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Construction of Innovation Mode of Engineering Drawing Courses Driven by Collaboration between AI and Industry-Education Integration in Application-Oriented Universities

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Abstract: *The rapid development of artificial intelligence (AI) technology poses new challenges to engineering drawing education. The traditional "manual drawing-software operation" mode makes it difficult to meet the needs of compound talent in the intelligent era. The teaching content and method are reconstructed by introducing case teaching, project-driven teaching, three-dimensional modeling, and virtual reality technology. The teaching effectiveness is improved by combining teacher training, school-enterprise cooperation, and dynamic teaching evaluation mechanisms. Practice shows that the reform has significantly improved students' spatial imagination ability, drawing skills, and innovative thinking, as well as strengthened teachers' teaching ability. Because of the problems of students' lack of interest in practice and teachers' lack of innovation, some suggestions for improving practice interest and optimizing the teachers' incentive mechanism are proposed. In the future, the course will deepen the application of AI technology, promote interdisciplinary integration, and improve the school-enterprise collaborative education system. It will cultivate engineering talent adapted to intelligent manufacturing.*

Keywords: *Application-Oriented Universities, Engineering Drawing Courses, AI Empowerment, Industry-Education Integration, Teaching Reform*

1. Introduction

In recent years, the rapid development of AI technology has profoundly changed traditional industries' practice modes and knowledge systems. Advanced technologies represented by deep learning, generative AI (such as GPT-4 and DALL·E), and computer vision have rapidly penetrated from theoretical research to industrial design, intelligent manufacturing, and other fields. The generative model can automatically generate complex drawings through text instructions. The multi-modal algorithm realizes the intelligent conversion of two-dimensional drawings and three-dimensional models. The AI-driven parametric design tools (such as the AI auxiliary function of Autodesk Fusion 360) have significantly improved the efficiency and innovation of engineering design. The AI technology wave has put forward new requirements for engineering drawing education. The dual structure of "manual drawing-software operation" in the traditional teaching mode has made it challenging to meet the needs of compound talent in the intelligent era [1-3].

At present, the integration of AI and engineering drawing faces multiple challenges. The existing teaching system lacks systematic and ethical application guidance for AI tools, and students are prone to fall into the dilemma of "technology dependence" and "lack of innovation." The deep integration mechanism of engineering drawing knowledge graphs and AI algorithms is incomplete. Key issues such as drawing semantic understanding and design intention reasoning must be broken through. Exploring the teaching reform path of AI empowerment on engineering drawing and constructing a new teaching mode of "man-machine collaboration" and "virtual and real combination" have become an inevitable choice to deepen the connotation of engineering education and cultivate the core competitiveness of future engineers [4-6].

In this context, application-oriented universities should actively explore the teaching reform path of engineering drawing courses. For example, introducing intelligent teaching methods, such as virtual reality technology and online learning platforms, can enhance students' learning experience and practical

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ability. Cooperation with enterprises can be strengthened to jointly develop practical teaching projects so that students can apply what they have learned in a real working environment and improve their ability to solve practical problems [7-8].

The development of AI technology provides a new idea and direction for the teaching reform of engineering drawing courses in application-oriented universities. Continuous innovation of teaching modes and means can cultivate more high-quality engineering and technical talent with an innovative spirit and practical ability and make greater contributions to society's sustainable development and progress.

2. Teaching method innovation

Innovating teaching methods is crucial to improving the teaching effect and stimulating students' learning interest and initiative. The traditional teaching methods focus on theory teaching and ignore students' practical operation and ability training in engineering drawing courses. Therefore, teachers must introduce more advanced and diversified teaching methods to meet modern education needs [9-10].

Case teaching is an efficient teaching method. Students can learn engineering drawing in real situations by introducing real engineering cases. It can enhance students' practical awareness and help them better understand and master the practical application of engineering drawing. In case teaching, teachers can guide students in analyzing the drawings and discussing their design ideas and drawing skills to improve their drawing ability and ability to solve practical problems.

Project-driven teaching is another effective teaching method. In this mode, students study and practice around a specific project in a group. This method can train students' teamwork ability and enable them to continuously hone their engineering drawing skills in practical operations. In project-driven teaching, teachers must pay close attention to students' progress, give timely guidance, and help ensure the project's progress.

In addition to innovative teaching methods, introducing modern methods is the key to teaching reform. 3D modeling software and virtual reality technology are indispensable in modern engineering drawing. Using these techniques, teachers can more intuitively display complex spatial geometric relationships and help students understand and master the basic engineering drawing principles and methods. For example, in the teaching of combination projection, teachers can use three-dimensional modeling software to dynamically demonstrate the change process of section and intersecting lines so that students can deepen their understanding of spatial geometric relations in an intuitive visual experience.

The innovation of teaching methods and the introduction of modern teaching methods are the key to improving the teaching effect of engineering drawing courses. Teachers can better stimulate students' learning interest and initiative and improve their engineering drawing ability and ability to solve practical problems through case teaching, project-driven teaching, and the application of three-dimensional modeling software and virtual reality technology. It is significant for cultivating professional talent with a solid engineering drawing foundation and good innovation ability.

3. Teaching staff construction

The construction of teaching staff needs to be addressed because it is the key link to improving teaching quality and promoting teaching reform. Efforts can be made from multiple dimensions to achieve this goal.

For the existing teachers, the teaching skills and professional knowledge training should be carried out regularly. It will update teachers' educational concepts and ensure their knowledge reserves to keep pace with the industry development. It can stimulate communication and cooperation between teachers to improve the teaching level by organizing internal seminars, teaching observation, sharing of teaching experiences, and other activities. External talent from other universities, research institutions, or enterprises should be introduced actively. They have rich practical experience and innovation ability and can bring new vitality and ideas to the teaching team. The talent is attracted to join the teaching team through recruitment, visiting professors, visiting scholars, and other forms. It will significantly improve the quality of teaching and research.

Establishing a school-enterprise cooperation mechanism is very effective. This mechanism gives teachers access to the latest industry technology and market dynamics and allows them to participate in

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practical projects. By cooperating with enterprises to carry out projects, teachers can more intuitively understand the industry's needs and problems. Teachers can feed these experiences and knowledge into teaching so that the teaching content is closer to reality and has more application value.

In addition to the above measures, a good teaching environment and atmosphere should be built so teachers can devote themselves to teaching and research. It includes providing sufficient teaching resources, complete teaching facilities, and a reasonable teaching evaluation system. Teachers can fully exert their talents and potential and contribute their strength to cultivating high-quality talent only in a positive and healthy teaching environment.

Strengthening the construction of teaching staff is a systematic project. It needs to start from many aspects to form a joint force. A high-quality and professional teaching team can be gradually created by strengthening teacher training, introducing excellent talent, establishing a school-enterprise cooperation mechanism, and creating a good teaching environment. It can provide a solid talent guarantee for the teaching reform of engineering drawing courses in application-oriented universities.

4. Teaching evaluation and feedback

Teaching evaluation and feedback mechanisms play an important role in teaching reform. Establishing these mechanisms helps teachers understand students' learning situations comprehensively and objectively. They also provide a strong basis for adjusting teaching methods and strategies and can promote the continuous improvement of teaching quality.

Various evaluation methods and tools from multiple dimensions can be used to construct a scientific and practical teaching evaluation system. As a common means of data collection, questionnaire surveys can widely and systematically collect students' views and suggestions on the course's teaching content, methods, and effects. Students' real feelings about the teaching process can be obtained in time to provide first-hand information for teaching improvement through regular questionnaire surveys.

In addition to the questionnaire survey, classroom interaction is an important way to evaluate students' learning. Teachers can evaluate students' learning engagement and thinking ability by observing their performance in class, such as questioning, discussion, and group cooperation. These evaluation methods are more intuitive and immediate, helping teachers adjust teaching strategies in time to stimulate students' learning interests and enthusiasm better.

Homework feedback is an effective way to test students' learning outcomes. Through careful correction and targeted comments on homework, teachers can understand students' specific situations regarding knowledge mastery, skill application, and problem-solving. Homework feedback can also provide students with in-time learning feedback to help them find and correct misunderstandings and deficiencies in learning.

In constructing the teaching evaluation system, teachers must consider the scientific nature of the evaluation criteria and the diversity of evaluation methods. The evaluation criteria should closely relate to the teaching objectives and talent training requirements. It should reflect the assessment of students' knowledge and skills and evaluate their learning attitude, innovative thinking, and practical ability. The diversity of evaluation methods helps us comprehensively evaluate students' learning outcomes from multiple perspectives, avoiding the one-sidedness and limitations of a single evaluation method.

Teachers can form a dynamic and circular teaching improvement process by establishing and implementing teaching evaluation and feedback mechanisms. In this process, teachers can adjust teaching strategies and methods according to students' situations and feedback to better meet their learning needs and industry development requirements. Students can clarify the learning direction, improve the learning effect in the timely teaching feedback, and finally realize their abilities' comprehensive development and improvement.

5. Analysis of reform effectiveness

After carefully designing and implementing teaching reform measures, the quality and effect of teaching in engineering drawing courses have improved remarkably. The improvement is not accidental but comes from a deep understanding of teaching concepts and the continuous innovation of teaching methods.

From students' perspectives, curriculum system optimization and teaching method innovation have

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significantly improved their spatial imagination and drawing skills. Increasing the practical operation gives students more opportunities to draw by hand. It deepens their theoretical knowledge and understanding and exercises their practical abilities. Using modern teaching methods such as three-dimensional modeling software and virtual reality technology, students can understand the spatial geometric relationship more intuitively in learning, improving their spatial imagination ability.

Students' innovative thinking and problem-solving skills have been effectively exercised. Introducing methods such as case teaching and project-driven teaching enables students to conduct initiative thinking and active exploration and find the best solution to the problem when facing practical problems. This teaching method stimulates students' interests and cultivates innovative thinking and problem-solving abilities.

The teaching reform focuses on strengthening the teaching staff construction and improving the teaching evaluation and feedback mechanism. Teachers' systematic training and practical exercises improve their teaching levels and abilities. A scientific teaching evaluation system is established. Students' learning situations and needs are understood, and the teaching strategies and methods are adjusted according to student feedback. These measures have jointly promoted the improvement of teaching quality.

Implementing a series of teaching reform measures has significantly improved the teaching quality and effect of the engineering drawing courses. Students' spatial imagination ability, drawing skills, innovative thinking, and ability to solve practical problems have been improved to varying degrees. Teachers' teaching levels and teaching abilities have also been significantly improved. The achievements of these reforms have laid a solid foundation for the future development of engineering drawing courses and provided a strong guarantee for the training of more professional talent with a solid engineering drawing foundation and good innovation ability.

6. Existing problems and improvement suggestions

Although the teaching reform of engineering drawing courses in application-oriented universities has achieved remarkable results, some problems remain. These problems mainly focus on students' learning attitudes and teachers' teaching methods, which have a certain impact on the deepening of the reform.

Some students show low interest in practical operations. It limits the improvement of their practical operation ability to a certain extent. Practical operation is an important link to cultivate engineering drawing ability. Through continuous practice, students can master drawing skills and improve their spatial imagination. Therefore, stimulating students' learning interests and improving their initiative has become an urgent problem.

To solve this problem, increasing the interest and practicality of practical operations is suggested. For example, some practical engineering project cases can be introduced to allow students to participate in the design and drawing process of the project so that they can feel the charm and practicality of engineering drawing in practice. Some challenging practical tasks can be set up to stimulate students' competition sense and exploration desire through competitions and rewards.

Some teachers lack innovation and flexibility in the teaching process, which affects the teaching effect to a certain extent. Teaching reform needs to update the teaching content and methods. It requires teachers to show enough innovation and flexibility in the teaching process to adapt to different students' learning needs and industry development changes.

Strengthening teachers' training and encouraging them to adopt innovative and flexible teaching methods and means are suggested to improve their teaching levels. For example, teachers can be regularly organized to participate in teaching seminars, workshops, and other activities to expose them to the latest teaching ideas and methods. An incentive mechanism can be established to recognize and reward teachers who are performing well in the teaching process to stimulate their enthusiasm and innovative spirit.

Establishing a sound supervision and assessment mechanism is suggested to ensure the effective implementation of teaching reform measures. Regular inspection and evaluation of the teaching process and students' learning outcomes can help teachers identify problems and make adjustments and improvements in time. This mechanism can quantitatively evaluate the effect of teaching reform and provide valuable feedback and direction for improvement.

Although the teaching reform of engineering drawing courses in application-oriented universities has achieved remarkable results, teachers must continue to pay attention to and solve the problems in the

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reform process. The in-depth development of teaching reform can be promoted by increasing the interest and practicability of practical operation, strengthening teachers' training, and establishing a complete supervision and assessment mechanism. It can contribute to cultivating more professional talent with a solid engineering drawing foundation and good innovation ability.

7. Conclusions

Engineering drawing courses will follow the pace of science, technology, and education and continue to evolve and innovate. The development trend covers teaching content renewal and teaching method innovation and involves deepening interdisciplinary and school-enterprise cooperation.

Regarding teaching content, engineering drawing courses will focus more on industry needs and technological development. It means that the course will be more practical and forward-looking, ensuring that students' knowledge is closely linked to future workplace needs. The courses will be regularly updated by introducing the latest engineering and drawing standards so that students can keep up with the pace of industry development. The courses will also emphasize cultivating innovative ability and stimulating students' innovative thinking by integrating innovative design and problem-solving elements. It will lay a foundation for students' future breakthroughs in the engineering field.

Regarding teaching methods and means, future engineering drawing courses will show more diversified and modern characteristics. The traditional blackboard plus chalk teaching mode will gradually give way to interactive and multimedia teaching methods. In particular, introducing advanced teaching methods such as 3D modeling software and virtual reality technology will significantly enrich the teaching content and improve the teaching effect. Students can understand complex spatial relationships more intuitively and improve their drawing skills through these modern tools. In addition, online teaching and remote collaboration will provide students with a more flexible and convenient learning experience.

Interdisciplinary integration is another important direction for the future development of engineering drawing courses. With the continuous progress of the engineering field, a single engineering drawing knowledge has been unable to meet the complex and changeable design requirements. Therefore, the courses will actively seek deep integration with other disciplines, such as computer science, material science, and mechanics. Cross-integration helps broaden students' knowledge and vision and cultivates their ability to solve complex problems in a multidisciplinary environment.

Establishing a complete school-enterprise cooperation mechanism will become a key link to promote the development of engineering drawing courses. Universities can keep abreast of the industry's latest developments and technical needs to adjust teaching strategies and directions through close cooperation with enterprises. School-enterprise cooperation can provide students with valuable practical opportunities and employment channels. It can help students accumulate practical work experience in school and fully prepare for their future careers. The trend will inject new vitality into the sustainable development of engineering drawing courses and cultivate more high-quality talent to meet social needs.

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