ISSN:3007-9659 DOI: https://doi.org/10.70114/ahmer.2025.2.1.P154

Application and Effect Analysis of Combined Teaching Method in Mechanical Drawing for Undergraduate Students in Vocational Colleges

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Abstract: Mechanical drawing course is an important foundational course for mechanical related majors, which lays a foundation for students' subsequent professional learning. This study focuses on the situation where undergraduate students from vocational colleges have boring content, poor spatial imagination, and complex knowledge that is difficult to master in mechanical drawing learning. Methods including computer 3D modeling, computer 2D drawing, VR+AR technology, artificial intelligence technology, gamification, etc. were adopted to effectively reconstruct course design and content, enhance students' learning interest and effectiveness, and provide ideas for future applications in other colleges.

Keywords: Mechanical Drawing, 3D Modeling, MR Technology, Artificial Intelligence.

1. Introduction

The series of mechanical foundation courses in vocational colleges is one of the most important professional foundation courses for mechanical and electrical majors. In the long-term teaching activities of the research group, it was found that some students in the series of mechanical foundation courses in vocational colleges and universities have difficulties in mastering mechanical drawing due to boring content, poor spatial imagination, and complex knowledge content. They also have difficulties in their hands-on ability, software operation ability, and academic performance,

Overall, the current teaching of mechanical drawing courses in vocational colleges urgently needs to focus on activating students' self-learning motivation, enhancing their learning engagement, and promoting the improvement of spatial abilities in the curriculum. Otherwise, achieving teaching knowledge goals (improving students' mechanical foundation level) and ability goals (laying a foundation for learning abilities in subsequent professional courses) will be impossible. Empirical research has found that, on the one hand, artificial intelligence technology, as an important development direction in the field of future technology, can enhance learners' interest in learning, learning efficiency, learning modes, and learning outcomes; On the other hand, gamified teaching method can regulate students' learning emotions, enhance their learning initiative and engagement through internal and external incentives. Therefore, this project believes that it is necessary to effectively integrate these two advanced educational technologies and teaching methods, comprehensively and systematically explore how the "artificial intelligence technology+gamification" teaching mode can help alleviate various learning difficulties encountered by vocational college students in mechanical foundation courses, and combine multimedia technologies such as VR/AR to scientifically and reasonably innovate and upgrade the existing teaching mode.

In terms of teaching format, traditional mechanical drawing teaching is mainly based on manual drawing teaching. However, at present, actual enterprises have basically adopted 2D+3D design in mechanical design. Manual drawing teaching can no longer adapt to the current applications of enterprises and industries. Traditional mechanical majors divide mechanical drawing, CAD drawing, and 3D software into several courses for teaching, and the disadvantage is that the entire course is not coherent. The actual operation in enterprises is to model the process from 2D to 3D and generate engineering drawings from 3D to 2D. Therefore, for students majoring in mechanical engineering, organizing their learning according to actual work processes is beneficial for them to master the entire process of modern manufacturing production and processing, and better serve their

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professional learning and future work. In addition, compared to the boring manual drawing, computer modeling and drawing can better enhance students' interest and innovation ability, and are more suitable for future work.

This study aims to address the situation of mechanical drawing learning for undergraduate students in vocational colleges, where the content is dull, the spatial imagination is poor, and the knowledge content is complex and difficult to master. Methods including computer 3D modeling, computer 2D drawing, VR+AR technology, artificial intelligence technology, gamification, etc. were adopted, and the curriculum system was reconstructed.

2. Teaching Implementation Methods

(1) Basic teaching implementation methods: According to the actual teaching, the teaching mode has been changed. The traditional mechanical drawing teaching consists of 64 hours of manual drawing process. After reform, the credit for manual drawing is controlled at around 20-24 hours, and the remaining 40-44 hours are computer drawing and 3D modeling. The specific teaching mode adopts the first part of manual drawing for basic knowledge training of three views, and the second part is the expression method of views. The teaching method starts with 2D computer drawing and conducts simple 3D modeling training; The third part is the part of part drawings and assembly drawings, mainly focusing on 3D modeling, assembly and engineering drawing generation, and animation generation.

(2) Application of teaching media and software: In the early stage, PPT is mainly used for teaching manual drawing, and students mainly use paper exercise sets for practice. In the later stage, Solidworks and AutoCAD software are mainly used for teaching 2D drawing and 3D modeling.

(3) Application of auxiliary teaching models and tools: Unlike traditional methods of mechanical drawing teaching, which use geometric shapes made of wooden and plastic molds, we adopt actual or simplified versions of mechanical and electrical equipment as the actual models and carriers for mechanical drawing teaching according to different majors. For example, the Intelligent Manufacturing Engineering Technology major uses robots as teaching carriers, the Mechanical and Electronic Engineering Technology major uses mechanical arms as teaching carriers, the New Energy Vehicle Technology major uses drive motors as teaching carriers, the Automation Technology major uses remote controls as teaching carriers, and the New Materials Technology major uses molds as teaching carriers. In addition to using unified teaching aids for the basic knowledge of the first part of the three views, in the learning process of view expression methods, part drawings, and assembly drawings, Each major utilizes a complete set of models for teaching. This can not only carry out characteristic teaching for different majors, but also form an orderly combination with subsequent professional courses, which is conducive to cultivating high-level technical and skilled talents for the profession.

(4) Strengthen practical teaching and comprehensive project design: An important difference between vocational undergraduate education and regular undergraduate education is the high proportion of experimental and practical training in vocational education. In the specific practical teaching process, in addition to the disassembly and mapping exercises of different teaching models in the above-mentioned majors, the course also arranges the disassembly and mapping of real parts and components, such as the disassembly and mapping of engines and motors, which greatly improves students' hands-on ability and professional level. At the end of the semester, a comprehensive project design was set up, with 6-7 students working in groups to complete a simple mechanical structure, model and draw, write a report, and finally create a PPT for defense.

(5) Using VR/AR combined with gamified teaching methods, on the one hand, MR (Merged Reality, which integrates virtual reality and augmented reality) as a high presence, high interactivity, and high autonomy educational technology can enhance learners' learning interest, learning efficiency, and spatial ability; On the other hand, gamified teaching method can regulate students'

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learning emotions, enhance their learning initiative and engagement through internal and external incentives.

(6) Introduction of artificial intelligence technology:In teaching, we focus on the application of artificial intelligence technology and introduce AI learning systems to assist students in teaching basic knowledge of mapping such as three views graphics and national standards. This can assist teachers in teaching and exam grading, as well as dynamically analyze and compare students' learning outcomes, facilitating high-level teaching.

3. Teaching Implementation Effect

3.1 Students' Experience of Complex Teaching Methods

Compared to traditional mechanical drawing teaching methods, students have a better experience with complex teaching methods. Firstly, students are very interested in changing the teaching mode to computer graphics and modeling. In the mid-term and final feedback, over 90% of students supported the use of computer graphics and modeling teaching methods, and 95% of students believed that this teaching method would be more interesting to them. The number of students answering questions after class increased by 100%. The improvement of auxiliary teaching models has also been welcomed by students. Compared with traditional wooden models, students prefer practical or simplified mechanical device models that are related to their majors. The number of disassembly and assembly times for students outside of class has increased by nearly 50%, and some students can also improve the mechanical devices and use 3D printing to achieve them, which enhances students' hands-on ability and interest in professional learning. Moreover, the course training room is open to students freely, and some students have also experienced mechanical processing tools, which has facilitated their later professional learning. Regarding the VR/AR teaching method, 80% of students believe that it effectively enhances students' understanding of complex shapes and mechanical structures, especially in the study of sectional views, which is of great help. Artificial intelligence assisted teaching has also been welcomed by students. For memorable content such as international standards, through the explanation of artificial intelligence systems, it is beneficial for students to deepen their understanding.

3.2 The Improvement of Students' Grades Through Complex Teaching Methods

By adopting a complex teaching method, students' academic performance has significantly improved. The average score for regular homework has increased from 85 to 92, the mid-term test score has increased from 80 to 85, and the average score for final exams has increased from 82 to 90, indicating that the complex teaching method has a good effect on teaching.

3.3 Teacher's Experience with Complex Teaching Methods

Teachers generally have an adaptive and appreciative attitude towards complex teaching methods. In the initial teaching process, it may be difficult for teachers to adapt to this complex teaching method, but after one to two semesters of teaching, they can become proficient in it. In addition, for the use of VR+AR technology, teachers have improved their teaching level through resource construction and self-learning, and promoted their application of information technology. The introduction of artificial intelligence technology greatly facilitates teachers' teaching. The most convenient thing is that artificial intelligence technology can help teachers grade students' homework and exams. According to statistics, the average time for teachers to grade homework has decreased by 40%, and the accuracy has increased by 20%. In addition, for the examination of some basic mechanical knowledge, the function of automatically generating test questions and assisting explanations in the question bank has been formed. Teachers can completely detach themselves from this part of the work, and students can also avoid determining the Q&A time with teachers, forming a 24-hour self-learning platform. In addition, teachers can effectively exercise students' hands-on ability, innovation ability, teamwork awareness, preliminary paper writing ability, and

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public speaking ability through final comprehensive assignments. Teachers can also extract teaching and research achievements from them and select outstanding students to participate in corresponding competitions.

4. Conclusion and Prospect

The research results of this study on the mechanical drawing course of undergraduate mechanical and electrical related majors show that the use of methods including computer 3D modeling, computer 2D drawing, VR+AR technology, artificial intelligence technology, gamification, etc. effectively achieved the reconstruction of course design and content, enhanced students' learning interest and effectiveness, greatly benefited both teachers and students, promoted teaching reform, and provided a beneficial attempt for vocational undergraduate mechanical drawing education.

The main improvement methods for the next step are as follows: firstly, expanding the scope of professional application and extending the research on mechanical drawing teaching reform to non mechanical majors; The second is to expand the scope of the drawing course and apply the teaching reform of mechanical drawing to majors such as architectural drawing and electronic drawing; The third is to expand the scope of courses and strive to apply them to other majors in mechanical and electronic fields.

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