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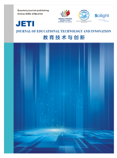

Article

The "Three Boards" Empower the Teaching Design of General Artificial Intelligence Education

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Abstract: As new-generation intelligent technologies rapidly evolve, enhancing artificial intelligence (AI) education has become a global consensus, and improving AI literacy is a key focus in higher education. To address the lack of relevant knowledge among non-computer science students, the complexity of the material, which leads to low interest and high difficulty in learning, this paper proposes a three-pronged teaching design model: "BOPPPS model + large language models (LLMs) + mind maps with 3w2h". This model aims to assist teachers in designing practical teaching cases and engaging, interactive activities, and provides examples of its application to help teachers better teach AI and improve the AI literacy of non-computer science students.

Keywords: artificial intelligence education; teaching design; large language model; mind map with 3w2h; BOPPPS model

1. Introduction

As the core engine driving the digital transformation of various industries, the development of artificial intelligence has been incorporated into China's national strategic top-level design. In 2017, the *Notice on the Development Plan for the New Generation of Artificial Intelligence* (State Council of the People's Republic of China, 2017) emphasized that the rapid advancement of AI will profoundly transform human social life and the world. Today, we recognize that AI has become a product of the era, enhancing core competitiveness. In January 2025, the Central Committee of the Communist Party of China and the State Council released the *Outline for the Construction of a Strong Education Nation (2024–2035)*, which clearly states the need to strengthen curriculum system reform and optimize the setting of disciplines and majors (Central Committee of the Communist Party of China & State Council, 2025), with a focus on the digital economy and future industries. Major universities are actively aligning their talent cultivation efforts with national strategies, focusing on cultivating a large number of high-quality talents in emerging fields to enhance the alignment between higher education and economic and social development, and to support economic transformation and upgrading. In April 2025, to fully implement the *Outline* and comprehensively support the construction of a strong education nation, the Ministry of Education of the People's Republic of China et al.(2025) jointly issued the *Opinions on Accelerating the Digitalization of Education*, emphasizing the need to build "general + specialized" AI general education courses at universities, using AI to empower course reform and innovative talent cultivation, and to develop an AI literacy education system to enhance students' intelligence literacy, innovation capabilities, and lifelong learning skills in the intelligent era. Therefore, major universities have introduced a series of AI general education courses for non-computer science students to help them improve their AI literacy and cultivate compound talents that meet the demands of the times. However, in the teaching process, two major challenges often arise: (1) how to teach computer-related subjects more differentially to students from non-computer science backgrounds; (2) how to better personalize learning for students from non-computer science backgrounds when faced with complex artificial intelligence technologies. These two issues are at the heart of cultivating AI literacy and are also the most challenging and difficult problems. To address these challenges, this article introduces a three-pronged approach: "BOPPPS model + LLMs + mind maps with 3w2h", which is applied throughout the entire teaching process—before, during, and after class—to help teachers teach more differentially and students learn more personalized.

2. Overview of "Three Boards" Enabling Artificial Intelligence General Education and Teaching

The BOPPPS teaching model is a closed-loop instructional framework that emphasizes student engagement and feedback. Its name is an acronym derived from six instructional stages: Bridge-in, Objective, Pre-test, Participatory Learning, Post-test, and Summary. As shown in Table 1, each stage features clear goals and a well-defined structure, facilitating effective lesson planning and classroom organization. Renowned for promoting instructional effectiveness, the BOPPPS model emphasizes active student participation throughout the learning process while supporting teachers in adjusting instructional activities based on feedback, thereby advancing student-centered pedagogy (Zhang & Zhu, 2016). In the context of general artificial intelligence (AI) education for non-computer science majors, students often lack prior domain knowledge and display limited interest in course content. The "Bridge-in" phase of the BOPPPS model, which encourages the use of cases, questions, or real-world scenarios to stimulate learners' motivation, helps to increase engagement with AI topics. Additionally, the "Pre-test" phase enables instructors to diagnose students' baseline understanding and clarify instructional goals, while the "Post-test" phase helps evaluate learning outcomes and cognitive progress. This feedback-driven approach allows for more targeted and adaptive instructional design, thereby enhancing students' AI literacy.

Table 1. BOPPPS teaching model.

Six Stage	Instructional Function
Bridge-in	Stimulates interest, connects prior knowledge
Objective	Guides learning direction and outcomes
Pre-test	Diagnoses learners' prior knowledge
Participatory learning	Emphasizes student-centered tasks and activities
Post-test	Measures outcomes and provides feedback
Summary	Reinforces learning, supports teacher and student reflection

With the rapid development of LLMs, intelligent teaching methods have garnered increasing attention. A systematic review found that a growing number of educators are employing LLMs in their instructional practice, yielding significant improvements in instructional design, content generation, and formative feedback (Duong Thi Thuy M. et al., 2024). Specifically, LLMs assist teachers in developing course handouts, case materials, and classroom questions, thereby enhancing the professionalism and engagement of instructional content. LLMs also automate the generation of exercises and explanations of complex concepts, streamlining lesson preparation. Moreover, LLMs support personalized learning by providing real-time question answering, error correction, and text rewriting services, substantially improving student autonomy and interactive learning. Xu et al. (2024) demonstrated that LLM-generated instructional designs, tailored to diverse learner profiles, improved both instructional efficiency and student engagement. Zhao (2024) examined the application of AI tools in higher education assessment and concluded that such tools can deliver high-quality, real-time personalized feedback, while also cultivating positive learning emotions. Liu et al. (2024) incorporated multi-modal large models into each phase of the BOPPPS model. For example, during the Bridge-in phase, the models generated course-relevant images, videos, or virtual simulations to stimulate student interest through multi-sensory engagement. In both the Pre-test and Post-test phases, the models were used to generate a variety of assessment formats. In the Participatory Learning phase, the models facilitated the creation of tasks such as voice-based Q&A, encouraging deeper cognitive processing and more dynamic classroom interaction.

Mind mapping, a graphical tool for structuring and organizing knowledge, is characterized by divergence, hierarchy, and inter-connectivity. It visualizes complex knowledge structures using keywords, images, and colors, thereby enhancing comprehension and retention. In computer programming languages teaching, Shahla Gul et al. (2023) regarded mind mapping as a problem-solving tool for teaching programming languages and explored its function in teaching. Research has found that mind maps force students to think before writing code. Therefore, they believe that students must be encouraged to use these tools to help them program better and understand programming concepts better. When combined with the 3w2h framework—"What to study", "Why study it", "Where to apply it", "How to study it" and "How much to study", mind mapping further strengthens the systematic design of instruction. The 3w2h model enables structured planning from goal-setting to instructional content (Zhang et al., 2023). Incorporating the mind map with 3w2h into instructional design not only helps students establish cognitive frameworks amidst complex course materials and reduce knowledge fragmentation, but also supports competency-based learning pathways. Specifically, clarifying the “Why” and “Where” dimensions enables students to understand the significance and application of what they are learning; “How” and “How much” help them adopt effective learning strategies and establish clear expectations; and constructing mind maps encourages students to externalize, organize, and reflect on their knowledge, fostering active learning skills. Furthermore, posing 3w2h-structured queries to large language models enhances the efficiency of human-AI interaction by improving the specificity of queries and the relevance of responses.

In conclusion, the BOPPPS model provides a structured, feedback-oriented instructional process that enhances classroom organization and student engagement in general AI courses. LLMs significantly reduce lesson preparation time, enrich instructional content, and support personalized learning. The mind map with 3w2h aids both instructors and students in clarifying knowledge structures, focusing learning objectives, and deepening understanding. Therefore, this paper proposes the integrated use of LLMs and the mind map with 3w2h within the BOPPPS framework to design a blended teaching approach that capitalizes on the strengths of all three, ultimately improving the effectiveness of AI education for non-computer science students.

3. The Design of the Teaching Model Integrating the Three Boards

This teaching model uses the BOPPPS model as the framework, with the 3w2h mind map and the large model as auxiliary tools. It outlines the implementation steps for three stages—pre-class, in-class, and post-class—based on the sequence of teaching activities. This results in an AI education model that integrates a large language model, a 3w2h mind map, and the BOPPPS model, as illustrated in Figure 1. The enhancement effects of LLMs and the 3w2h mind map on each stage of the BOPPPS model are shown in Tables 2 and 3.

Table 2. LLMs Empowering Each BOPPPS Stage.

BOPPPS Stage	Example of LLM Support
Bridge-in	Generates stories, cases, or questions to arouse curiosity
Objective	Automatically writes layered objectives
Pre-test	Creates diagnostic questions, quickly analyzes learners’ knowledge
Participatory	Designs group activities, debates, and role-play scenarios
Post-test	Generates quizzes and formative assessments with explanations
Summary	Summarizes content via diagrams or text; provides data-driven feedback

Table 3. Mapping the Relationship Between mind map with 3w2h and BOPPPS.

3w2h Element	Corresponding BOPPPS Stage	Collaborative Function
Why	Bridge-in	Motivates and contextualizes new knowledge
What + How much	Objective	Clarifies content and learning expectations
How much	Pre-test + Post-test	Establishes and evaluates knowledge depth
How	Participatory	Organizes learning strategies and interaction
Where	Participatory + Summary	Enables knowledge application and reflection

3.1. Pre-Class Stage

Adequate preparation before class is the foundation of classroom teaching. Teachers should complete four tasks before class: (1) Clarify the teaching objectives. The teaching objectives should clearly outline the knowledge, skills, or abilities that students need to acquire, and provide precise operational expressions, making the objectives actionable, measurable, and achievable (Zhao, 2025). (2) Release teaching resources. Teachers can publish resources such as PPT, videos, large model interaction prompts, and 3w2h mind maps on platforms like the National Smart Education Service Platform. Using 3w2h mind maps to present teaching content and learning goals helps students preview lessons by focusing on these goals, and provides large model interaction prompts to enhance learning efficiency. (3) Publish pre-class quizzes. Teachers can use large models to generate test questions, refine them based on students’ professional backgrounds, and create targeted pre-class quizzes to assess students’ interest in learning and their previewing status, which can be published through the teaching platform. (4) Design teaching activities. Teachers can use large models to find more suitable teaching methods, cases, and application scenarios for students, and design teaching activities based on students’ previewing situations to help students better learn about artificial intelligence. Students can use large models and other tools to study independently, fill out 3w2h mind maps, complete pre-class quizzes, and lay a solid foundation for classroom learning.

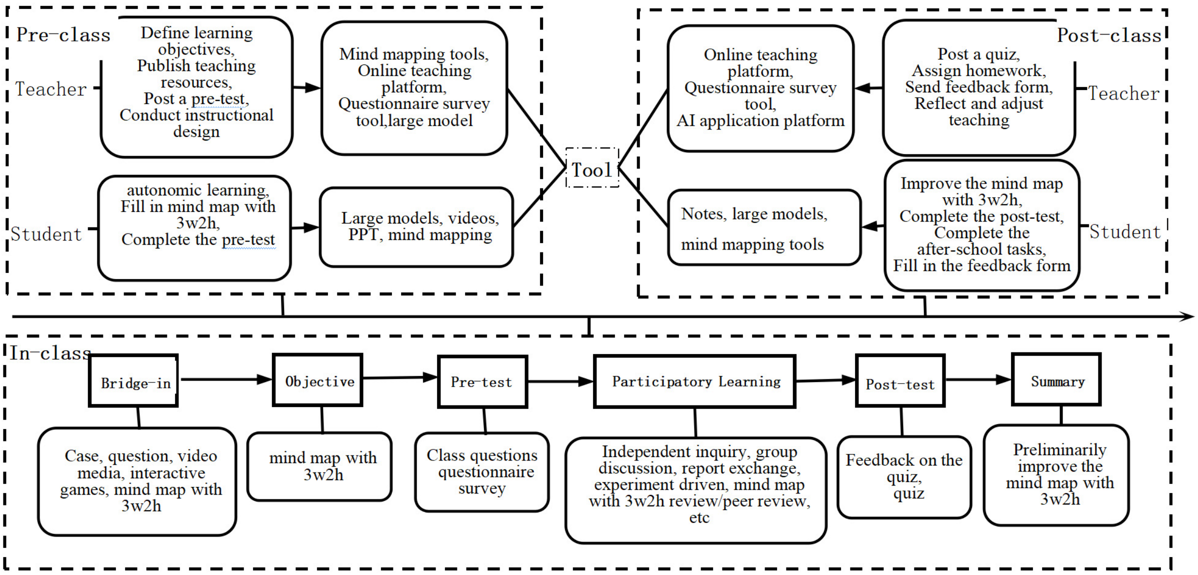

Figure 1. Design of artificial intelligence education and teaching model.

3.2. In-Class Stage

The in-class phase, as the core of teaching implementation, involves teachers completing the design of in-class activities before class. Teachers can use the BOPPPS teaching model to carefully design in-class activities, using the 3w2h mind map as a focal point to closely align with the teaching objectives and facilitate interactive learning. During the lesson, the 3w2h mind map can be repeatedly integrated to deepen students' understanding and retention of key concepts. Firstly, at the beginning of the class, teachers can employ various methods such as questioning, case studies, media (such as students' 3w2h mind maps), review, and interactive games, integrating real-life examples or students' professional fields to strengthen the connection between knowledge points and students, thereby stimulating their interest and focusing their attention. Secondly, teachers can present the learning objectives from the 3w2h mind map and engage students in participatory activities like group discussions, presentations, experiment-driven learning, case analysis, hands-on practice, interactive games, voting feedback, student explanations, and peer reviews of the 3w2h mind map, ensuring that students are actively engaged both mentally and physically, to achieve the learning goals. Additionally, teachers can interact with AI platforms like multi-modal large models in real-time during the class, explaining relevant knowledge through practical demonstrations and encouraging students to explore independently to internalize the knowledge. Thirdly, through question-and-answer sessions and in-class quizzes, teachers can promptly assess students' learning outcomes. Lastly, by refining the 3w2h mind map, teachers can summarize the entire class, helping students consolidate their knowledge and build a comprehensive framework of the lesson. Since a pre-test has already been conducted before class, teachers can decide whether to conduct a pre-test during the class based on specific circumstances. Teachers can use methods such as classroom questioning, short quizzes, and true or false questions to assess students' preparation, understand their interests, abilities, and knowledge base, identify available student resources, adjust the difficulty and pace of subsequent lessons, and ensure that course objectives are clear and manageable.

3.3. Post-Class Stage

Post-class evaluation and reflection are crucial for the teaching cycle. Teachers should complete the following tasks after class: (1) Design post-class tests or assignments based on pre-class and in-class situations to assess students' achievement of learning objectives. For example, assign practical tasks like AI application interactions, allowing students to gain hands-on experience with AI applications and tools, thereby enhancing their AI literacy. Since general AI courses often cater to students from various majors, different professional task designs can be created using large models. (2) Publish feedback forms to gather student feedback on the class. (3) Organize students' online and offline learning data and feedback, summarize the issues that arise, reflect on the teaching process, and adjust future lessons accordingly. Students should further refine their 3w2h mind maps, complete post-class tests or other assignments, and fill out feedback forms. They can also use large models for personalized Q&A sessions, which helps deepen their understanding and memory of the material and enhances their practical skills.

4. A Case of Teaching Design Integrating the Three Boards

This teaching design case selects the relevant content of "text classification" and carries out the three-board teaching design of "BOPPPS model + LLMs + mind maps with 3w2h".

4.1. Pre-Class Stage—Teacher Guidance + Online Independent Learning of Students Assisted by Large Model

Based on the integrated teaching model of "BOPPPS model + LLMs + mind maps with 3w2h", the first step is to set clear teaching objectives. According to Bloom's Taxonomy, students' cognitive processes can be divided into six levels from basic to advanced: knowing, understanding, applying, analyzing, synthesizing, and evaluating. Teachers can use this method to set specific, actionable learning goals that guide students in their autonomous learning. As shown in Figure 2, the objectives for this lesson could be: to understand the definition of text classification and explain it in your own words; to know the stages of development of text classification technology and the principles of related models; to describe the processes involved in text classification when not following a tutorial; to identify an application scenario related to your major that was not covered in class; to determine which preprocessing methods are needed based on specific task analysis; and to apply at least one feature representation method to digitize a piece of text. Once the learning objectives are clear, teachers can distribute the 3w2h mind map (as shown in Figure 2) and pre-class quizzes. Questions can be set related to the previous stage of knowledge, such as "What are the core processes of speech recognition?"; questions related to life experiences, such as "Which punctuation marks have emotional connotations?"; questions related to this lesson, such as "What type of classification does the library classification system belong to?"; and questions related to both this and the previous lessons, such as "Is a voice assistant an application scenario of text classification?"

At this stage, teachers can provide students with interactive prompts for large models to enhance learning efficiency and boost students' AI literacy. For example, a prompt might be: "I am a student majoring in sports, currently studying the text classification aspect of artificial intelligence technology. Please introduce the key points of text classification using the 3w2h (what, why, where, how, how much) framework and explain its application in sports." DeepSeek, for instance, provides applications in sports, such as automatically identifying the type of sports news (football, basketball, etc.) and classifying athletes' social media posts into positive or negative emotions. When explaining the technical implementation process, DeepSeek uses the classification of sports event reports as an example to illustrate how to preprocess texts and represent features. By integrating professional background explanations, this approach helps establish a connection between students and the knowledge points, reduces students' unfamiliarity with the knowledge points, enhances their understanding and enthusiasm for learning, and increases their interest in artificial intelligence.

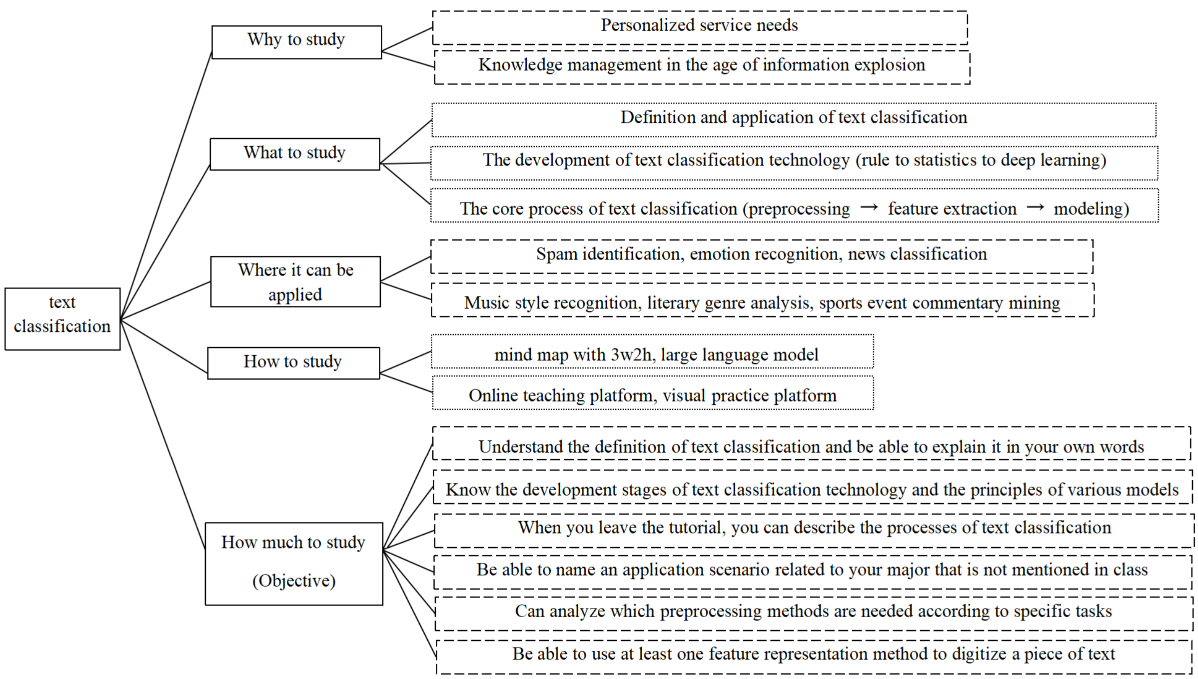

Figure 2. Mind map with 3w2h.

4.2. In-Class Stage—Participatory Teaching Activities Based on BOPPPS Model and 3w2h Mind Mapping

In class, the first step is to design an effective introduction. An effective introduction helps establish a connection between students and the learning content, thereby increasing their attention and engagement in the classroom, leading to a positive start for the lesson. The teacher can present the application scenarios listed in the 3w2h mind map and ask, "How does a voice assistant like Siri recognize user intent?" By showcasing the mind map, the teacher can capture the students' attention and naturally introduce the theme of the lesson: text classification. Next, the learning objectives from the 3w2h mind map are presented. Based on these objectives, relevant knowledge points are selected from the mind map for a pre-test, such as: What are the similarities in the processes of speech recognition and text classification? How do you understand text classification? This helps to understand the students' current level of knowledge, allowing for flexible adjustments to subsequent participatory teaching activities to better meet their specific needs and further boost their enthusiasm for learning. Participatory teaching is a crucial component of classroom instruction, aimed at stimulating student thinking, promoting communication, and developing comprehensive skills. For example, Table 4 outlines game interactions and classroom discussions, facilitating deep engagement between teachers and students to achieve the learning objectives. To assess the achievement of these objectives, the teacher can conduct a post-test using the 3w2h mind map, such as summarizing the basic process of text classification or providing several options for students to determine which does not belong to the text preprocessing steps. Some questions can be repeated from the pre-test, such as asking how students understand "text classification" to check if they have gained new insights. Finally, teachers can analyze the post-test situation, answer students' doubts, summarize and review around the teaching objectives, and make preliminary improvement to the 3w2h mind map, so as to deepen students' memory of knowledge and let students have an overall understanding and understanding of "text classification".

Table 4. Teaching activity design of "text classification" classroom.

Teaching Activity	Teacher Activities	Student Activities	Teaching Equipment/Means	Teaching Aims
Game interaction Poll feedback	(1) Continuously play rock-paper-scissors and let one gesture appear the most times; (2) Let the students further analyze the reasons according to the statistical results	(1) Predict the next gesture; (2) Analyze the reasons for different prediction results	Use online teaching platform or questionnaire design tool to collect students' prediction results and display statistical results	(1) To inspire students to think about the impact of data sets and their composition on model training; (2) Let students have an overall understanding of the principles of relevant models.
Feedback on the quiz	Q: If you want to classify the music reviews in the picture as positive, neutral, or negative, what do you need to do with the reviews in the picture? Is it ok to do nothing?	Analyze the text (including expressions, punctuation marks, etc.) in the diagram and answer questions	Students answer independently, or students are randomly selected to answer by using the teaching platform or lottery tool	(1) Explain the importance of text preprocessing; (2) Explain different methods of text preprocessing; (3) Explain the necessity of specific task analysis to improve students' cognition and application ability.
seminar Answers shared	(1) Then explain the knowledge points of word segmentation and feature representation; (2) Let students preprocess, segment words and other operations on new comments; (3) supplement, improve and evaluate students' sharing	Communicate with classmates, organize answers and share them	Students speak freely	(1) Let students understand the process of text classification; (2) Through hands-on practice, enhance students' understanding, recognition and application analysis of text classification technology.

4.3. Post-Class Stage—Summary and Reflection to Facilitate Learning and Teaching

First, the teacher assigns post-class quizzes or tasks. For this class, a text classification task is assigned to students, who are required to design an automatic recognition processing plan and provide the rationale, to assess their understanding of the class material. Additionally, some tasks are reserved for students who have extra capacity for further learning. Second, the teacher can ask students to provide feedback on the following points: (1)

What knowledge was learned in this class? What content did they not understand? (2) What aspects of this class do they like? What aspects do they dislike? (3) What suggestions do they have for the next class? Finally, the teacher will organize and analyze the feedback submitted by students, as well as their online and offline learning activities, and adjust future teaching based on these insights. This approach not only meets the students' learning needs but also continuously improves the teacher's teaching skills.

5. Conclusions

Education is a complex process, especially for general AI courses for non-computer science majors, where students often lack a foundational knowledge base and interest in learning. To help students grasp theoretical knowledge, teachers need to design more engaging participatory teaching activities and tasks that stimulate their interest in learning and meet the personalized needs of different majors and students. This article, based on the six elements of the BOPPPS model and adhering to a student-centered approach, designs a participatory teaching model that integrates pre-class, in-class, and post-class activities, using the 3w2h mind map and large language models as supplementary tools. The aim is to provide a practical application model for general AI courses for non-computer science majors, illustrated with the example of the "text classification" knowledge point. Special attention is given to integrating real-world cases and application scenarios related to students' professional backgrounds into teaching tasks and activities, creating a rich and engaging resource library, and effectively organizing it through online teaching platforms. This instructional model can reduce teachers' preparation time, enrich teaching resources, and promote personalized learning for students. In practice, teachers can select appropriate teaching models or combine multiple models based on the course's characteristics and student conditions, designing feasible teaching plans to enhance teaching quality and efficiency and improve students' overall abilities.

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