Reconstruction of the 5E Teaching Model Empowered by DeepSeek

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Abstract: *The rapid development of artificial intelligence (AI) technology, especially the proliferation of generative AI represented by large language models, has brought disruptive challenges to traditional educational models. When knowledge can be instantly stored, retrieved, and generated by AI, the focus of education must shift from the transmission of knowledge to the cultivation of higher-order thinking and innovation abilities. In response to the "AI challenge," this paper deeply analyzes the fundamental changes that must occur in educational goals, teacher-student roles, and curriculum logic in the era of intelligence. Based on DeepSeek, which reshapes course logic and content, the teaching model is reconstructed around "human-AI collaboration in problem-solving." This involves transforming teaching roles and methods, advocating for "teachers as guides, AI as partners," shifting learning paradigms and pathways, and emphasizing "student-centered" approaches. The process of autonomous and inquiry-based learning is conducted with the full accompaniment of AI tools such as DeepSeek.*

Keywords: *AI challenge; DeepSeek; 5E teaching model; innovative education; human-machine collaboration*

1. Educational Challenges in the AI Era

We are at a historic turning point, with large language models such as DeepSeek and ChatGPT, which are as significant as the birth of the internet. They are not merely more powerful information retrieval tools but are "cognitive partners" [1] equipped with deep understanding, logical reasoning, and content generation capabilities. This means that the explicit knowledge accumulated by humanity over thousands of years can almost instantly be memorized, processed, and output by AI. The traditional education model, centered on "knowledge transmission" and focused on "teachers, textbooks, and classrooms," is being fundamentally shaken. The global education community faces the AI challenge: when knowledge is easily accessible, what is the core value of teachers? What, then, is the fundamental goal of education?

1.1 The Shift in Educational Goals from "Knowledge Transmission" to "Capability Reshaping"

The traditional education model is akin to a "knowledge packaging and transmission" system, with its core value lying in efficiently transferring the accumulated knowledge of humanity to the next generation. The advent of AI has rendered this system’s efficiency advantage obsolete. The necessity of memorizing historical dates, formulas, theories, grammar rules, and other "factual knowledge" has been significantly diminished. Education must now address the question: with the assistance of AI, which higher-order cognitive abilities must still be forged by the human brain? How can one question the answers provided by AI? How can one judge the authenticity, accuracy, and potential bias of its information? This is far more challenging than simply accepting knowledge. The core of human-AI interaction is "asking questions," and the ability to pose profound, precise, and clever questions will determine how much value can be gained from AI. This will become a core competency in the future. How can the multi-dimensional information fragments generated by AI be integrated into a logical, deep, and innovative new perspective or product?

The fundamental goal of education must shift from "cultivating knowledge containers" to "cultivating well-rounded individuals with sustainable development capabilities." The focus should be placed on empathy, a sense of responsibility, integrity, perseverance, and other qualities; the ability to appreciate beauty, create beauty, manage emotions, and build deep interpersonal relationships; as well

as the ability to learn how to learn, self-plan, reflect, and adjust.

1.2 The Disruptive Reconstruction of the Teacher's Role: From "The Sage on the Stage" to "The Guide by Your Side"

Teachers are no longer the sole authority on knowledge; their role must undergo a fundamental transformation. The core work of teachers is no longer to impart knowledge, but to teach methods. They need to design learning pathways, guide students on how to use AI tools for exploration and validation, and act as "navigators" between students and the ocean of AI. Teachers will focus more on inspiring students' intrinsic motivation, providing emotional support, fostering teamwork, and shaping students' character through example and instruction. They are the "warm AI" companion, the "person with warmth" beside it. Teachers must design more project-based learning, inquiry-based learning, debates, and workshops, offering immersive experiences that allow students to apply AI tools and human intelligence together while solving complex, real-world problems.

1.3 The Comprehensive Failure and Reconstruction of Teaching and Evaluation Systems

The existing teaching and evaluation systems are built on the foundations of "preventing cheating" and "assessing memory and understanding," but AI has rendered this system obsolete in an instant. Under AI, evaluation will focus more on the learning process, such as students' thinking pathways, iteration cycles, and collaboration, rather than on the final submission of a perfect report (which may be AI-generated). The importance of traditional closed-book exams and standardized answers will diminish, while evaluation methods that reflect students' genuine involvement and creativity, such as oral defenses, project presentations, portfolios, and group practices, will become the mainstream. Courses need to significantly reduce the proportion of factual knowledge and increase content on AI itself, information literacy, media critique skills, and those soft skills in which humans excel.

In response to the challenges of the AI era, we introduce the advanced AI large model DeepSeek as a core empowering partner, and build and practice the innovative system of the "DeepSeek-powered 5E Teaching Model." This system systematically elaborates on "what to teach," "how to teach," and "how to learn" in the AI era, aiming to cultivate future innovators who can harness AI, rather than being replaced by it.

2. The 5E Teaching Model and Its Limitations

2.1 The "Problem-Cognition-Oriented" 5E Teaching Model

To construct a new model, the first step is to break away from the traditional "knowledge-cognition model." In this model, students build a network in their brains centered around knowledge points and standard answers. They are good at solving "familiar" problems but lack the intrinsic motivation to discover new problems and explore the unknown. To address this, Professor Zhao Hong proposed the "Problem-Cognition Model" [2]. This model asserts that the primary goal of education is not to fill students with knowledge, but to implant a new cognitive paradigm in their brains—the starting point and main thread of all learning and exploration is "problem." The essence of learning is to solve problems and innovate, while knowledge and methods are the "tools" and "materials" needed in the process of solving problems. The model aims to cultivate students' ability to form an habitual thinking chain, from "identifying problems" to "solving problems" and then to "evaluating and reflecting."

To implement the educational philosophy of the "Problem-Cognition Model" into every course and class, we will adopt the 5E Teaching Model. This model emphasizes a student-centered approach, problem-oriented learning, and the use of constructivist learning methods. It specifically includes five components:

Engagement: Stimulate students' interest and activate prior knowledge through problem scenarios or project designs.

Exploration: Allow students to independently explore new concepts through experiments, discussions, or project practices, exposing cognitive biases.

Explanation: Teachers guide students in summarizing rules, while students attempt to articulate their understanding and correct misconceptions.

Elaboration: Apply knowledge to new contexts, such as solving real-world problems or expanding project designs, to reinforce deep understanding.

Evaluation: Throughout the process, diversified assessment methods are used, including self-reflection, peer evaluation, and teacher feedback, with a focus on skill development rather than a single outcome [3,4].

The 5E model is a cyclical, iterative, and spiral process that keeps students immersed in an environment of "learning to solve problems." This continuous immersion subtly constructs the "Problem-Cognition Model" in their minds.

2.2 Limitations in the Practice of the 5E Model

The 5E model has significantly enhanced students' scientific inquiry and problem-solving abilities [5,6]. However, the following issues remain in practice:

In the Engagement phase, the creation of scenarios often relies heavily on teachers' experience, lacking precise diagnosis of students' prior concepts, which leads to insufficient cognitive conflict stimulation.

In the Exploration phase, students' autonomy is limited, with many following predefined experimental steps, failing to fully demonstrate the complete inquiry chain of "problem-evidence-conclusion."

There is insufficient technological empowerment. The traditional model relies on manual lesson planning and evaluation, making it difficult to achieve personalized learning paths and dynamic resource adaptation.

AI's intelligent diagnostic and dynamic feedback capabilities can precisely identify logical gaps in students' problem-solving processes and provide step-by-step guidance, addressing the technological shortcomings of the traditional model [7].

3. Reconstruction of the 5E Teaching Model Empowered by DeepSeek

In the AI era, especially with the empowerment of advanced large models like DeepSeek, the 5E teaching paradigm has gained unprecedented powerful tools and implementation pathways. The core framework of the new 5E teaching model empowered by DeepSeek can be summarized as: "teacher-led, student-centered, AI-assisted," forming a three-in-one system.

3.1 Reshaping Course Logic and Content

At the level of "what to teach," the teacher's role shifts from being the transmitter of knowledge to the guide of the learning process, reconstructing course content and logic. At the cognitive level, the focus is on enhancing the "problem-cognition model" and understanding the "laws of human-AI collaborative world operation." At the skill level, the goal is to cultivate the ability to collaborate with DeepSeek in exploring, innovating, and solving problems. The course logic transitions from "linear knowledge map expansion" to "problem-chain-driven exploration." The entire course is designed as a complete 5E inquiry cycle. Based on knowledge maps and competency maps, teachers deconstruct and integrate the competencies and knowledge points that students need to master into individual learning tasks. Each learning task is strictly designed according to the 5E steps and narrated from the students' perspective, making it more immersive and actionable [5].

For example, in the "Applied Regression Analysis" course, the goal of the simple linear regression experiment is to understand the principles of simple linear regression, master least squares estimation, model testing, and diagnostic methods, and apply Python for implementation. The DeepSeek-powered 5E teaching steps are designed as follows:

3.1.1 Engagement (Engage) — Posing Questions to Stimulate Interest

In the traditional approach, the teacher presents a scatter plot using a PowerPoint slide, such as a "Income vs. Consumption" scatter plot, and asks students if a linear relationship exists.

Under the empowerment of DeepSeek, students ask DeepSeek: "Give me an example from real life that is suitable for simple linear regression analysis and explain the relationship between the variables,"

and "Why might income and consumption not have a perfect linear relationship? What are the possible influencing factors?" DeepSeek provides rich real-world examples, such as "study time vs. exam scores" and "advertising investment vs. sales," and begins to discuss the meaning of the "error term," guiding students to think about the uncertainty of the model.

3.1.2 Exploration (Explore) — Hands-on Data, Initial Attempts

In the traditional approach, the teacher provides a dataset, and students use Excel or Python to create a scatter plot.

Under the empowerment of DeepSeek, students instruct DeepSeek: "Please generate a dataset that fits the simple linear regression relationship, containing 30 samples, and add some random disturbances." DeepSeek generates the data and provides the Python code, which students can run to obtain the dataset. Students then further inquire: "Please give me the Python code using matplotlib to plot the scatter plot and add a trend line." DeepSeek provides the complete code, and students run it to observe the preliminary relationship.

3.1.3 Explanation (Explain) — Theoretical Elucidation, Model Construction

In the traditional approach, the teacher derives the least squares formula and explains the meaning of the regression coefficients.

Under the empowerment of DeepSeek, students ask DeepSeek: "Explain the concept of least squares in geometric terms." "What are the basic assumptions of the simple linear regression model? What issues arise if these assumptions are violated?" After DeepSeek answers, students gain an understanding of the least squares principle and the basic assumptions of regression. Students then further inquire, "How can I perform simple linear regression using Python's statsmodels library and output the summary table?" DeepSeek provides a code example, and students run it to interpret results such as R-squared, coefficient significance, etc.

3.1.4 Elaboration (Elaborate) — In-depth Application, Model Diagnostics

In the traditional approach, the teacher explains concepts such as residual plots, heteroscedasticity, and outliers.

Under the empowerment of DeepSeek, students ask DeepSeek: "How can I plot a residual plot using Python? How do I determine if the residuals satisfy homoscedasticity and independence?" DeepSeek provides the code and explains how to make these determinations. Students then further inquire: "If the residual plot shows a funnel shape, what does it indicate? How should this be addressed?" DeepSeek explains the issue of heteroscedasticity and provides potential solutions.

3.1.5 Evaluation (Evaluate) — Comprehensive Testing, Reflection and Improvement

In the traditional approach, a homework assignment is given, and students submit reports.

Under the empowerment of DeepSeek, the teacher uses DeepSeek: "Please generate a problem for simple linear regression, including data, model construction, hypothesis testing, and residual analysis requirements." DeepSeek generates personalized problems, with different students receiving different datasets to prevent plagiarism. While writing their reports, students can ask DeepSeek: "What does it mean if the p-value in my regression model summary is less than 0.05?" "How should I interpret the 95% confidence interval for the regression coefficients?" DeepSeek helps students understand the results, but students must integrate and analyze them on their own.

At the end, students ask: "Summarize the main steps of simple linear regression and common pitfalls." DeepSeek generates a checklist, and students review their learning outcomes. The students reflect on their own progress, and the entire learning process helps them realize DeepSeek's immense potential. In the future, they can build such intelligent assistants in more fields. Collaborating with AI will become their core competence.

3.2 Transforming Teaching Roles and Paradigms — Teachers as "Guides," Students as "Actors," and DeepSeek as "Partners"

Students are the absolute subject and center of the learning process. They are no longer passive recipients, but instead explore freely according to the 5E inquiry process. In collaboration with their DeepSeek partner, students personally experience the entire 5E inquiry process, making learning an "adventurous journey" filled with challenges and a sense of accomplishment. DeepSeek transcends the

role of traditional tools here; it is an all-weather, full-process, intelligent "cognitive partner" and "collaborative partner." At every stage of the 5E process, it provides indispensable support.

In the E1 stage, DeepSeek helps students expand their thinking and pose more profound questions.

In the E2 stage, as a conversational partner, it guides students with Socratic questioning, diving deeper into the essence of the topic.

In the E3 stage, DeepSeek offers precise knowledge explanations, case analyses, and skill guidance.

In the E4 stage, it assists with debugging code, writing reports, and generating plans, working collaboratively to complete tasks.

In the E5 stage, DeepSeek helps organize logic, provides feedback and suggestions, and aids in critical reflection.

The teacher’s role shifts from the front to behind the scenes, transitioning from "lecturer" to "guide." Their main responsibility is to design high-quality learning tasks and pathways. When students encounter bottlenecks in their exploration, the teacher provides directional guidance, inspiration, and encouragement, rather than giving direct answers. The teacher focuses on students' learning states, offering humanistic care and value-oriented guidance, which AI cannot replace. A process-oriented evaluation system is designed to measure students' cognitive depth, skill level, and innovative thinking.

This model perfectly addresses the challenges of the AI era. Learning is no longer a uniform activity that takes place in a fixed classroom; instead, it is a personalized, inquiry-based learning process conducted by students in the company of AI partners and under the guidance of teachers.

4. Discussion and Outlook

The proposal of the DeepSeek-powered 5E teaching model is not only a response to the present but also a forward-looking approach for the future. As the dawn of AGI (Artificial General Intelligence) and even ASI (Artificial Superintelligence) gradually approaches, education must become more visionary.

Teachers must possess stronger interdisciplinary knowledge integration, curriculum design, and guidance skills. The focus of teacher development should shift from "how to teach knowledge" to "how to design learning experiences." In the AI era, where disciplinary boundaries are increasingly blurred, broad knowledge, critical thinking, cultural literacy, values, and creativity will become key advantages that distinguish humans from AI. These qualities also form the foundation of human leadership in human-AI collaboration. As most productive work is expected to be completed by AI in the future, the purpose of education will return to its essence — promoting holistic human development, helping learners discover themselves, and realize their full potential.

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References

[1] Ge, Kun, Xu, Haifeng, and Liu, Xiaoyuan. "The Current Status, Hotspots, and Frontiers of AI Teaching Research in Universities." Higher Education Forum, 06(2024): 13-18+82.
[2] Zhao, Hong, Guo, Yun, and Zhang, Jian. "Research and Practice on 'What to Teach,' 'How to Teach,' and 'How to Learn' in the AI Context — The Proposal of an Innovative Teaching Model." Chinese University Teaching, 05(2025): 79-87.
[3] Wu, Chengjun, and Zhang, Min. "The Connotation, Examples, and Essential Features of the American Biology '5E' Teaching Model." Curriculum, Teaching Material, and Teaching Method, 30.06(2010): 108-112.
[4] Hu, Jiuhua, and Gao, Chong. "Analysis of the 5E Teaching Model in China's Educational Practice and Its Research Progress Abroad." Chemical Education, 38.01(2017): 5-9.
[5] Zhao, Chengling, Zhao, Wenjun, and Jiang, Zhihui. "Design of the 5E Inquiry-Based Teaching Model for STEM Education." Modern Educational Technology, 28.03(2018): 106-112.

[6] Liu, Huiling, Tan, Dingying, and Chen, Pingping. "Application of the 5E Teaching Model Based on Knowledge Graph in C Language Teaching." Computer Knowledge and Technology, 21.13(2025): 136-139+156.
[7] Luo, Mei. "Discussion on the AI Teaching Transformation and Information Literacy Enhancement for College Foreign Language Teachers under the Smart Campus Context." Guangxi Education, 33(2024): 16-22.