Research on the Teaching Reform of the "Die Manufacturing Technology" Course Empowered by AI

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Abstract. The teaching mode of traditional engineering manufacturing courses has been unable to adapt to the development of education digitalization. The teaching team of Jianghan University's “Mold Manufacturing Technology” has carried out in-depth reform and innovation in the aspects of course content, teaching methods, assessment and evaluation methods with the help of AI technology, and achieved a comprehensive upgrade of course teaching. Based on the concept of output-oriented education (OBE), the training plan and teaching syllabus have been revised, and AI technology has been used to improve the classroom teaching methods, taking tasks and projects as the orientation, organizing and implementing the teaching process by means of group cooperation and combining theory with practice, and further improving the teaching effect through the application of artificial intelligence technology. At the same time, it has established a process assessment and evaluation method that emphasizes application and emphasizes ability cultivation. The results show that the curriculum reform empowered by AI has achieved remarkable teaching effects and provided a new path for the exploration of teaching reform for application-oriented courses.

Keywords: Die manufacturing process; Teaching reform; AI technology; OBE concept

1 Introduction

With the development of technology, artificial intelligence (AI), relying on advanced technologies such as deep learning, natural language processing, and machine learning, has become an important driving force for the reform and development of higher education[1-3].

The Material forming and Control engineering major of Jianghan University has passed the national first-class undergraduate professional certification. Under the background of engineering professional certification, the reform of results-oriented education (OBE) has been carried out in an all-round way, its core is student-centered and focuses on student learning outcomes. Adhering to the new teaching concept of engineering education and conforming to the needs of professional construction, we have revised the professional training plan and teaching syllabus. This paper focuses

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on exploring how to reform the teaching content, teaching method and assessment method of "Mold Manufacturing Technology" course with the help of artificial intelligence, hoping to provide a new idea and method for the teaching reform of engineering courses in colleges and universities.

2 The Deficiencies of the Traditional Teaching Model

As a core professional course of material forming and control engineering, "Mold Manufacturing Technology" covers the basic theoretical knowledge and practical skills of Die parts machining and special processing, as well as the manufacturing process and assembly method of typical mold parts. Since 2007, our school has offered this course for undergraduates majoring in material forming and control engineering. In the past, theoretical courses were combined with experimental courses, but this traditional teaching mode has obvious shortcomings. The teaching process is dominated by theory, and it is difficult for students to become the main body of learning. The disconnection between teaching content and practical application is not conducive to cultivating students' ability to solve complex engineering problems; The single assessment and evaluation method only focuses on examination results and ignores the comprehensive assessment of students' learning process, which cannot provide strong support for continuous improvement of teaching and is not conducive to the continuous progress of students[4-6].

3 The Deficiency of Traditional Teaching Mode

3.1 Rreform of Training Program and Teaching Syllabus

In order To meet the talent demands of the modern mold industry, a significant adjustment was made to the training program in 2020, increasing students' practical learning hours. A project-based teaching reform was carried out in the practical part of the course in the course syllabus. Seven teaching projects were set up, including five classroom practical projects, one extracurricular practical project, and one school-enterprise cooperative training project. The Classroom practical projects focus on CNC machining, EDM and laser machining. The homework requires students to work together to design a small machine and give the manufacturing process. School-enterprise cooperation training projects include mold manufacturing process control and programming and manufacturing mold parts with CNC machine tools.

3.2 Reform of Teaching Content and Methods

In the classroom teaching practice, the teaching method of "Mold Manufacturing Technology" course pays attention to the application of theoretical knowledge to practice, mainly to improve students' hands-on ability. The classroom teaching process takes case analysis as the main means to actively create a strong interactive teaching atmosphere. Always adhere to the student-centered, according to the characteristics of declarative knowledge, procedural knowledge and strategic knowledge in the curriculum, targeted selection of heuristic, inquiry and case teaching methods. Through these diversified teaching methods, we can fully mobilize students' enthusiasm for active learning, and focus on cultivating students' ability to think positively, solve problems and practice. In addition to the combination of multimedia teaching, traditional blackboard writing and physical example teaching, AI is used to optimize mold design and manufacturing process and improve teaching efficiency and quality, such as the use of AI to optimize mold design and manufacturing process planning, so as to enhance students' innovative ability and practical ability. Using the idea of knowledge graph, the main knowledge points of the course are extracted, the relationship between the knowledge points is clear, and the knowledge points are explained, questioned and practiced.

In the part of experiment teaching, the traditional teaching mode of teacher demonstration and student imitation is changed, and the experiment is divided into 5 teaching projects. They are EDM programming, wire cutting processing, CNC lathe programming, CNC milling and laser processing. Each project is explained theoretically and guided by the teacher. Students are divided into several groups. Each group uses AI tools to create and analyze models, complete the programming, debugging and operation of model processing, machine tool processing path design and other tasks, and complete the experiment report.

This course has carried out school-enterprise cooperation in production, teaching and research jointly with Wuhan Boyue Mold Technology Co., Ltd. The cooperative teaching is divided into theoretical teaching and practical teaching. The main technical personnel of Boyue Mold Company are hired as enterprise lecturers and have come to the school to conduct theoretical teaching for 8 class hours. They have taught about the current situation and development trend of molds, mold design, manufacturing process regulations and examples of the working parts of molds, assembly and debugging of plastic molds, etc. The practical course with 8 class hours is carried out in Boyue Mold Company. Firstly, AI technology is used to simulate and imitate the design and manufacturing process of molds. Then, students are divided into 4 groups to have on-site classes in the production workshop. The enterprise lecturers have explained on site the contents such as CNC machining, EDM machining, WEDM machining and numerical control programming.

3.3 Reform of Assessment and Evaluation Methods

The assessment of course grades has changed the traditional evaluation method that mainly focuses on examination results, and mainly assesses students' learning process instead. Students use AI tools to complete the review and practice of knowledge points, and finish an assignment on compiling the process regulations for mold parts that takes into account special processing and numerical control processing techniques. The project assignments are completed by the division of labor among group members. The average score of the group members serves as the score given by the judges, and the individual score is given by the group leader according to personal contributions, which has greatly increased the enthusiasm of each group member to participate.The assessment/evaluation links and target scores for the achievement of course objectives are shown in Table 1.

Table 1. Achievement of assessment/evaluation and grade ratio.

Course objective	Support graduation requirements	Assess/evaluate project and target scores			target scores
		homework	Course project	Final examination	
Ojb1	Graduation requirements1-4	3	12	20	35
Ojb2		3	8	8	19
Ojb3		11		8	19
Ojb4		3	4	4	11
Ojb5	Graduation requirements11-2		8		8
Ojb6	Graduation requirements9-2		8		8
total		20	40	40	100

4 Results & Discussion

After the course is completed, the "Course Assessment Results Analysis Method" is adopted to evaluate the achievement of the course objectives. Based on the calculation results of the achievement degrees of each objective, a comparison is made with the calculation results of the previous round, so that the achievement situation of each objective can be analyzed and used to guide the continuous improvement of teaching methods. Ninety percent of the course grades come from the assessment results of technical indicators, and 10 percent come from the assessment results of non-technical indicators (teamwork); the assessment results of the technical indicator abilities account for 70 percent.

Taking the course grades of students majoring in Material Forming and Control Engineering in the class of 2021 as an example, from the evaluation results of the achievement of the course objectives, it can be seen that the teaching reform measures have achieved remarkable results. Not only have all the achievements of the course objectives exceeded the threshold value of 0.68, but also, compared with the results of the students in the class of 2020, the achievement situations of Course Objectives 1 and 2 have both been improved (as shown in Figure 1).

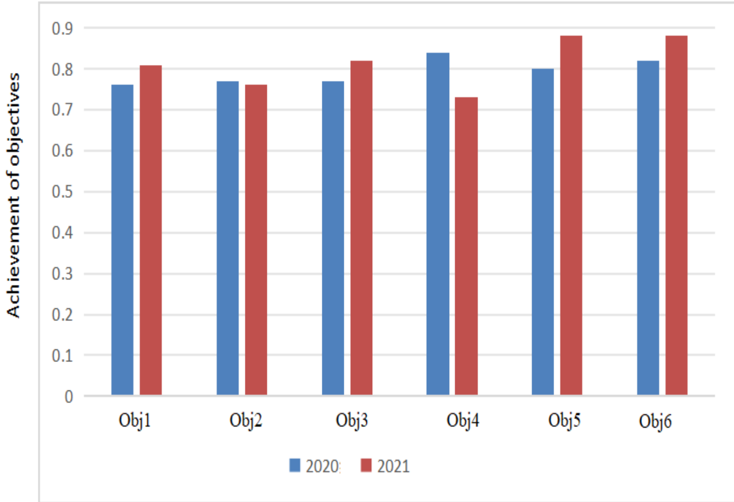

Fig. 1. Comparison of the achievement of course objectives between this round and last round .

The traditional course teaching and assessment models have been changed. Theory has been combined with practice, project-based teaching has been implemented, and industry and enterprise resources have been fully utilized to carry out school-enterprise cooperative teaching. After the implementation of the course reform, it was found through summary and questionnaire surveys that the course reform has achieved good results. The course teaching team, together with enterprise teachers, has further improved the course syllabus based on the actual needs of enterprises.

The method of project-based teaching has been recognized by students. Teaching theoretical knowledge by combining the actual situations and production cases of enterprises, and the auxiliary use of AI technology in the teaching process have increased students' enthusiasm and participation. Meanwhile, teachers' teaching efficiency and teaching quality have also been significantly improved.

The form of students completing projects in groups has effectively cultivated their practical and innovative abilities. In the process of completing small machinery in groups, students' team awareness, cost control awareness, and the ability to divide labor and cooperate have all been enhanced. Enterprise practice teaching has enabled students to have a more intuitive understanding of the production processes and operation situations of enterprises, and a deeper appreciation of the application of knowledge.

5 Conclusion

Based on the OBE (Outcome Based Education) concept, in-depth curriculum reforms have been carried out for the course "Die Manufacturing Technology". The training program and teaching syllabus have been revised, and a large number of innovative reforms have been carried out in the course teaching content, teaching methods and school-enterprise cooperation teaching. Moreover, AI technology has been actively adopted to assist the application and practice in curriculum reforms, exploring more efficient and intelligent teaching models and methods, and remarkable teaching effects have been achieved. The application of knowledge graphs in teaching has been recognized by students. Teaching theoretical knowledge in combination with the actual situation of enterprise production and production cases has increased students' interest in listening to lectures and their enthusiasm for participating in discussions. The form of projects completed by groups has strengthened students' cooperation and practical abilities. During the process of completing small machinery in groups, students' team spirit, cost control awareness, division of labor and cooperation abilities, etc. have all been improved. Through enterprise practice teaching, students can intuitively and deeply understand the actual production process and business conditions of enterprises, and have a deeper understanding of the knowledge in practical scenarios. The curriculum teaching reform empowered by AI has provided new ideas and methods for the exploration of teaching reform for application-oriented courses.

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