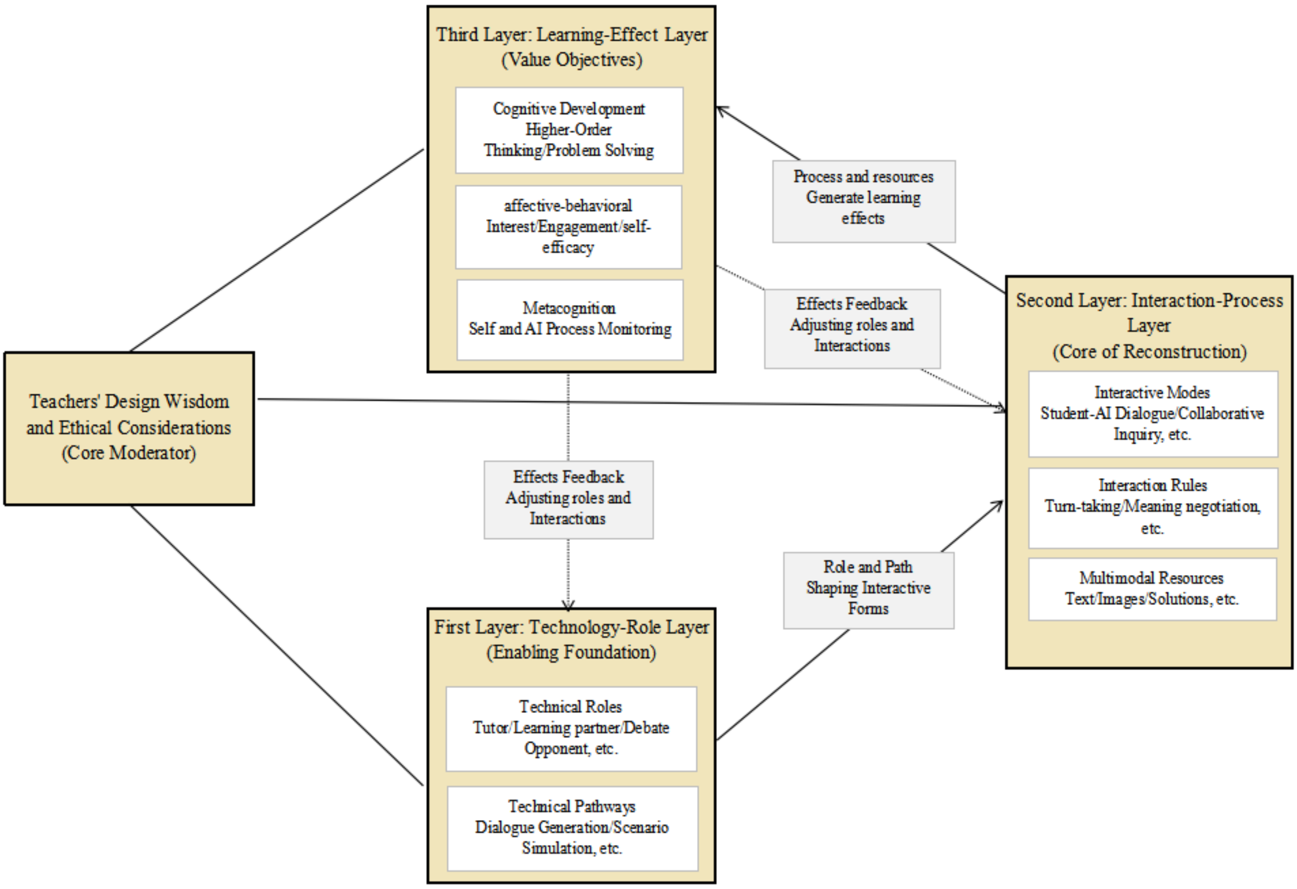

Figure 1: Analytical Framework

3. ANALYSIS OF GENERATIVE AI-EMPOWERED CLASSROOM INTERACTION MODELS

Based on the "technology-role-interaction-effect" analytical framework, this chapter aims to systematically organize and summarize the typical patterns of generative AI-empowered classroom interactions in current basic education practices. Analysis of existing literature and representative cases reveals that generative AI does not intervene in classrooms through a singular, static form. Instead, it dynamically reconstructs the interactive relationships and teaching processes among teachers, students, and machines by assuming diverse roles. Based on the core roles AI assumes in interactions, the qualitative changes it induces in interaction structures, and the primary pedagogical effects it pursues, this research categorizes current mainstream practices into three core enabling models: the immersive experience model as a "context co-creator," the inquiry-based model as a "thinking coach," and the adaptive learning model as a "personalized tutor." These three models are not mutually exclusive; they often intersect and integrate in actual classrooms, collectively aiming to foster deep learning and cultivate core competencies, As shown in Table 1.

Table 1: Three Core Models for Generative AI-Empowered Classroom Interaction

Mode Dimension	Mode One: Immersive Experience Mode as a "Scenario Creator"	Model Two: The Inspirational Inquiry Model as a "Thinking Coach"	Model Three: Adaptive Learning Model as a "Personalized Tutor"
Core Character	Multimodal Resource Generator, Virtual Scenario Builder.	Socratic questioner, scaffolding for thought processes, debate facilitator.	One-on-one learning partner, real-time feedback provider, learning progress analyst.
Technical Pathway	Text-to-image, text-to-video, virtual digital humans, multimodal fusion generation.	Conversational large language models, chain-of-thought prompts, visual reasoning tools.	Adaptive learning algorithms, learning diagnostics models, affective computing, multimodal perception and interaction.
Interactive Reconstruction	Reconstruct cognitive contexts, transform abstract knowledge into concrete forms, and stimulate empathy and intuitive understanding.	Redesign the learning process, transforming one-way instruction into guided, debate-style deep dialogue.	Reconstruct the teaching relationship, transforming the uniform teaching pace into personalized and continuous precise support.
Typical Effect	Enhance learning interest, immersion, and emotional resonance; overcome barriers to understanding abstract knowledge.	Promote critical thinking, metacognitive skills, and problem-solving abilities; deepen the level of classroom discussions.	Achieve personalized instruction at scale; Enhance learning autonomy and self-efficacy; Implement targeted instructional interventions.

3.1 Model One: Immersive Experience Model as a "Scenario Creator"

The core of this model lies in leveraging generative AI's powerful multimodal content generation capabilities to transform abstract, static, or experientially distant knowledge into tangible, interactive, and empathetic scenarios. This fundamentally reconstructs the "interactive" relationship between students and knowledge content, shifting it from passive reception to immersive experience.

In terms of role, AI primarily functions as a "resource generator" and "scenario builder." It transcends the "resource repository" positioning of traditional multimedia tools, capable of instantly generating highly customized scenario materials that did not previously exist, tailored to teaching needs. For instance, in a Chinese language class, AI can dynamically generate the numb expression "between the eyes" of the fictional character "Xiang Linsao," instantly bringing textual descriptions to life and enabling students to achieve unprecedented emotional resonance and depth of understanding. In science or history classes, AI can facilitate dialogues between students and virtual digital humans like 'Einstein' or "Li Bai," allowing knowledge to be naturally conveyed through lifelike interactions.

In terms of interactive reconstruction, this model shifts away from the indirect path of traditional teaching-"teacher verbal description → student imaginative comprehension"-and establishes a direct pathway: "teachers and students jointly present contextual demands to AI → AI generates concrete scenarios → teachers and students observe, explore, and engage in dialogue within the scenarios." Interaction no longer occurs solely between teachers and students; it now incorporates a deep "dialogue" process between students and the generated scenarios. For instance, in a math class, the abstract Fibonacci sequence can be transformed by AI into a visual challenge-based game, allowing students to explore mathematical patterns through interaction with the game mechanics. This reconstruction significantly reduces cognitive load, enabling students to allocate more cognitive resources to higher-order thinking activities.

Its pedagogical efficacy is notably manifested in stimulating intrinsic motivation, fostering emotional engagement, and promoting intuitive comprehension. When knowledge is presented through vivid, impactful contexts, students' eyes "light up," fundamentally enhancing their attention and participation. This is particularly crucial for learning content requiring strong contextual support, such as literary appreciation, historical understanding, and scientific imagination.

3.2 Model Two: The Inspirational Inquiry Model as a "Thinking Coach"

This model focuses on the most essential cognitive activities in the learning process, aiming to leverage generative AI's conversational and reasoning capabilities to act as a relentless questioner and cognitive scaffolding provider-a "thinking coach" that elevates classroom interactions from superficial Q&A to deep critical thinking.

In its role, AI embodies a "Socratic questioner," "debate opponent," or "collaborative inquiry partner." Chongqing Jukui Middle School's[7] "gentle guidance" AI teaching assistant exemplifies this approach. When students attempt to directly demand answers, it does not comply but responds: "While I cannot provide the answer directly, we can gradually trace a solution path along your existing knowledge map." This positioning transforms AI from an answer provider into a thinking facilitator.

In terms of interactive reconstruction, this model subverts the fixed pattern of "teacher asks-student answers-teacher evaluates," introducing an inquiry-based cycle of "AI persistent questioning-student reflective response-teacher-student-machine collaborative refinement." For instance, in argumentative writing or science inquiry classes, AI can be programmed as an opposing debater to engage students in multiple rounds of debate, compelling them to continually strengthen their argumentative logic. Another innovative practice is "AI debate-based teaching," which stimulates multi-perspective thinking by organizing human-machine and machine-machine debates. Furthermore, leveraging "visual reasoning" technology, AI can dynamically map complex problem-solving processes-such as line segment relationships in mathematics-step by step. This makes implicit thought processes explicit, achieving true "integration of numbers and shapes" and providing "scaffolding for thinking."

Its pedagogical efficacy directly targets cultivating higher-order thinking skills. Through sustained heuristic interactions, students systematically develop critical analysis, logical reasoning, and creative problem-solving abilities. Simultaneously, this process builds metacognitive skills, teaching students to monitor and adjust their own thought processes.

3.3 Model Three: Adaptive Learning Model as a "Personalized Tutor"

This model addresses the core educational imperative of "scalable personalized instruction." By leveraging generative AI's data-aware and adaptive capabilities, it creates a highly customized "one-on-one" learning environment for each student, thereby redefining the alignment between teaching and learning within standardized classrooms.

In its role, AI functions as an "omniscient personalized tutor"[8]. It serves not only as a distributor of learning resources but also as an intelligent companion capable of "listening," "observing," and "understanding" students' learning states. For instance, the latest generation of AI learning devices can seamlessly perceive the problems students point to, their real-time handwriting, and the tone of their questions through cameras and microphones, thereby providing continuous guidance without interrupting their thought processes. Within the "teacher-student-machine" triadic collaborative classroom, AI functions as an "intelligent teaching assistant" and "data analyst." It processes real-time class-wide learning dynamics and visualizes analytical insights for teachers. This liberates teachers from burdensome uniform instruction, allowing them to focus on personalized emotional support and higher-order thinking guidance.

In terms of interactive reconstruction, this model achieves a profound shift in teaching interaction from "group synchronous" to "individual asynchronous" and "group-individual collaboration." Before class, AI analyzes student learning profiles to generate tailored pre-class plans for learners at different proficiency levels. During class, AI supports simultaneous personalized practice and interaction for the entire class-for instance, through AI-powered listening and speaking response

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devices, each student's oral practice receives instant scoring and feedback. After class, AI generates personalized diagnostic reports and reinforcement exercises, forming a precise "assessment-feedback-improvement" loop. In online classrooms, AI "learning companions" can even enable one-on-one interactions during large-scale live sessions, boosting student engagement rates from single digits to 100%.

Its pedagogical efficacy primarily manifests in enhanced learning efficiency and motivation through extreme personalization. Students learn at their own pace, receive timely positive feedback, thereby strengthening their sense of control and self-efficacy. For teachers, this means liberation from repetitive tasks, transforming them into educational researchers and guardians of student growth.

In practice, these models often intertwine. A high-quality AI-integrated lesson might begin with an AI-generated immersive scenario (Model One), where group inquiry unfolds with AI agents serving as "thinking coaches" to guide discussions (Model Two). Simultaneously, all students' perspectives and process data undergo real-time AI analysis to support teachers' personalized guidance (Model Three). Looking ahead, advancements in agent technology will enable the emergence of a highly anthropomorphic, comprehensive "AI teaching partner" capable of scenario creation, cognitive facilitation, and personalized insights. This will further accelerate the maturation of a new triadic collaborative educational ecosystem involving teachers, students, and machines.

4. ANALYSIS OF THE EFFECTS OF GENERATIVE AI ON CLASSROOM INTERACTION

The integration of generative AI into classrooms is far more than a superficial change in form; its fundamental purpose lies in enhancing the substantive effectiveness of teaching and learning by restructuring interactions. To systematically evaluate its impact, this chapter employs a "technology-role-interaction-effect" analytical framework, combined with the widely accepted three-dimensional model of student development-cognitive, behavioral, and affective-to conduct a comprehensive analysis of how generative AI empowers classroom interactions. Meta-analytic research indicates that generative AI yields an overall effect size of medium to large magnitude($g=0.623$) on student development, demonstrating a positive impact[9]. However, this effect is not uniform; its intensity and manifestation are moderated by factors such as subject area, application method, and teaching scale. Furthermore, its implementation is accompanied by significant technical and ethical challenges.

4.1 The presentation of multi-dimensional empowerment effects

4.1.1 Cognitive Development: From Knowledge Acquisition to Leaps in Thinking

At the cognitive level, generative AI demonstrates its most significant impact through deepening conceptual understanding and catalyzing higher-order thinking. Challenges in traditional teaching-such as abstract mathematical principles or obscure classical Chinese texts-are transformed into tangible, actionable experiences through AI's dynamic visualization (e.g., geometric transformation animations, historical scene generation) and embodied interaction (e.g., dialogues with a "digital Confucius"). This significantly reduces cognitive load and enhances depth of understanding. For instance, in teaching the lesson "Two Children Debating the Sun," AI-generated scientific diagrams and real-time debate frameworks helped students integrate classical texts with scientific reasoning. This facilitated a cognitive leap from "word-by-word analysis" to "philosophical reasoning," boosting class comprehension accuracy by 35% [10].

More importantly, generative AI is evolving from a "knowledge transmitter" to a "thinking coach." By emulating the "teaching thought chain" of exemplary educators-inspire, guide, and probe-AI can make implicit thought processes explicit. It guides students through complete inquiry and reasoning pathways rather than providing direct answers[11]. This interactive model directly targets the cultivation of critical thinking, creative thinking, and metacognitive abilities. Meta-analysis research confirms that generative AI exerts a moderate positive effect on these higher-order cognitive skills.

4.1.2 Capacity for Behavior: From Passive Reception to Active Construction

In terms of behavioral capacity, generative AI has reshaped students' action patterns in the classroom. First, it significantly boosts student engagement through personalized task delivery, gamified challenges, and instant feedback. For instance, in AI-enhanced math inquiry classes, students can drag parameters, verify conjectures in real time, and receive immediate analytical feedback. This low-risk, high-feedback interactive environment markedly increases classroom participation rates and interaction depth.

Second, the integration of generative AI with learning analytics technology provides robust support for cultivating students' autonomous learning abilities. Liu et al. (2025) constructed an “SDL” framework in their study, demonstrating that AI can serve as an intelligent scaffold, providing personalized guidance throughout the entire process of learners setting goals, planning pathways, monitoring progress, and engaging in reflection[12]. This support enables students to gradually transition from reliance on teacher directives to becoming autonomous individuals capable of managing their own learning. Simultaneously, through collaborative task completion with AI, students develop foundational digital-age human-machine collaboration skills-including clearly articulating needs, critically evaluating AI-generated content, and effectively integrating human and machine strengths.

4.1.3 Emotional Attitude: From Instrumental Detachment to Emotional Investment

Emotional attitudes represent an indispensable yet difficult-to-quantify dimension in education. Generative AI demonstrates unique value in this domain by enhancing social presence. When AI engages through anthropomorphic appearances, voices, and conversational styles, it effectively triggers learners' mental schemas to perceive it as a social interaction partner, thereby fostering more positive emotional engagement[13]. This “human-like” interactive experience, combined with the immersive learning environments it creates (such as the virtual reality experience of the Temple of Heaven), significantly boosts students' interest in learning and their sense of immersion in the context.

Furthermore, generative AI's “adaptive support” feature-by providing appropriately challenging tasks and immediate positive feedback-enables more students to experience the “reach-for-the-top” success, thereby strengthening their sense of self-efficacy and achievement in learning. For students who remain silent in traditional classrooms due to fear of making mistakes, engaging in “private” dialogues and practice sessions with AI also offers an emotionally safe space for trial and error.

4.2 Analysis of Effect Modifying Factors

The educational effects of generative AI are not uniform, as they are significantly modulated by various contextual factors.

(1) Differences in subjects and application methods: Effects exhibit pronounced “subject specificity.” For instance, AI demonstrates particularly pronounced effect sizes in medicine and social sciences-fields requiring extensive scenario simulations and case-based reasoning. Conversely, its impact is relatively limited in information engineering, which emphasizes rigorous logic and practical skill application[14]. Regarding application methods, conversational interactive tools centered on dialogue and Q&A generally outperform purely content-generating or assessment-feedback tools, as they more closely align with the essence of pedagogical interaction and cognitive training.

(2) Teaching Scale and Intervention Design: Meta-analyses reveal a concerning trend: as experimental sample sizes increase, the positive effects of generative AI diminish, potentially yielding negative outcomes in large-scale settings[9]. This suggests that GenAI's current personalized advantages may be diluted in oversized classrooms, demanding higher standards for instructional design and teacher guidance. Simultaneously, sustained, repeated interventions prove more effective than one-time use in promoting learning, as students require time to adapt and learn how to collaborate effectively with AI.

(3) Adaptability Across Educational Stages: Research by Hu Qintai et al. (2025) indicates that generative AI exerts a more pronounced moderating effect on students' cognitive and affective development during the basic education stage. This may stem from students' heightened curiosity at this stage, coupled with AI's concrete and gamified characteristics aligning more closely with their cognitive profiles.

4.3 Challenges in Practice and Ethical Reflections

While acknowledging its positive effects, we must remain acutely aware of the challenges accompanying the deep integration of generative AI into classrooms.

(1) Cognitive risks stemming from technological limitations: The inherent “hallucination” issues, “black-boxed” reasoning processes, and fragmented knowledge organization of current large language models represent their most fundamental technical shortcomings. This may lead students to encounter and internalize misinformation, or settle for superficial connections rather than deep comprehension, thereby stifling critical thinking and potentially fostering cognitive inertia. Furthermore, AI's “hollowed-out” capacity for emotional understanding and value guidance renders it incapable of replacing human teachers' role in fostering emotional resonance and moral education.

(2) Ethical and Social Challenges Arising from "Over-Empowerment": When AI assumes excessive interactive, evaluative, and managerial functions, it risks "over-empowerment." This may distort the essence of teaching, reducing classroom interactions to algorithmically predetermined and monitored processes, thereby undermining teachers' instructional autonomy and students' capacity for independent thinking. Simultaneously, data privacy, algorithmic bias, and the widening digital divide caused by unequal access to technology are all critical social and ethical issues that must be taken seriously[15].

(3) Absence of Human-Machine Trust and Social Norms: Students, aware they interact with machines, may disregard traditional teacher-student social norms, exhibiting disobedience or excessive dependence. Therefore, establishing healthy algorithmic trust-neither blind faith nor outright rejection-and developing new interaction etiquette within this emerging human-machine duality is crucial for ensuring the quality of emotional engagement.

5. RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

Although this paper provides a preliminary outline of the patterns and effects of generative AI-enabled classroom interactions in basic education through a systematic review, significant limitations remain: First, existing empirical studies predominantly focus on short-term interventions and small-sample case studies, lacking long-term tracking and verification of learning outcomes at scale; Second, research predominantly describes generic models, with insufficient analysis of differentiated empowerment pathways and adaptability across disciplines (e.g., humanities vs. sciences) and educational stages (e.g., elementary vs. middle school). Third, discussions remain weak regarding the transformation of teachers' roles as key designers, their training needs, and practical challenges they face (e.g., technological ethical judgments, balancing human-machine responsibilities).

In view of this, future research should focus on the following directions: conducting longitudinal designs and large-sample experiments to examine the sustained effects and boundary conditions of AI empowerment; Deepen the research on "precise empowerment" based on disciplinary logic and establish an interactive design principle that is divided into disciplines and layers. Focus on the development of "teacher-AI collaborative capabilities", and develop corresponding training courses and support tools; It also prospectively explores the ethical norms, evaluation systems and ecological governance frameworks in human-machine collaborative classrooms, in order to promote the transformation of this field from technological application to educational innovation that is warm, profound and responsible.

6. CONCLUSION

Through a systematic literature review, this study ultimately reached the following core conclusions: Generative AI is profoundly reshaping the interactive structure and processes of basic education classrooms through three core modes-contextual co-creation, cognitive coaching, and personalized tutoring- demonstrating significant enabling potential across three dimensions: cognitive deepening, behavioral activation, and emotional engagement. However, its effectiveness varies depending on subject characteristics, application methods, and teaching scale, and it consistently carries ethical risks such as the "black box" of technology, "hallucinations," and "over-empowerment."Therefore, future educational practices should not merely focus on the superficial application of technological tools. Instead, they should strive to build a new ecosystem of "human-machine symbiosis" centered on teachers' pedagogical wisdom and humanistic care, and oriented toward the development of students' higher-order thinking and digital literacy. By embracing technological possibilities while remaining true to the essence of education, we can achieve a genuine elevation in the quality of classroom interaction and the depth of educational content in the intelligent era.

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