Research on Empowering Classroom Teaching Mode of "Mechanical Design" with Generative Artificial Intelligence Technology

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Abstract: This article proposes a reform framework for the teaching mode of Mechanical Design, which is empowered by generative artificial intelligence technology, to address the problems of knowledge abstraction, limited practical scenarios, and single evaluation dimensions in traditional classroom teaching of "Mechanical Design". Through the development of course teaching resources based on DeepSeek, the construction of a course teaching evaluation system, and the application of a combination of virtual and real teaching methods, this study explores the reform of the classroom teaching mode of "Mechanical Design", providing a technological path and teaching paradigm for the digital transformation of mechanical courses that can be referenced. This study is not only the application of technical tools, but also a deep reshaping of the teaching philosophy, process, and evaluation of "Mechanical Design". It can effectively stimulate students' innovative potential and cultivate their comprehensive ability to solve complex engineering problems. The formed "AI empowered" teaching model paradigm can provide a replicable and promotable practical path and theoretical reference for the digital and intelligent teaching reform of similar engineering courses under the background of new engineering.

Keywords: Generative AI; DeepSeek; Mechanical Design; Classroom Teaching Mode; Teaching Reform

1. Introduction

With the rapid development of technology, generative artificial intelligence technology is gradually penetrating into various fields, and the education sector is also facing new opportunities and challenges [1,2]. In higher education, the traditional classroom teaching mode of "Mechanical Design" mainly relies on teacher lectures, with students passively receiving knowledge. This mode has certain limitations in cultivating students' innovative thinking and practical abilities.

"Mechanical Design", as a core course in mechanical engineering, has strong comprehensiveness and practicality. However, there are some issues in the current teaching process. On the one hand, the teaching content is relatively abstract, and students have difficulty understanding complex mechanical structures and design principles. Traditional teaching methods are difficult to effectively stimulate students' interest in learning. On the other hand, in practical engineering applications, mechanical design requires continuous innovation and optimization, and traditional teaching methods are inadequate in cultivating students' innovative design abilities. Generative artificial intelligence technologies, such as DeepSeek, have powerful capabilities in data analysis, image generation, intelligent interaction, and more. Introducing it into the classroom teaching of "Mechanical Design" is expected to provide a new way to solve the above problems. By utilizing the advantages of DeepSeek, abstract teaching content can be visualized, helping students better understand the principles of mechanical design; it is also possible to stimulate students' learning initiative and cultivate their innovative thinking and practical abilities through intelligent interaction with them. Therefore, exploring the reform of classroom teaching mode for "Mechanical Design" based on DeepSeek has important practical significance.

Therefore, we will propose reasonable solutions to the problems of abstract teaching content and poor teaching effectiveness in

traditional "Mechanical Design" teaching. We plan to use the latest DeepSeek platform in generative artificial intelligence technology to develop visual teaching resources that are deeply integrated into specific teaching processes, gradually improving students' innovative thinking abilities, exploring new models for cultivating innovative application talents in mechanical engineering majors, and providing reference for the development of informationization in other engineering majors. This will lay the foundation for the integration of artificial intelligence technology and engineering education, promote the improvement of practical teaching level in engineering majors in our province, enrich the practice of deep integration of generative artificial intelligence technology and future university education and teaching. Therefore, the research work in this article has significant practical significance.

2. Current Research Status at Home and Abroad

The concept of artificial intelligence (AI) has had a natural connection with education and teaching since its inception. It has played an important role in innovating teaching models, optimizing educational management, building an educational ecosystem, and promoting educational development. In recent years, some schools have begun to use artificial intelligence tools to assist in the teaching of "Mechanical Design" courses in engineering education. For example, by combining virtual reality (VR) and augmented reality (AR) technologies with artificial intelligence, an immersive learning environment can be provided for students to better understand mechanical structures and design processes. Using Generative Adversarial Networks (GANs) to generate preliminary sketches of mechanical design schemes, providing creative inspiration for designers. Meanwhile, some intelligent tutoring systems utilize natural language processing technology to interact with students, answer their questions, and guide them to think and explore. In addition, some intelligent teaching systems can provide personalized learning advice and guidance based on students' learning situations and characteristics. For example, well-known universities such as Stanford University and Massachusetts Institute of Technology in the United States, as well as the Open University in the United Kingdom, have successively added teaching content based on virtual simulation in some online open courses [3,4]. It can be said that in the field of AI enabled information-based teaching, developed Western countries led by the United States are at the forefront of the world. In recent years, Chinese universities have also gradually attached importance to information-based teaching. In 2019, the Ministry of Education put forward a major measure of "promoting the deep integration of educational information technology and education teaching". Many universities and scholars at home and abroad have also conducted exploratory research on the integration of artificial intelligence technology with information-based teaching [5-7]. Liu et al. [8] elaborated on the ideas of information technology teaching construction from several aspects, including connotation, main line, and approach, based on the perspective of talent cultivation goals and sharing of practical teaching resources. Shen [9] proposed a teaching reform plan for civil engineering courses empowered by generative artificial intelligence, based on curriculum content reform that closely meets professional needs, combined with diversified teaching methods such as classroom practice activities driven by generative artificial intelligence and independent exploration after class. Pan et al. [10] used modern physics experiment courses and ChatGPT 4 language model as examples to systematically analyze the opportunities and challenges faced by the application of generative artificial intelligence in traditional physics experiment teaching from multiple dimensions such as teachers, students, experimental equipment, and experimental environment. At present, there is relatively little research in China on the deep application of generative artificial intelligence technology, especially emerging technologies like DeepSeek, in the reform of the classroom teaching mode of Mechanical Design. Most research is still in the exploratory stage and has not yet formed a systematic and mature teaching model and method.

These studies provide reference for the research in this article, but there is a lack of cases that further refine and apply generative artificial intelligence technology to the teaching of mechanical engineering. At the

same time, there is a lack of mature theoretical models on how to apply generative artificial intelligence technology to classroom teaching. The course of "Mechanical Design" serves as a bridge for students in this major to transition from theoretical courses to researching practical problems in mechanical engineering technology. It plays a crucial role in cultivating students' innovative thinking, practical skills, teamwork, and other application abilities. We plan to conduct research on the classroom teaching of "Mechanical Design", elaborating on the student-centered construction concept, and combining generative artificial intelligence technology to plan the construction content based on DeepSeek's "Mechanical Design" teaching resource development, teaching method innovation, and teaching evaluation system construction. We will highlight the cultivation of students' independent innovative design, teamwork, and practical ability to solve engineering problems, and explore a new teaching mode for "Mechanical Design" based on DeepSeek.

3. Research Content

3.1 Develop Teaching Resources for "Mechanical Design" Based on DeepSeek

Utilize DeepSeek's image generation function, develop visual teaching resources for mechanical design, and build a virtual simulation teaching platform. Such as 3D models of mechanical parts, motion simulation animations, etc., help students better understand mechanical structures and motion principles. Introducing high-quality enterprise resources from the industry, innovating teaching modes on the DeepSeek technology-based virtual simulation teaching platform for "Mechanical Design", conducting project training for students through real enterprise cases, and allowing experienced enterprise engineers to participate in guiding students' virtual simulation teaching. Our teachers lead students to participate in the development of real enterprise projects together.

3.2 Build a Teaching Evaluation System for "Mechanical Design" Based on DeepSeek

Establish a diversified teaching evaluation index system that includes not only traditional exam scores, but also students' performance in classroom interaction, project practice, innovative design, and other aspects in the evaluation scope. Using DeepSeek to analyze students' learning process data, such as learning time, learning behavior, homework completion status, etc., to achieve real-time monitoring and dynamic evaluation of students' learning situation, providing a basis for teaching improvement. Starting from the objectivity and scientificity of evaluation, a teaching evaluation system is constructed that includes four aspects: evaluation subject, evaluation object, evaluation content, and evaluation criteria. This system forms a closed loop for all aspects of virtual simulation teaching based on DeepSeek, which is conducive to the continuous improvement of teaching effectiveness.

3.3 Innovate the Teaching Method of Combining Virtual and Real Elements in "Mechanical Design"

Based on DeepSeek, combining DeepSeek technology, guide students to apply mechanical design knowledge and skills in project practice, and cultivate their innovation and practical abilities. Carry out problem-based teaching, use DeepSeek to propose inspiring questions, stimulate students' thinking and exploration desires, and improve students' problem-solving abilities. Adhere to the principle of combining reality with virtuality and promoting each other, and focus on the collaborative implementation of knowledge transmission, ability cultivation, and quality improvement. Enrich teaching content and forms, visualize abstract textbook knowledge through virtual scenes, and integrate knowledge points to enhance students' interest in learning.

4. Research Approach

The basic idea of this article is shown in Figure 1. Through the cooperation between schools and enterprises to jointly establish industry colleges, high-quality projects and human resources from enterprises are introduced, and teachers and students from our school are encouraged to participate in the secondary development of projects. Both schools and enterprises jointly complete the construction of a virtual simulation experimental teaching platform and management evaluation system based on Deepseek technology. Then, based on this

resource platform, innovative practical teaching methods combining virtual and real are developed, and a virtual simulation practical teaching evaluation system is constructed. After completing basic practical training, students can further organize virtual simulation project competitions, cultural exchanges, and other activities based on Deepseek technology, in order to improve the reform of the virtual simulation teaching mode of "Mechanical Design" empowered by Deepseek technology led by industry colleges.

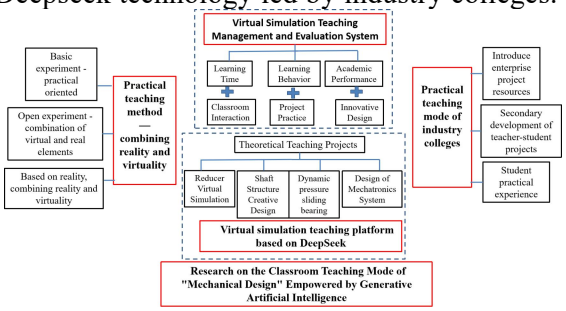

Figure 1. Framework Diagram of Research Ideas for this Project

The specific research methods and steps include:

(1) Establishment of a virtual simulation platform and evaluation system for "Mechanical Design" based on DeepSeek

The virtual simulation platform consists of modules such as information management system and experimental teaching application system. The information management system includes user management, course management, etc. The experimental teaching application system is a virtual simulation experiment system based on DeepSeek technology, where students can conduct virtual experiments such as virtual design, motion simulation, virtual assembly, and virtual measurement. The virtual simulation experiment teaching management and evaluation system includes various virtual experiment plan arrangements, experiment preview appointments, experiment approval and execution, experiment score evaluation, etc.

(2) Exploration of virtual simulation teaching mode combining reality and reality

Innovate new methods and models of practical teaching on the required virtual simulation resource platform. Grasp the balance between virtual simulation experiments and real experiments in the teaching of "Mechanical Design", complement each other in the practical teaching process, combine reality and virtuality, and ensure that reality is not virtual. The final effect of online virtual simulation experiments is tested through offline practice, and this promotes mutual improvement between the two. Guide students to stimulate their interest, fully implement the student-centered concept, and focus on cultivating students' abilities in independent hands-on, teamwork, and application innovation.

5. Conclusion

This article explores the integration mechanism of artificial intelligence technology and engineering education curriculum by applying DeepSeek technology to the teaching of "Mechanical Design", providing new cases and empirical research for the development of artificial intelligence education application theory. From the perspective of generative artificial intelligence technology, this study explores how to optimize the teaching content, methods, and evaluation of "Mechanical Design", providing new ideas and methods for course teaching research. By using DeepSeek technology to develop a virtual simulation teaching platform, exploring a virtual simulation teaching mode that combines reality and virtuality, and constructing a teaching system that meets the needs of cultivating innovative talents, it is beneficial to enhance the comprehensive literacy of mechanical engineering students, such as thinking innovation ability and practical collaboration ability. By reforming the teaching model based on DeepSeek, we aim to stimulate students' innovative thinking and practical abilities, enabling them to better grasp the principles and methods of mechanical design, and cultivate mechanical professionals with innovative and practical abilities. This meets the urgent need for engineering education certification to cultivate innovative talents and has certain practical value.

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