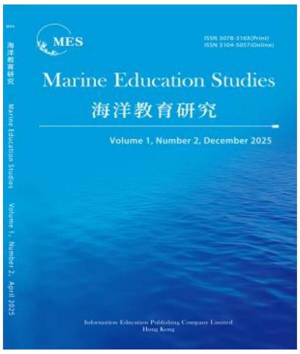

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AI-Enabled College Classroom Teaching: Exploration and Practice in the Course "Marine Engineering Introduction"

Xiao Liusheng

Abstract: The current development, existing challenges, implementation pathways, and practical exploration of Artificial Intelligence (AI) technology-enabled classroom teaching in colleges are explored in this paper. Firstly, the current state of AI-enabled classroom development and six core dilemmas are analyzed, then the implementation pathways including constructing a collaborative ecosystem, updating teaching philosophy, innovating teaching models, optimizing teaching content, and improving evaluation systems are summarized. Finally, taking the course "Marine Engineering Introduction" as an example, the paper details specific measures for AI-enabled teaching reform, including using AI for heuristic education, optimizing the presentation of teaching content, building student profiles for personalized tutoring, innovating online-offline integration, scenario-based role-playing, and project-case teaching models. The practice results indicate that this reform has significantly enhanced students' classroom engagement, learning interest, and comprehensive abilities, with both course average scores and diversified capabilities showing substantial improvement. This study provides a reference for a new paradigm of "human-machine collaboration" in intelligent education, promoting high-quality development of higher education in the future.

Keywords: AI-enabled classroom teaching; Marine Engineering Introduction; teaching reform; personalized learning; intelligent teaching

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题目：人工智能赋能高校课堂教学:《海洋工程概论》课程的探索与实践

摘要：本文探讨了人工智能技术赋能高校课堂教学的现状发展、现存挑战、实现路径及实践探索。首先，分析了人工智能赋能课堂的发展现状与六大核心困境；进而，从构建协同生态系统、更新教学理念、创新教学模式、优化教学内容、完善评价体系等方面总结了其实施路径；最后，以《海洋工程概论》课程为例，详细阐述了人工智能赋能教学改革的具体措施，包括运用 AI 进行启发式育人、优化教学内容呈现、构建学生画像与个性化辅导、创新线上线下融合、情景角色扮演及项目案例教学等模式。实践结果表明，该改革显著提升了学生的课堂参与度、学习兴趣及综合能力，课程平均成绩与多元化能力均呈现大幅提高。本研究为智能教育"人机协同"新范式提供了参考，助推未来高等教育高质量发展。

关键词：人工智能赋能课堂教学；海洋工程概论；教学改革；个性化学习；智能教学

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With the rapid development of Artificial Intelligence (AI) technology, its application in higher education has become increasingly widespread and in-depth. The "Outline of the Plan for Building an education-powered country (2024-2035)" clearly states the need to promote AI's role in transforming education. As pioneers in building an education-powered country, universities exploring effective pathways for AI-enabled classroom teaching is of great significance. AI's powerful capabilities in generative creation, deep understanding and interaction, autonomous decision-making and execution, massive data-driven insights, and complex recognition and prediction provide a foundation for the digital transformation of higher education, offering transformative power to break free from traditional educational constraints and return to the essence of education.

1. Current Status and Problems of AI-Enabled Classroom Teaching

1.1. Development Status

1.1.1 Differences and Characteristics in University Practices

At the university practice level, different types of institutions demonstrate differentiated exploration and characteristics. Comprehensive universities leverage their disciplinary breadth and resource advantages to achieve multidimensional breakthroughs: Peking University promotes strategic integration of AI and education through establishing an Artificial Intelligence Development Committee, a program for cultivating top talents, and interdisciplinary research platforms; Tsinghua University develops intelligent teaching assistant systems and integrates AI into traditional discipline simulation teaching; Shanghai Jiao Tong University builds an intelligent teaching platform and conducts virtual simulation experiments; Fudan University focuses on personalized learning and classroom interaction innovation; Zhejiang University creates an intelligent education ecosystem encompassing a smart teaching platform, intelligent tools, and a big data center; and Xi'an Jiaotong University emphasizes the construction of smart classrooms and online courses. Specialized universities leverage disciplinary strengths to form focused areas: Beijing University of Posts and Telecommunications advances "boundaryless university" construction through an "AI-EMS" linkage mechanism, with its "ICT Intelligent Teaching Platform" having been promoted to over 550 institutions; University of Electronic Science and Technology of China integrates AI into all aspects of electronic information disciplines, develops intelligent teaching assistants, and conducts virtual training; and Beijing Normal University focuses on intelligent education evaluation to provide a scientific basis for teaching improvement.

1.1.2 Application Coverage and Evolutionary Trends

From the perspective of application coverage and evolutionary trends, AI applications have expanded from initial fields such as computer science and information technology to all disciplines including science, engineering, humanities, and medicine, such as virtual experiments in science and engineering, text mining in humanities, and surgical simulation in medicine; course types have extended from specialized courses to general education and public basic courses, such as oral English assessment and interactive case discussions in ideological and political courses. In terms of development trends, the integration of AI and classroom teaching is moving toward deeper integration and personalization. The deep integration of large models, VR/AR, and IoT technologies will give birth to more innovative models and scenarios, intelligent teaching environments will be further upgraded, personalized learning will become mainstream, and interdisciplinary teaching will be better promoted with the help of AI.

1.1.3 Penetration Throughout the Teaching Process

AI penetration throughout the teaching process is deepening. Before class, intelligent lesson preparation systems integrate resources and assist teachers in optimizing teaching plans through learning situation analysis, such as Tsinghua University's intelligent lesson preparation assistant that can automatically generate lesson plans, and Shanghai Jiao Tong University's teaching management platform that provides learning situation reports to help teachers adjust strategies. During class, intelligent interactive devices enhance participation, virtual teaching assistants support management, AI speech technology assists language teaching, and VR/AR technologies create immersive environments, such as Beijing Institute of Technology's intelligent assistant, Peking University's English listening and speaking classroom evaluation system, and Xi'an Jiaotong University's medical virtual simulation platform. After class, AI generates learning reports through multi-source data, and intelligent question-answering systems provide 24-hour tutoring, such as University of Electronic Science and Technology of China's personalized homework system and Beijing University of Posts and Telecommunications' intelligent question-answering application.

1.1.4 Stage Achievements

Significant outcomes have been achieved in resource construction, model innovation, learning experience enhancement, and teaching evaluation upgrading. In resource construction, numerous digital teaching materials and online course resources have been developed, and educational resource sharing platforms have promoted the sharing of high-quality resources among universities, such as Fudan University's digital teaching materials and the "China University MOOC" platform. In model innovation, inquiry-based, participatory, and blended teaching models have been advanced, such as Peking University's problem scenario creation and Zhejiang University's online-offline integration. In learning experience, personalized recommendations meet differentiated needs, and immersive environments enhance learning interest, such as Beijing Normal University's intelligent learning system and Shanghai Jiao Tong University's AR history course. Teaching evaluation has been upgraded by introducing multiple evaluation subjects and comprehensive evaluation content, such as Tsinghua University's multi-subject evaluation and Xi'an Jiaotong University's combination of process and result evaluation.

1.2. Existing problems of AI-Enabled classroom teaching

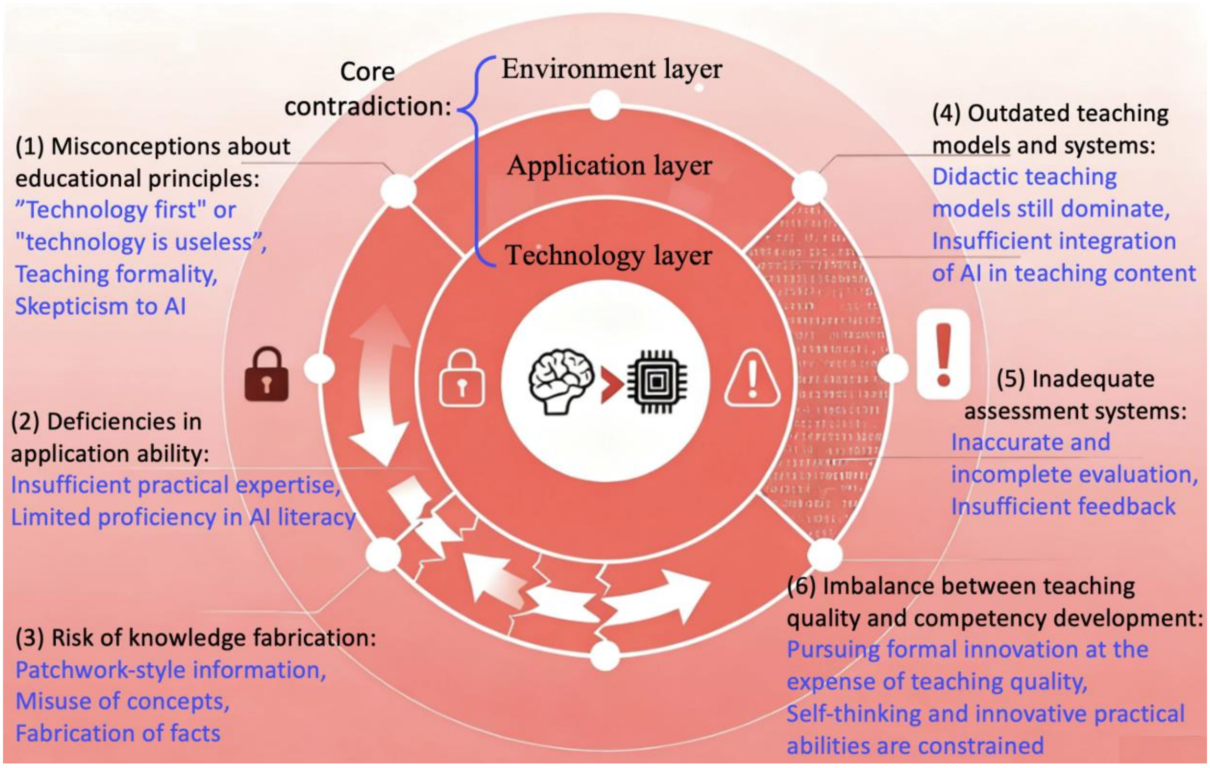


Figure 1 Existing problems in AI-enabled classroom teaching

1.2.1 Conceptual and Cognitive Biases

Some university teachers and administrators have insufficient understanding of the concept of AI-enabled classroom teaching, holding two extreme views: “technology first” or “technology is useless”. Some over-rely on AI technology, neglecting that the essence of education is cultivating people, and in teaching pay excessive attention to showcasing technology while ignoring students' emotional experience, humanities cultivation, and value shaping, resulting in teaching becoming a mere formality. Others adopt a skeptical and resistant attitude toward AI technology, believing it will replace teachers, and refuse to accept its application in teaching, hindering the innovation and development of teaching models (Yang et al., 2025:11). Furthermore, some students have misunderstandings about AI-assisted learning, believing that with AI assistance they can relax their requirements, over-rely on AI to obtain answers and complete learning tasks, and lack independent thinking and exploration spirit.

1.2.2 Application Ability Shortcomings

Many teachers lack sufficient AI technology application capabilities. Although some universities have carried out AI technology training, the content often focuses on technical operation, making it difficult for teachers to effectively integrate AI with teaching content and methods. Some teachers cannot proficiently use digital tools such as intelligent assessment systems and virtual simulation technologies, affecting the effectiveness of AI-enabled classroom teaching (Zhang, 2025:18). In addition, due to differences in family background and previous educational experience, students have varying digital literacy and AI tool usage abilities, encountering difficulties when using intelligent learning platforms and participating in AI-assisted teaching activities, which prevents them from fully enjoying the learning convenience brought by AI technology and affects the overall teaching effect.

1.2.3 Risk of Knowledge Fabrication

AI-generated content has accuracy and reliability issues, bringing the risk of knowledge fabrication to classroom teaching. AI-generated text may have problems such as "patchwork" information presentation, "dice-rolling" algorithm mechanisms, and output text that is difficult to trace, with generated knowledge and information possibly lacking structure, having weak connections, and even containing concept misuse and factual fabrication (Zhang&Liu, 2025:7). In classroom teaching, if teachers directly apply AI-generated content without careful verification, they may transmit incorrect knowledge to students, affecting their knowledge construction (Han&Cai, 2025:6). Meanwhile, students who over-rely on AI to obtain knowledge may accept unverified information, leading to misunderstandings and inhibiting the development of independent thinking and knowledge exploration abilities.

1.2.4 Lagging Teaching Models and Systems

Currently, university classroom teaching models still lack sufficient innovation under AI empowerment. Traditional lecture-based teaching models still dominate, with AI technology applications mostly remaining at the auxiliary level and failing to achieve fundamental transformation of teaching models. Furthermore, intelligent technology integration is insufficient, classroom interaction models are single, and students' sense of participation and learning enthusiasm are low, failing to effectively use intelligent technology to achieve true teaching model innovation (Chen&Wu, 2025:6). In terms of teaching systems, the integration of teaching objectives, content, methods, and evaluation with AI technology is not well-coordinated, with insufficient connection and linkage between various elements.

1.2.5 Imbalance Between Teaching Quality and Competency Development

Although AI has improved teaching efficiency to some extent, the improvement in teaching quality is not significant. Some universities, when applying AI technology, pursue formal innovation while neglecting the core of teaching quality—the mastery of knowledge and development of abilities by students. Teaching content and methods are disconnected from the development of digital and intelligent technologies, with knowledge learned by students during school differing from actual enterprise needs, affecting students' employability (Liu, 2025:6). In terms of competency development, AI technology application has not effectively promoted the development of students' higher-order thinking abilities, innovation capabilities, and practical skills. Over-reliance on AI to generate answers and solutions has led to students lacking the ability to think independently and solve complex problems. Excessive use of virtual simulation experiments may cause students to neglect the cultivation of actual operation abilities.

1.2.6 Incomplete Evaluation Systems

The incomplete teaching evaluation system is an important issue facing AI-enabled classroom teaching. Traditional teaching evaluation mainly focuses on exam scores, making it difficult to fully reflect students' learning situation and ability development. Current evaluation methods have problems such as low operability and insufficient accuracy in process evaluation and comprehensive ability assessment, making it impossible to accurately measure students' learning outcomes in the digital and intelligent context (Li&Huang, 2025:3). Although AI provides new means and methods for teaching evaluation, many problems remain, such as some evaluation tools being unable to accurately capture students' performance in complex learning environments, the risk of data leakage and abuse caused by the large-scale collection and analysis of students' learning data, and the failure to effectively use evaluation results to provide feedback for teaching improvement.

2. Analysis of Implementation Paths in China Universities

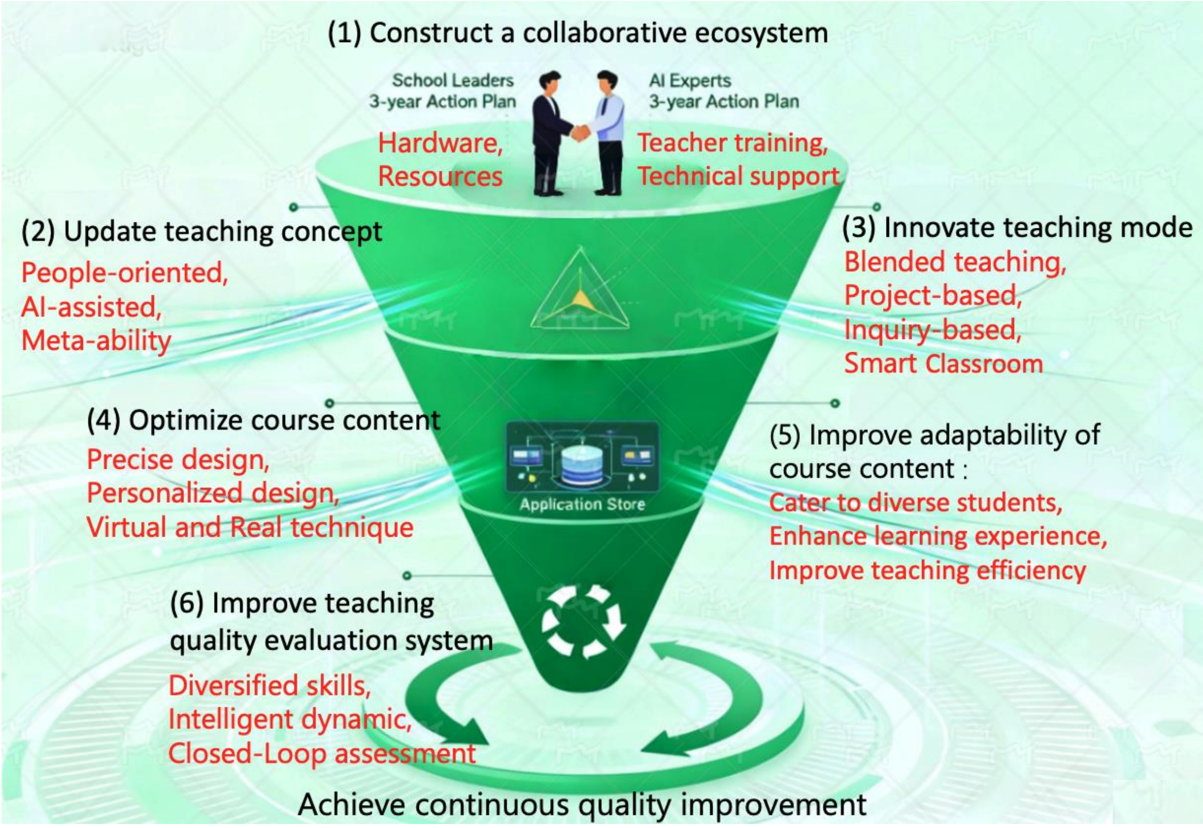


Figure 2 Summary of implementation paths for AI-enabled classroom teaching in universities

2.1. Constructing a Collaborative Ecosystem

Universities should increase investment in intelligent teaching environments, fully construct teaching spaces such as smart classrooms, intelligent laboratories, and intelligent libraries, and reasonably configure diverse resources such as intelligent teaching terminals and platforms to provide hardware support for AI technology application (Du&Liu, 2025:6). Through industry-education integration and ecosystem co-construction, resources from institutions, enterprises, and industry associations should be integrated, with the three parties working together to build course resource libraries and share high-quality AI education resources (Jiang&Quan, 2025:19). Through diverse training, team building, and teaching competitions, teachers' abilities in digital teaching resource construction and intelligent teaching method application should be enhanced (Xu et al., 2025:13). Developing high-quality "AI+" boutique courses requires joint efforts from educational decision-makers and frontline university teachers, continuously promoting the digital transformation of university courses through education and training, practical exploration, and experience sharing (Zhang&Zou, 2025:8).

2.2. Updating Teaching Philosophy

Educators should recognize that AI technology is a tool for assisting teaching rather than replacing teachers, and that the essence of education remains cultivating students' comprehensive qualities and abilities. As AI can search and reorganize human knowledge repositories in nanoseconds, the core competitiveness of education is shifting toward cultivating non-computable "meta-competencies"—creative imagination, complex emotional cognition, and ethical value judgment. This forces the education system to transition from a knowledge transmission paradigm to a wisdom cultivation paradigm (Huang, 2025:1-2)&(Zhong, 2025:2). Furthermore, teachers should establish a student-centered teaching philosophy, using AI technology to meet students' personalized learning needs and promote their all-round development. At the same time, they should avoid over-reliance on technology, give play to teachers' leading role and humanistic care, and enhance students' initiative (Guo, 2025:008).

2.3. Innovating Teaching Models

Combining online learning with offline teaching, AI can provide personalized learning resources and tutoring for online learning, monitor course learning in real-time, and conduct intelligent group discussions, while offline classes focus on teacher-student interaction, group discussions, and practical operations (Chen&Wu, 2025:6). AI can assist students in project design and interdisciplinary teaching, guiding them to apply multi-disciplinary knowledge to solve project problems and improving their comprehensive knowledge application and problem-solving abilities (Cui&Xu, 2025:4). AI can create problem scenarios to guide students' independent exploration and thinking, continuously present meaningful questions during class, and involve both teachers and students in a "doing research" style teaching process to cultivate students' research thinking and innovation abilities (Guo, 2025:008). AI digital and intelligent technologies can combine with VR/AR to build simulation environments (such as virtual maritime navigation) to enhance practical experience (Li, 2025:9).

2.4. Optimizing Teaching Content

Adjusting the difficulty and depth of teaching content according to students' knowledge weaknesses and cognitive levels, AI technology can accurately identify students' mastery of various knowledge points and potential learning obstacles through learner modeling and prediction models, with intelligent recommendation algorithms providing adaptive learning services, transforming teaching from the traditional teacher-centered approach to a learner-centered one and meeting students' personalized learning needs (Zhang, 2025:18). Teachers can use AI technology to analyze students' classroom participation, homework completion and knowledge mastery, adjusting course content accordingly to improve teaching precision. Combining with Virtual Reality (VR) and Augmented Reality (AR) technologies, AI creates immersive learning environments, and in science, engineering and medical education, virtual simulation experiments allow students to conduct practical operations in safe and economical environments (Li, 2025:9).

2.5. Improving Teaching Quality Evaluation System

Constructing a "knowledge + abilities + literacy" indicator system that not only focuses on students' knowledge mastery but also on their comprehensive qualities such as innovation ability, practical ability, and collaboration ability, creating a reasonable and comprehensive evaluation "baton". Using AI to implement dual dynamic process evaluation for both teachers and students, through building an intelligent teaching interaction evaluation system that integrates multiple data collection tools to record teacher-student interaction behaviors and student participation, generating detailed interaction evaluation reports, and enabling teachers to develop targeted interaction improvement strategies. A data-driven AI evaluation system realizes the transformation from static evaluation to dynamic evaluation and real-time monitoring of process evaluation (Bai, 2025:16). Furthermore, feedback and application of evaluation results should be strengthened, promptly providing results to teachers and students to help teachers improve teaching methods and strategies and guide students to adjust learning plans and methods.

3. Classroom Practice—Taking "Marine Engineering Introduction" as an Example

The "Marine Engineering Introduction" course in the Ship and Ocean Engineering major faces three teaching pain points. (1) Content dimension: The single and boring PPT presentation format and lack of interesting and interactive teaching resources make it difficult to stimulate students' learning interest; (2) Model dimension: The long-term rigid teaching model results in insufficient classroom interaction, low student engagement, and limited knowledge absorption efficiency; (3) Ability dimension: The path for cultivating students' innovative practical abilities is unclear, and personalized learning needs are difficult to be accurately met. Therefore, reforming AI-enabled classroom teaching is urgently needed.

3.1. Reform Measures

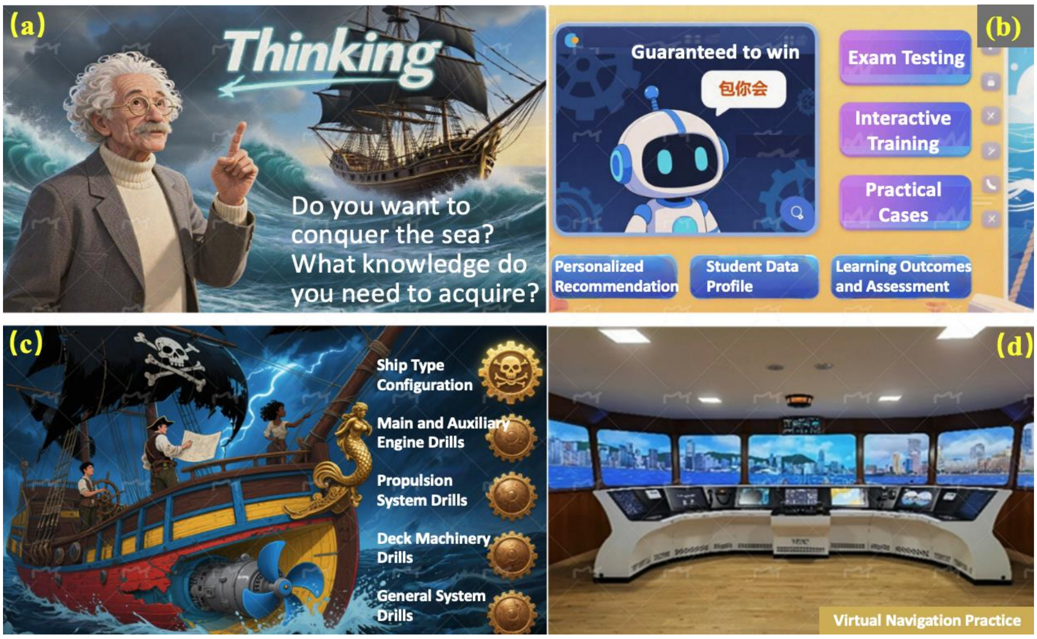


Figure 3: Reform ideas for AI-enabled classroom teaching: (a) "Face-to-face with celebrities" heuristic education, (b) "Teaching-learning-evaluation" intelligent assistant, (c) Modular interactive training library, (d) Marine vessel virtual navigation system

3.1.1 **Updating teaching philosophy**

Clarify that AI is an auxiliary teaching tool, with the core being cultivating students' "meta-competencies" and promoting the transformation from knowledge transmission to wisdom cultivation. Adopt the "face-to-face with ancient and modern celebrities" approach, developing heuristic scenario vlogs featuring mentors such as Einstein, Newton, and Caribbean pirates to guide students to think actively and learn independently. The specific steps are: design scenarios, raise questions, guide thinking, provide frameworks, mark key and difficult points, and emphasize significance and value. Furthermore, students' subjective initiative should be stimulated through homework assignments that encourage them to use popular AI tools to independently design case-based vlog scenarios integrating learned knowledge with interdisciplinary elements and innovative ideas, conducting independent research and designing a case scenario microfilm as extra credit, fully practicing the teaching philosophy of "guiding students to learn independently and efficiently".

3.1.2 **Optimizing teaching content**

Optimizing teaching content design requires precision, diversity, modernity, and dramatization, covering main knowledge points while making interesting courses to increase students' interest and knowledge mastery. Lesson plan PPTs should integrate "images-text-videos", highlight key and difficult points, have clear knowledge graph structures, reasonable pacing, scientific interaction design, and intersperse cutting-edge hot topics to create an engaging first classroom experience. Furthermore, responding to students' demand for "short, flat, and fast" knowledge acquisition, scene theaters and vlog designs should be added, integrating course knowledge points into microfilm vlog styles popular among young people, such as a scenario where Captain Jack Sparrow encounters a severe storm or grounding and needs to coordinate with the chief engineer, first mate, electrician, and deck crew to work together. Or scenarios where a famous shipping magnate introduces their maritime kingdom, different ship types, and international conventions, while the chief engineer and other crew members explain internal and external structures and power systems, making knowledge transmission interesting and vivid.

3.1.3 **Student personalized portraits and evaluation mechanisms**

Student-centered, using AI technology to meet individual needs and enhance student initiative and educational effectiveness, creating an intelligent second classroom. Develop engaging "teaching-learning-evaluation" intelligent question-answering and evaluation assistants, virtual scene two-dimensional robot dialogue systems, and modular training libraries covering textbooks, test questions, and practical cases. Pushing personalized test questions and virtual teacher answering scenarios according to students' different learning outcomes and progress. AI analyzes student data to build portraits, evaluates learning effectiveness, and pushes personalized learning paths and resources, realizing the shift from teacher-centered to learner-centered teaching. This requires university-level planning and construction of hardware and software platforms, which will be further implemented in the near future.

3.1.4 **Innovating teaching models**

Integrating online and offline advantages, AI provides personalized resources and tutoring, with online learning focusing on interaction, practice, and thinking guidance, while offline classes and on-board practice focus on key and difficult points and cultivating innovative practical abilities. Combining with VR technology to achieve virtual-real integration and immersive environments, enhancing students' practical abilities through experiences with large ship handling simulators, navigation simulators, main propulsion system simulation platforms, and main engine disassembly simulation platforms. Conducting project-case learning, with scientific research feeding back into teaching by condensing teachers' research projects into classroom teaching cases, implementing inquiry-based analytical discussions, using AI to create scenarios that involve both teachers and students in a "doing research" style of teaching, cultivating students' interdisciplinary knowledge integration, problem analysis and solving abilities, and innovative practical skills.

3.2. Practical Results

Evaluating learning outcomes should consider multiple dimensions, including learning enthusiasm, learning autonomy, academic performance, logical thinking, teamwork, and innovative practical abilities. A comprehensive assessment can more scientifically reflect teaching effectiveness and provide feedback for optimizing future teaching practices. Figure 4 shows the "process-result" learning effect evaluation, including learning process, academic performance, and other diversified abilities. It can be seen that the student engagement rate is nearly 100%, with classroom activity and participation close to 90%, more than double the previous 30%, and students' interest and enthusiasm have increased dramatically. Comparing the exam scores on core chapter content over the past five years, after the AI-enabled classroom teaching reform, the score concentrated above 90 points is significantly increased, and the scores between 60-70 points are grammatically decreased.

Most notably, as AI empowers various industries worldwide, students' diversified abilities have become increasingly important, including understanding of cutting-edge developments, AI tool usage, scientific research thinking logic, interdisciplinary knowledge integration ability, innovative practical ability, teamwork ability, and self-driven learning ability. It can be seen that after this classroom teaching reform, multiple abilities have been improved comprehensively and significantly by about 50%, which will better cultivate more high-quality talents meeting the needs of the new era.

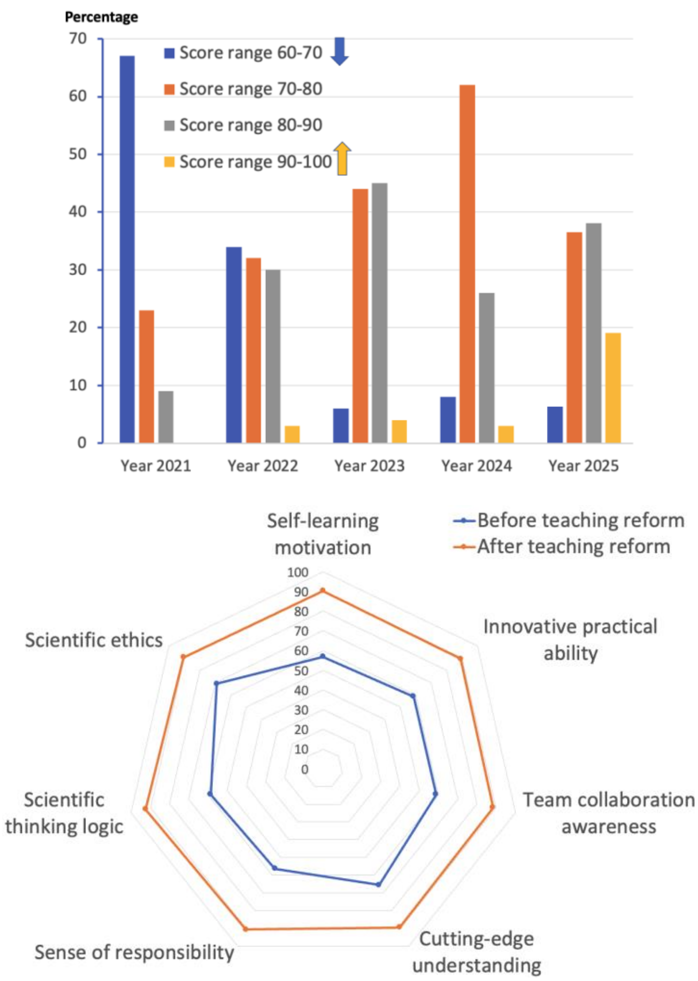


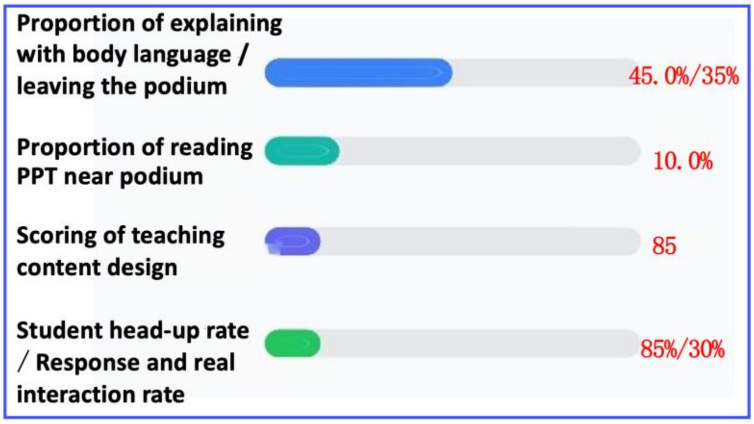
Figure 4 Teaching practice effects: (a) Comparison of student performance over the past five years-knowledge mastery, (b) Evaluation of diversified abilities including self-driven learning, scientific thinking, teamwork, and innovative practice.

3.3. AI-Enabled Rapid Video Analysis and Teacher-Student Behaviors Evaluation

The integration of AI into classroom teaching has enabled rapid video analysis to intelligently evaluate teacher-student behaviors. As demonstrated in Fig. 5(a), AI algorithms can automatically extract and quantify key indicators: the proportion of time spend on explaining with body language (45.0%), the proportion of time leaving the podium (35%), the proportion of time reading PPT while stationary near the podium (10.0%), the scoring of teaching content design (85), students’ head-up rate (85%), and effective response and interaction rate (30%). These quantifiable metrics offer objective data for assessing classroom teaching behaviors.

Fig. 5(b) conceptualizes the interactive relationship among teacher behavior, teaching content, and student behavior. AI-driven video and behavioral analysis allows us to explore how teacher behaviors (e.g., utilization of body language and lecture mobility), teaching content design, and student behaviors (e.g., attention and interactive engagement) interact. This analysis can preliminarily unveil the mapping relationships among these three dimensions, providing a basis for understanding the mechanisms of effective teaching.

Looking forward, while current AI-based analysis can roughly identify and calculate these indicators to analyze the relationship among "teacher behavior–student behavior–teaching content design" and support continuous improvement of classroom teaching, deeper explorations are needed. Future research should focus on identifying valid indicators that truly reflect the quality of teaching effectiveness and establishing their evaluation criteria. Based on this, an AI-empowered platform for the precise capture, analysis, and quantitative evaluation of teacher-student behaviors in classroom teaching should be developed. Eventually, this platform should be personalized and promoted across different types of courses with distinct characteristics, thus facilitating data-driven and tailored advancements in teaching practices.



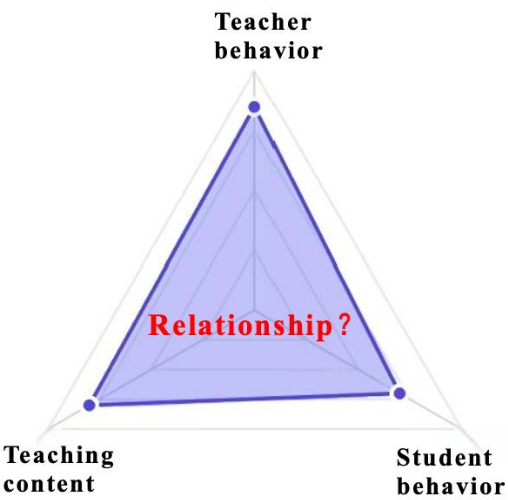


Figure 5 (a) Quantitative visualization of key Indicators for Teacher-Student Behaviors in AI-Enabled Classroom Teaching, (b) Relationship concept of teacher behavior, teaching content and student behavior, revealing the interactive mechanisms of effective teaching

4. Conclusions and Prospects

This study takes the "Marine Engineering Introduction" course as an entry point to systematically explore the paths and models of AI-enabled classroom teaching. By constructing a "meta-competency" oriented teaching philosophy, integrating online and offline advantages, and innovatively adopting methods such as "face-to-face with celebrities" heuristic education, knowledge-point integrated vlog design, "teaching-learning-evaluation" intelligent assistants, project-case learning, and virtual simulation practice, a comprehensive transformation of the entire teaching process has been achieved. The practice results indicate that this model has significantly improved students' classroom participation, learning interest and comprehensive abilities. The score concentrated above 90 points is significantly increased, the scores between 60-70 points are grammatically decreased, and diversified abilities are improved by more than 50%, providing an operable practical model for university AI-enabled teaching reform.

In the future, the practice scope will be further expanded, interdisciplinary and project-based learning will be deepened, and a new paradigm of "human-machine collaboration" in intelligent education will be constructed. At the same time, efforts should be made to improve the verification mechanism and academic standards for AI-generated content, strengthen student data privacy protection, and establish a sound ethical and governance framework for AI education applications, using technological innovation to continuously promote high-quality education development.

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