Research on the Teaching Reform of Engineering Drawing Course Based on AI Technology

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Abstract: *With the rapid development of artificial intelligence (AI) technology and its wide application in the field of education, the traditional teaching model is being gradually overturned, showing a trend of developing towards intelligence, digitalization and personalization. Engineering drawing course, as a basic course in engineering education, aims to cultivate students' mastery of the basic theories, skills and standard norms of engineering drawing. Traditional teaching methods and means have many limitations in knowledge transmission, interaction methods and personalized support, resulting in insufficient learning interest of students and uneven spatial imagination. However, AI technology, combined with virtual reality technology (VR), can effectively solve the above problems. In the engineering drawing course, AI technology can assist teaching from aspects such as intelligent guidance, graphic recognition and automatic evaluation, personalized learning path recommendation, virtual simulation and intelligent Q&A, which can effectively enhance students' learning interest, optimize learning effects and improve students' practical abilities.*

Keywords: *Artificial Intelligence Engineering, Engineering Drawing, Personalized Learning, Virtual Reality Technology*

1. Introduction

The "Engineering Drawing" course is an introductory course for engineering majors and one of the compulsory basic courses. Generally, engineering drawing is referred to as the language of the engineering field [1]. The main purpose is to cultivate students' spatial thinking ability, master the basic methods and norms of engineering drawing, and lay a solid foundation for subsequent professional courses. The main contents include the drawing of geometric figures, the conversion of three views, the analysis and expression of spatial shapes, etc [2]. At present, the traditional engineering drawing course teaching mostly adopts paper textbooks and two-dimensional CAD software. The teaching methods are monotonous, the classroom interaction is poor, and the effect of students' spatial thinking training is uneven. They cannot smoothly complete the understanding and switching between two-dimensional space and three-dimensional space. There is a lack of real-time feedback during the learning process, which makes it difficult to guarantee the learning effect. In the face of the transformation of educational informatization in the new era, how to enhance the teaching quality of engineering drawing courses and students' learning outcomes by leveraging artificial intelligence (AI) technology has become a hot issue at present.

Artificial Intelligence (AI) is a discipline that studies the use of computers to simulate certain human thinking processes and Intelligent behaviors (such as learning, reasoning, thinking, planning, etc.), creating computers with intelligence similar to that of the human brain, enabling computers to achieve higher-level applications [3]. Artificial intelligence will involve disciplines such as computer science, psychology, philosophy and linguistics. Artificial intelligence is a new technological science at the technical application level of thinking science, which is used to simulate and expand human intelligence through theories, methods, technologies and application systems. It has become a strategic technology leading the future. With the development of artificial intelligence technology in recent years, artificial intelligence has brought positive changes to modern society. AI technology can provide various intelligent teaching supports for mechanical drawing courses, such as automatic graphic recognition, better understanding of the conversion between two-dimensional and three-dimensional Spaces with VR technology, personalized learning effect evaluation, virtual simulation and interactive Q&A, etc. These teaching supports not only effectively enhance the quality of classroom teaching, but

also provide students with real-time learning guidance and intelligent assessment functions, helping them understand complex engineering graphics concepts more intuitively and master the skills of mechanical design and drawing in practice.

2. Problems existing in the traditional teaching of the "Engineering Drawing" course

2.1 The teaching method is monotonous

Traditional engineering drawing teaching mainly relies on classroom lectures by teachers, with students passively accepting knowledge. Teachers unidirectionally impart knowledge to students on the podium, ranging from the composition of points, lines and surfaces to various complex three-view diagrams, such as intersecting bodies, combined bodies and part diagrams, all mainly through teachers' explanations, blackboard drawing and PPT presentations. This approach lacks effective interaction with students, who are often in a passive state of accepting knowledge. Three views of the combination is shown in Figure 1.
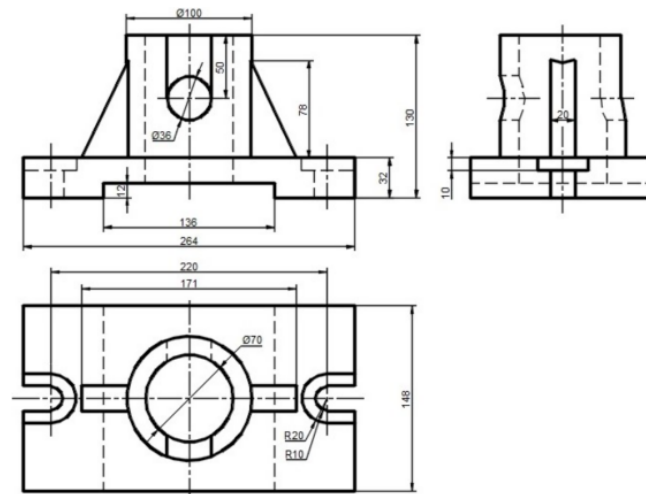
Figure 1 Three views of the combination

2.2 Teaching resources are limited

Students have weak spatial thinking ability and insufficient understanding of the structure of complex products. The traditional teaching method of mechanical drawing often uses teacher's blackboard writing, PPT courseware, viewing drawings or wooden models. From the actual effect, students still feel abstract and not intuitive.Teaching overly relies on textbooks, the update speed of textbook content is slow, and it is mostly presented in the form of text and static pictures. For some abstract and complex shapes, it is difficult for students to connect three-view diagrams with three-dimensional solids through spatial imagination. Students who use exercise books to draw by hand or the 2D drawing software CAD for practice cannot effectively cultivate and exercise their spatial thinking ability, resulting in uneven levels of students' abilities.

2.3 The learning evaluation is not perfect

The examination content is mostly based on the knowledge points in the textbooks, and rarely involves the assessment of applying the learned knowledge to solve practical engineering problems. Traditional learning evaluation mainly relies on the final exam results, focusing on the assessment of theoretical knowledge while neglecting students' performance during the learning process, such as the quality of homework completion and practical abilities. This single evaluation method cannot comprehensively and accurately reflect students' learning situations and is prone to causing students to fall into the mode of exam-oriented learning. After teachers grade homework and test papers, they often fail to provide timely feedback on students' learning progress, which may lead to long-term knowledge gaps in students during the learning process and prevent them from adjusting their learning strategies in a timely manner.

3. The Application of AI Technology in Mechanical Drawing Courses

In the teaching of mechanical drawing courses, the application of AI technology can promote innovation in teaching modes in multiple aspects, including intelligent tutoring systems, learning analysis systems, intelligent teaching platforms, etc. In engineering drawing teaching, intelligent tutoring systems can answer students' questions in real time, learning analysis systems can track students' learning behavior, and intelligent teaching platforms can adjust teaching content and methods according to students' characteristics.

For example, AI can improve the accuracy and targeting of teaching through data analysis and personalized learning path design. With the help of intelligent algorithms, AI can provide real-time learning feedback to students, helping them quickly find solutions when facing difficulties. AI assisted drawing software can detect in real-time whether the drawing meets the standards during the student's drawing process, provide error prompts and correction suggestions. AI technology can achieve dynamic monitoring and intelligent analysis in teaching evaluation. By tracking students' homework, exercises, interactive feedback and other data throughout the process, it can evaluate students' learning outcomes in real time and provide specific improvement suggestions. Based on this data, teachers can adjust their teaching strategies in a timely manner to ensure that every student receives effective tutoring at the appropriate time.

3.1 The application advantages of AI in education

(1) Personalized education: Artificial intelligence can provide personalized educational services based on students' learning data and performance. By analyzing students' interests and abilities, designing appropriate learning content and methods, we can improve learning effectiveness and quality.

(2) Precision teaching: Artificial intelligence education can help teachers adopt different teaching methods and content for different students, thereby achieving "teaching according to aptitude" and cultivating students' thinking, analysis, innovation, and communication abilities.

(3) Educational resource sharing: Artificial intelligence can achieve the sharing and transmission of educational resources, improving teaching efficiency and quality. Through intelligent search and recommendation, students and teachers can share teaching resources and knowledge together, promoting educational reform and innovation

(4) Improving teaching efficiency: Artificial intelligence can automate and intelligentize the teaching process, reduce the workload of teachers, and improve teaching efficiency and quality. The teaching plan and difficulty can be automatically adjusted according to students' learning progress and abilities, making teaching more efficient and targeted.

(5) Improving teaching quality: Artificial intelligence can monitor and analyze students' learning data and performance in real time, identify their learning problems and difficulties in a timely manner, adjust teaching strategies and methods in a timely manner, and improve teaching quality and effectiveness.

(6) Cultivating innovation ability: Artificial intelligence education focuses on cultivating students' innovative thinking and practical abilities. By guiding students to participate in project development, practical operations, and innovation competitions, it cultivates students' innovation ability and practical experience.

3.2 Intelligent guided learning system

The AI-based intelligent guidance system can analyze students' learning behavior data in real time and automatically generate personalized learning paths based on students' performance and mastery in the course. By leveraging AI technology to establish student models and collecting students' learning data, such as study time, course visit frequency, homework completion status, test scores, and interaction participation, etc., we analyze and model students' learning styles, knowledge mastery, learning abilities, and other aspects to understand their learning situations and recommend suitable practice exercises. The students' understanding should be summarized and communicated to the teacher so that they can help address common problems in the next lesson.

3.3 Intelligent tutoring and interaction

Convolutional neural networks (CNNS) in AI technology can automatically recognize and parse mechanical drawings made by students, and perform geometric matching and error analysis in accordance with engineering drawing standards [4]. This system can automatically detect errors made by students in aspects such as dimensioning, line type selection and projection relationship in their drawings, generate detailed error analysis reports, and put forward improvement suggestions. This automated graphic recognition and evaluation technology can significantly enhance the efficiency and accuracy of job assessment.

Teachers construct problem maps and record voice or video to help students solve problems. Students can raise questions to the intelligent Q&A system either by voice or text. The system can understand the students' questions and provide corresponding answers and solutions in combination with the course knowledge base. This can effectively solve the problem of limited time for students to ask questions in class, increase the frequency of interaction between teachers and students, and improve the learning effect.

3.4 Create a virtual practical teaching platform

The fundamental reason for students' difficulty in recognizing assemblies is their lack of structural understanding of such assemblies, which means they have not disassembled or assembled such products. We create a realistic 3D interactive virtual experimental platform using VR technology. The laboratory is centered around Unity3D technology and presents interactive 3D models of product structures that require cognition on the experimental platform. Students can practice drawing, assembling parts, and interacting with 3D graphics in a virtual environment, thereby expanding virtual practical teaching [5]. Students can log in to the VR virtual laboratory platform on their computers and repeatedly disassemble and assemble models through input devices such as mice and keyboards. The system also provides three different disassembly and assembly methods, including disassembly animation demonstration, mouse click disassembly, and mouse free drag disassembly. The three methods gradually allow students to operate independently from the basics. The virtual training platform can recognize students' operations in real time and provide operation suggestions, thereby helping students gradually improve their understanding and operational ability of complex drawing problems in virtual scenes, and cultivating their spatial thinking ability. Use the VR platform to learn about gear reducers is shown in Figure 2.
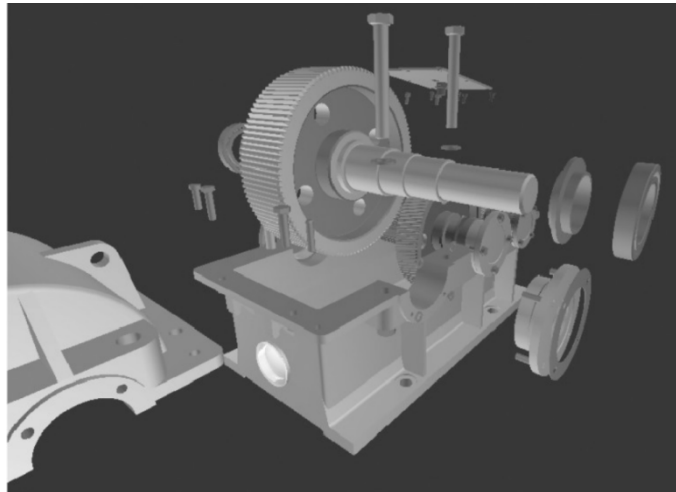
Figure 2 Using VR platform to learn gear reducer

3.5 Analysis of Students' Learning Outcomes and Teachers' Teaching Feedback

By analyzing data such as students' regular homework completion, platform tests, final exam scores, and mechanical surveying and mapping scores, teachers can identify problems existing in the teaching process, weak points in students' learning, and sort out, summarize and update the problem graph and knowledge graph. Students are accustomed to learning, finding solutions, participating in classroom interactions and discussions on the platform after class, which can also effectively enhance their

enthusiasm and initiative in learning.

After teachers use AI technology to create a smart education platform for teaching practice, they can utilize the platform's data analysis function to comprehensively and promptly understand students' learning situations, thereby enabling them to adjust teaching strategies more specifically. The intelligent tutoring system and interactive functions can reduce teachers' teaching burden, allowing them to devote more energy to teaching design and research, and effectively improve teaching quality.

4. Conclusion

Teaching reform of engineering drawing courses based on artificial intelligence (AI) technology and with the aid of virtual reality (VR) technology can effectively address the limitations of traditional classrooms, such as teacher-student interaction, support for students' personalized learning, insufficient learning interest, and after-class Q&A. By leveraging AI technology to develop a smart learning platform, it can assist teaching in engineering drawing courses from aspects such as intelligent guidance, personalized learning path recommendation, intelligent tutoring and interaction, and virtual simulation. This can effectively enhance students' learning interest, optimize learning outcomes, and improve their practical abilities.

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