Exploration of an Interdisciplinary Teaching Model in Primary Schools Supported by Generative Artificial Intelligence

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Abstract: *With the rapid advancement of generative artificial intelligence (Generative AI) technology, its potential for application in the educational field is becoming increasingly evident, demonstrating significant innovative value, particularly in interdisciplinary teaching at the primary school level. This paper explores the application models of generative AI in primary school interdisciplinary teaching and analyzes its functions in areas such as teaching support, content generation, and evaluation feedback. Generative AI can dynamically generate personalized learning content based on students' learning needs and provide teachers with precise instructional guidance through intelligent analysis, thereby enhancing teaching effectiveness and fostering the development of students' interdisciplinary thinking. Interdisciplinary teaching not only facilitates the integration and innovation of student knowledge but also cultivates their critical thinking and problem-solving abilities. The findings of this study indicate that generative AI can effectively promote classroom interaction, optimize the learning environment, and guide students in forming autonomous learning and interdisciplinary thinking patterns. In the future, with the continuous progress of artificial intelligence technology, generative AI will play an even greater role in the field of education, driving profound transformations in educational models.*

Keywords: *Generative Artificial Intelligence; Interdisciplinary Teaching; Primary Education; Teaching Support; Content Generation; Intelligent Evaluation*

Introduction

In recent years, generative artificial intelligence technology has made significant progress, and its ability to autonomously generate content and provide personalized learning support has begun to demonstrate strong application potential in the field of education. This is particularly true in primary education, where generative artificial intelligence can offer innovative solutions for interdisciplinary teaching. Traditional subject-based teaching models are often confined to knowledge transmission within a single discipline, whereas the interdisciplinary teaching model requires students to establish connections between different subjects, thereby promoting the development of comprehensive skills.

Generative artificial intelligence effectively promotes the implementation of interdisciplinary teaching by dynamically generating multimodal learning materials, intelligently recommending educational resources, and adapting based on students' learning progress and interests. This technology not only optimizes instructional content but also enhances classroom interactivity and learning outcomes, assisting students in achieving knowledge integration across multiple disciplines. Based on this, this paper aims to explore an interdisciplinary teaching model in primary schools supported by generative artificial intelligence, providing theoretical reference and practical guidance for educators, while revealing its potential and innovativeness in promoting students' holistic development.

1. Application Background of Generative Artificial Intelligence in Education

1.1 Technological Development of Generative Artificial Intelligence and Its Convergence with Education

Generative artificial intelligence (Generative AI) represents a significant breakthrough in the field of artificial intelligence in recent years. Its core lies in training models to generate new data content,

rather than relying solely on predefined patterns or rules. Unlike traditional artificial intelligence, generative artificial intelligence can autonomously produce multimodal content such as text, images, and audio that conform to certain rules. This characteristic opens up new possibilities for applications in the educational field. Particularly in primary education, generative artificial intelligence can significantly enhance teaching effectiveness by dynamically generating learning materials, customizing personalized learning content, and providing intelligent tutoring. Generative models such as GPT, DALL·E, and DeepMind's AlphaFold have demonstrated substantial potential in various knowledge generation and application domains. In educational applications, generative artificial intelligence offers teachers more flexible instructional assistance tools, making teaching content more engaging and diverse, thereby effectively helping students understand and master interdisciplinary knowledge systems [1].

Currently, the application of generative artificial intelligence in education is primarily reflected in two aspects. On one hand, artificial intelligence can dynamically generate customized learning materials based on students' learning progress and interests, such as personalized readings, exercises, and experimental designs. On the other hand, it can provide intelligent assistance for classrooms through functions like voice recognition, automated assignment grading, and generating discussion materials, thereby enhancing teaching interactivity and student engagement. With technological advancements, generative artificial intelligence will become more integrated into interdisciplinary education, helping students identify intrinsic connections between different subjects and thus better achieve knowledge integration and innovation.

1.2 Theoretical Framework and Practical Significance of Interdisciplinary Teaching

Interdisciplinary teaching is an instructional approach that integrates knowledge from different disciplines by breaking the boundaries of traditional subjects. It emphasizes cultivating students' comprehensive abilities through the integration of multiple academic fields, particularly focusing on critical thinking, innovation capability, and problem-solving skills. This teaching model originates from the educational requirement for students' holistic development, embodying the integrative and practical nature of knowledge, and holds profound significance in promoting students' multidimensional thinking development.

At the primary school level, interdisciplinary teaching is particularly important, as this period represents a critical stage for the development of students' cognitive abilities. During this phase, the boundaries between fields of knowledge are not yet distinct, and students exhibit strong curiosity to explore the world. Interdisciplinary learning can help students comprehend phenomena within a broader knowledge context, thereby cultivating their comprehensive capabilities. The core concept of interdisciplinary education extends beyond the integration of subject knowledge to focus on developing students' cross-domain thinking patterns. For example, combining science with mathematics, intertwining literature with history, and integrating art with technology all contribute to helping students develop a holistic understanding of the complex real world.

The introduction of generative artificial intelligence has created new possibilities for interdisciplinary teaching. AI can automatically integrate learning materials from different disciplines and generate coherent interdisciplinary course content based on students' learning progress, thereby helping students establish connections across various fields. This dynamically generated learning content not only enhances learning efficiency but also provides personalized educational experiences tailored to students' learning needs and interests, ultimately achieving the goal of deep learning.

1.3 Innovative Application Potential of Generative Artificial Intelligence in Primary Education

The innovative application potential of generative artificial intelligence in primary education is immense, particularly in enabling interdisciplinary teaching models. Traditional subject-based instruction often focuses on knowledge transmission and in-depth exploration of disciplinary content, whereas interdisciplinary teaching requires students to comprehensively apply knowledge from different subjects for cognitive expansion. In this process, generative artificial intelligence serves not only as a teaching aid but also directly influences students' learning pathways and cognitive structures through intelligent methodologies [2].

In practice, generative artificial intelligence can automatically generate interdisciplinary resources related to learning topics through real-time analysis of students' learning processes, and adaptively adjust these resources according to students' knowledge structures. For example, while students are

studying language subjects, generative artificial intelligence can analyze their understanding of historical and cultural contexts to automatically generate historical texts or cultural elements, thereby helping students establish interdisciplinary connections. Furthermore, AI can provide teachers with personalized teaching suggestions by predicting students' learning challenges through data analysis and offering targeted instructional resources. This deeply customized teaching support makes education more precise and effective.

Generative artificial intelligence further enhances students' active participation in interdisciplinary projects. Through interactive engagement with AI, students not only establish connections across various disciplines but also discover the inherent logic between different fields of knowledge. For instance, utilizing voice generation technology, students can conduct cross-disciplinary dialogues with AI to explore issues spanning literature, art, science, and other domains. During this process, students' thinking becomes broadened while their creativity and problem-solving abilities are substantially improved. Generative artificial intelligence serves not merely as a knowledge delivery tool but rather as a catalyst for developing students' creative thinking. Through such interactive and customized learning models, students can identify their genuine interests at the intersection of multidisciplinary knowledge and achieve deep understanding through autonomous exploration.

2. Design of an Interdisciplinary Teaching Model in Primary Schools Supported by Generative Artificial Intelligence

2.1 Analysis of the Teaching Support Functions of Generative Artificial Intelligence

The value of generative artificial intelligence in education extends beyond knowledge generation to include deep support for and intelligent regulation of the learning process. Its core advantage lies in the ability to accurately identify students' knowledge mastery levels, interest preferences, and cognitive styles through natural language processing, knowledge graph construction, and deep learning algorithms, thereby enabling differentiated and personalized teaching support. The dynamic adaptation capability of generative artificial intelligence allows it to continuously adjust learning pathways during instruction and provide resources tailored to students' cognitive levels at different learning stages. For primary school students in a critical period of cognitive development, such dynamic support is particularly important, as it can effectively alleviate cognitive load during learning and promote multidimensional thinking construction.

In interdisciplinary teaching design, generative artificial intelligence can create multimodal resources such as images, audio, simulated experiments, and interactive texts, transforming abstract knowledge into concrete forms. For instance, AI can convert geometric concepts in mathematics into visual graphics and integrate them with spatial cognition in natural sciences, thereby enhancing students' intuitive understanding. Through such multimodal expression, AI not only increases classroom engagement and interactivity but also expands students' capacity for integrating interdisciplinary knowledge. Its support function is further demonstrated through intelligent guidance in classroom interactions, where AI generates guiding questions or prompts based on students' immediate feedback, fostering independent inquiry and interdisciplinary knowledge transfer. The integration of generative artificial intelligence shifts learning from passive reception to dynamic participation and deep construction, offering new intelligent-driven possibilities for interdisciplinary teaching [3].

2.2 Integration of Interdisciplinary Teaching Content and Generative Models

The essence of interdisciplinary teaching lies in breaking disciplinary boundaries and reconstructing knowledge systems to enable students to establish organic connections across different subjects. Generative artificial intelligence provides robust technical support for this process through its capabilities in semantic comprehension and generative modeling. It can reorganize and integrate core knowledge points from various disciplines by leveraging large-scale knowledge corpora and semantic correlation algorithms, thereby generating logically coherent and hierarchically clear instructional content. Unlike traditional teaching methods that rely on manual design by educators, AI generative models exhibit high flexibility and adaptability, enabling them to dynamically draw upon knowledge from mathematics, science, literature, art, and other disciplines around a given theme, and transform it into learning materials easily comprehensible and operable for primary school students through natural language generation.

This generation process emphasizes not merely the simple accumulation of knowledge points, but more importantly, the complementary and interconnected logic between disciplines. For example, in an interdisciplinary course themed "Water Resources," generative artificial intelligence can integrate knowledge of the water cycle from science, statistical methods from mathematics, and descriptive writing techniques from language arts to construct a comprehensive interdisciplinary learning unit. This automated content integration not only ensures the systematic nature of the knowledge framework but also possesses dynamic iteration capabilities, enabling continuous adjustment and optimization based on students' learning feedback. The content generated by generative artificial intelligence emphasizes multidimensional cognitive linkages, allowing students to simultaneously activate various competencies such as logical reasoning, data analysis, and creative expression during the learning process, thereby promoting the three-dimensional construction of cognitive frameworks.

2.3 Teaching Evaluation and Feedback Mechanism Based on Generative Artificial Intelligence

Teaching evaluation and feedback constitute a critical component of interdisciplinary instruction, and generative artificial intelligence provides powerful support for innovating this aspect. Traditional evaluation models often overemly rely on summative assessment of outcomes, neglecting dynamic changes during the learning process and individual student differences. Through deep data mining and real-time analysis, generative artificial intelligence can comprehensively monitor students' knowledge acquisition, thinking processes, and innovative expression at various learning stages, thereby establishing an intelligent evaluation system that incorporates both procedural and developmental dimensions [4].

The evaluation mechanism of AI relies on multimodal data analysis, encompassing students' language expression, problem-solving paths, knowledge transfer ability, and performance in interdisciplinary tasks. Through natural language processing and speech recognition, AI can assess students' conceptual accuracy and expression clarity in language-science integrated tasks; through learning trajectory modeling, AI can identify students' thinking logic during problem-solving and evaluate the depth of their interdisciplinary connections. Generative artificial intelligence can also produce visual feedback reports, enabling both teachers and students to intuitively grasp learning progress and identify areas needing improvement, thereby enhancing learning transparency and targeted instructional support.

Furthermore, the feedback mechanism of AI possesses predictive and guiding capabilities. It not only presents learning outcomes but also generates personalized improvement suggestions and proposes adjustments to learning paths based on students' knowledge graphs and learning patterns. For instance, in interdisciplinary tasks, AI can prompt students on how to more effectively integrate mathematical reasoning into scientific experiments, or how to more precisely interpret data results in verbal expressions. Such a feedback mechanism transforms evaluation from a static, one-directional process into a dynamic, interactive one, enabling students to continuously refine and enhance their skills through ongoing feedback, thereby facilitating the precise achievement and long-term development of interdisciplinary learning objectives.

3. Optimization Pathways for Generative AI-Driven Interdisciplinary Teaching Models in Primary Schools

3.1 AI-Enhanced Classroom Interaction and Learning Environment Optimization

The introduction of generative artificial intelligence in classroom settings has transformed traditional teaching interaction patterns, creating a more open and flexible learning environment. Through its multimodal generation capabilities, AI can instantly produce images, stories, experimental simulations, and data models relevant to lesson themes, thereby enriching students' perceptual experiences and deepening their comprehension. This dynamically generated content liberates classrooms from dependence on singular textbook resources, transforming them into real-time expanding knowledge ecosystems. During interactions with AI, students not only gain multidimensional learning information but also develop sustained learning motivation through immediate feedback.

The optimization of the learning environment is reflected in AI's intelligent adjustment of teaching scenarios. For example, generative artificial intelligence can provide supportive information in real time based on the progress of classroom discussions, promoting in-depth exchanges between teachers

and students as well as among students. It can also create immersive exploratory environments for interdisciplinary topics through the construction of virtual learning spaces, enabling students to establish interdisciplinary knowledge connections through simulated experiments, contextual stories, and data analysis. This AI-supported interaction and environmental optimization infuses the classroom with greater vitality, making the learning process more diverse and efficient [5].

3.2 Guidance and Enhancement of Students' Learning Habits and Thinking Modes

Generative artificial intelligence not only provides knowledge support but also plays a guiding role in cultivating students' learning habits and thinking modes. By tracking learning processes over extended periods, AI can identify individual differences in students' learning pace, knowledge mastery, and cognitive development, thereby generating personalized learning recommendations. This continuous feedback helps students gradually develop learning habits characterized by self-planning, active exploration, and continuous reflection.

In the cultivation of thinking modes, AI-generated interdisciplinary tasks often exhibit complexity and openness, compelling students to integrate knowledge from multiple disciplines and develop multi-perspective thinking pathways when solving problems. Through interaction with AI, students can continuously optimize their cognitive structures during processes of reasoning, creation, and critical analysis. The generative capabilities of AI expose students to diverse problem scenarios and solution approaches, stimulating their imagination and innovative potential while promoting the formation of interdisciplinary thinking patterns. This enhancement in thinking modes not only expands the depth and breadth of knowledge acquisition but also establishes a solid foundation for students' future academic development.

3.3 Transformation of Teacher Roles and Innovation of Teaching Strategies

In the generative artificial intelligence-driven interdisciplinary teaching model, the role of teachers has undergone significant changes. Teachers are no longer merely unidirectional transmitters of knowledge, but have become learning facilitators, resource integrators, and cognitive stimulators. AI can undertake substantial information generation and analysis tasks in teaching, thereby creating more space for teachers to focus on students' cognitive development and individual differences. This role transformation enables teachers to be liberated from routine instructional tasks and concentrate more on integrating interdisciplinary knowledge and cultivating students' capabilities [6].

The innovation of teaching strategies represents a crucial direction for teachers to adapt to AI-supported environments. Teachers need to incorporate AI-generated dynamic resources into curriculum design, establish student-centered interdisciplinary task systems, and flexibly utilize AI's feedback mechanisms to adjust instructional plans during teaching processes. Through collaborative work with AI, teachers can further transform abstract concepts into concrete learning experiences, making complex interdisciplinary knowledge more accessible for comprehension. In this process, teachers serve not merely as AI users but also as designers and promoters of model innovation, whose adjustments in teaching strategies will directly impact the depth and breadth of interdisciplinary education.

Conclusion

The application of generative artificial intelligence in primary school interdisciplinary teaching holds broad prospects, capable of significantly enhancing teaching effectiveness and fostering the development of students' interdisciplinary thinking. Through intelligent teaching support, students can receive personalized educational experiences within dynamically generated learning environments, while teachers can focus more on addressing individual student needs and integrating interdisciplinary knowledge. In the future, with continuous technological advancement and deeper application, generative artificial intelligence will play an increasingly important role in innovating educational models. Specifically, AI will not only further enhance classroom interaction and learning environment optimization but also promote the cultivation of students' autonomous learning habits, nurturing their innovative thinking and problem-solving abilities. However, to better achieve these goals, it remains necessary to strengthen teacher training, helping them adapt to the new AI-supported teaching models. Furthermore, future research could further explore the deep integration of generative artificial intelligence with interdisciplinary education, particularly its potential in intelligent evaluation and

personalized learning path design, thereby advancing the development of personalized and intelligent education.

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