Teaching Reform of Automotive Electrical and Electronic Technology Course Under the Background of Intelligence Education

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Abstract. Automotive electrical and electronic technology is a professional core course for automotive majors in colleges and universities, it plays an important role in the achievement of the training goals of automotive majors. In response to the problems of poor integration of theoretical teaching and practical teaching, outdated teaching model, and single assessment and evaluation method in the course teaching, adhering to the student-centered teaching concept, and with the help of modern information technology, the teaching reform is carried out in terms of teaching resources, teaching model, and teaching evaluation, which effectively solved the teaching pain points, cultivated students' practical innovation ability and comprehensive quality, and achieved the teaching objectives of the course.

Keywords: automotive electrical and electronic technology · intelligence education · modern information technology · teaching reform

1 Introduction

In order to cope with the new opportunities and challenges brought by Industry 4.0, in 2017, China issued the "Development Plan for the New Generation of Artificial Intelligence", which emphasizes the development of intelligence education and the creation of a new education system of intelligent learning and interactive learning [1]. In the "Education Informatization 2.0 Action Plan" issued in 2018, it is clearly stated that leading education modernization with the support of education informatization is a strategic choice for China's education reform and development in the new era, and it is of great significance for building a strong country in education and human resources [2].

Automotive electrical and electronic technology is a professional core course for automotive majors. The teaching content involves many disciplines such as artificial intelligence, control theory, network technology and mechanical engineering [3], and has strong intersectionality, comprehensiveness, practicality. It is an important course to support the achievement of professional talent training objectives and cultivate students' practical and innovative ability.

2   The Problems Existed in the Automotive Electrical and Electronic Technology Course of Teaching

2.1   The Combination of Theoretical Teaching and Engineering Practice Is Not Close, and Students' Ability to Apply Knowledge and Innovate Is Insufficient

The single source of teaching resources, few practical teaching links and poor integration between theoretical teaching and engineering practice lead to poor knowledge application ability and insufficient innovation ability of students.

2.2   The Teaching Model is Outdated, Resulting in Students' Lack of Interest in Learning and Poor Learning Initiative

In the teaching process of the course, teachers' classroom teaching is the main part, classroom interaction is less, and Blended teaching is a mere formality. The teaching content is highly theoretical, and the progress of the class is fast. Students are prone to fear difficulties, resulting in loss of interest in learning and lack of learning initiative.

2.3   The Evaluation Method is Single, and Students Generally Lack Attention to the Learning Process

The course is evaluated based on the usual grades and the final exam. The usual grades include attendance and homework grades, which leads to students neglecting the course learning process, low head-up rate in class, and serious plagiarism in homework, which is not conducive to the construction of students' knowledge system and the cultivation of their knowledge application ability.

The teaching team of the course implements the requirements of the new engineering construction, adheres to the teaching concept of "industry demand-oriented, student-centered, and practical innovation ability training as the goal", and uses modern information technology to carry out teaching reform, create smart classrooms, and achieve curriculum teaching goals.

3   Exploration on Teaching Reform of Automotive Electrical and Electronic Technology Course

3.1   Construct the Diversified Teaching Resources

3.1.1   Using Modern Information Technology to Construct Virtual Teaching Resources

In order to solve the problems of insufficient practical teaching resources, insufficient time for practical teaching and disconnection between theoretical and practical teaching, modern information technology is fully used in course teaching, such as virtual reality technology and virtual simulation technology, and virtual teaching resources are developed in various ways. The deep integration of virtual technology and education teaching is an effective means to optimize educational resources and improve teaching quality

[4]. The virtual teaching resources developed for the course include: 1) a large number of teaching animations, which be used for demonstration during classroom teaching. 2) VR virtual disassembly and assembly experimental platform of automotive electrical appliances, which students can realize virtual experiments simultaneously with classroom theoretical learning. 3) Multisim virtual simulation circuit of automotive electrical appliances, which teachers can use for classroom demonstration and fault analysis; students can build their own experimental circuits in combination with learning contents to deepen their understanding of theoretical knowledge.

3.1.2 Use Online Teaching Platform to Enrich Online Teaching Resources

The online teaching resources of the course are enriched through self-built and quoted ways to meet the personalized needs of students. Using the Superstar platform, the online course of automotive electrical and electronic technology is built to meet the needs of students' online autonomous deep learning. Introduce the China University MOOC "Automotive Electrical and Electronic Technology" course to meet the needs of students' fragmented learning. Introduce the national high-quality course "Automotive Engine Electric Control System Maintenance" to meet the needs of some students' super practical ability.

3.1.3 Build Offline Teaching Resources Through the Integration of Production and Education

Relying on Jiangling Automobile Co., Ltd., a cooperative enterprise of Robot Modern Industry College, 12 teaching projects and a large number of teaching cases have been developed to make the course content keep up with the cutting-edge technology and meet the needs of the industry.

3.2 Innovate the Blended Teaching Model Based on Collaborative Knowledge Construction

With the support of modern information technology, a blended teaching model based on collaborative knowledge construction is constructed according to the theory of collaborative constructivist learning [5]. Through pre-class guidance, in-class discussing and after-class thinking, it realizes student-centered, promotes students' deep learning, and cultivates students' practical innovation ability. The teaching model of the course is shown in Fig. 1. Intelligence education tools and resources used in the course is shown in Table 1.

3.2.1 Pre-class Guided Learning

Students are guided by the guided learning checklist to complete online learning and achieve collaborative knowledge construction through online discussion and learning community exchange and sharing. Teachers monitor students' online learning data in real time through the learning platform, analyze and process the data to optimize the course teaching plan.
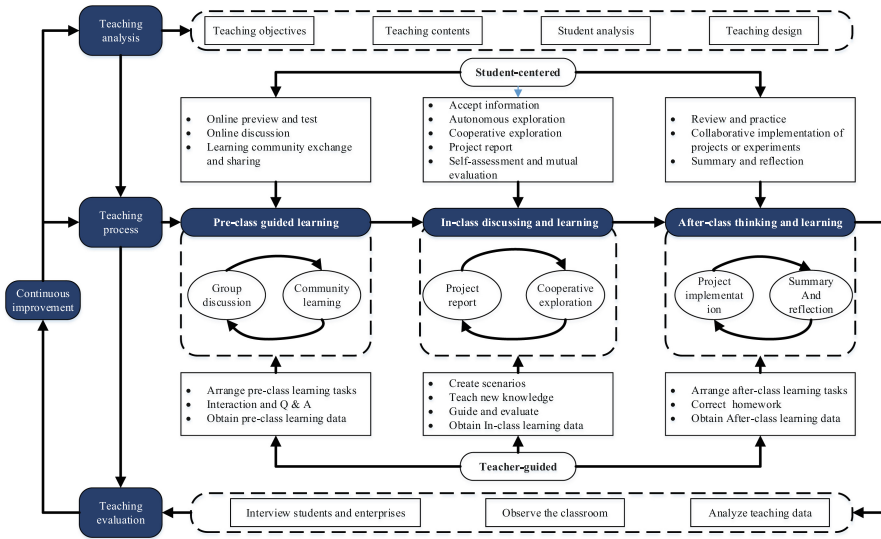
Fig. 1. Blended teaching model based on collaborative knowledge construction

3.2.2   In-class Discussing and Learning

Through the creation of scenarios, case studies, classroom discussions, project display, flipped classroom and other diverse teaching activities to achieve seminar learning, and complete collaborative knowledge construction. Teachers use the "Superstar Learning Pass" to conduct in-class tests to test the teaching effect of the course and adjust the teaching plan accordingly. Students' classroom discussion and project design results are uploaded to the "Superstar Learning Pass". Teachers can carry out projection display and comment. Teachers and students can carry out teaching evaluation through the "Superstar Learning Pass", realizing self-evaluation, mutual evaluation, teacher evaluation and enterprise tutor evaluation.

3.2.3   After-Class Thinking and Learning

Teachers issue a list of thinking tasks to guide students to think and reflect. Students submit homework and learning community communication and sharing through online learning platform to complete the consolidation and improvement of knowledge; through teamwork to complete teaching projects and extracurricular practice to achieve collaborative knowledge construction; carry on after-class reflection according to the project evaluation results, complete the reflection report and upload it to the "Superstar Learning Pass". Cultivate students' high-level abilities such as critical thinking, design and analysis and evaluation of engineering problems. Using virtual teaching resources to carry out after-class virtual experiments; for students with personalized training needs, extracurricular independent practice is carried out through experimental elective courses and open laboratories, so that students can explore and learn independently and further improve their engineering practice ability.

Table 1. Intelligence education tools and resources used in the course

Intelligence education tools and resources	Effect
Online teaching platform: • Superstar • China University MOOC	Pre-class: Online preview and opinion sharing After-class: submit homework and project results
Interactive tools: • Tencent conference • QQ group	Pre-class: online discussion After-class: project discussion, summary and reflection
Teaching tools of classroom • Superstar Learning Pass	In-class: classroom check-in, in-class test, scare-answering
Virtual teaching resources: • teaching animations • virtual disassembly system • virtual simulation circuit	In-class: demonstration After-class: virtual experiment

3.3 Reform the Course Assessment and Evaluation System

The assessment and evaluation of this course adopts a combination of process evaluation and summative evaluation [6]. The process evaluation results are obtained through statistics recorded by the online teaching platform and intelligent tools such as "Superstar Learning Pass". The process evaluation includes several parts: online video viewing (5%), chapter test (3%), online discussion (2%), homework (10%) and project design (20%). The subjects of project evaluation are diversified, including self-evaluation, intra-group mutual evaluation, inter-group mutual evaluation and teacher evaluation. Reduce the proportion of objective questions such as multiple-choice questions and blank-filling questions in the final examination papers, cancel judgment questions, increase the proportion of subjective questions, and focus on assessing students' comprehensive ability to use knowledge. Through the reform of diversified evaluation methods, the problems in teachers' teaching process and students' learning process will be found and improved in a timely manner so as to improve the quality of teaching.

4 Effectiveness Analysis of Teaching Reform

This teaching reform program has been practiced in the 2019 and 2020 vehicle engineering majors, and has achieved good teaching results. Through the teacher's classroom observation and the questionnaire of the end of the course in 2022 (see Table 2), it is shown that this teaching reform program broke the dullness of the course, improved the students' classroom participation, increased the interest of the course, stimulated students' interest and potential in learning, the rate of head-up in class is obviously improved, and the rate of homework plagiarism is greatly reduced. The passing rate of Course examination exceeded 90%, and the excellent and good rate reached over 48%. Through the teaching reform, students' ability to analyze and solve problems, practical

Table 2. Students' evaluation of teaching effect

Item	Evaluation		
	Good effect	General effect	Poor effect
Improve learning initiative	86.5%	13.5%	0%
Increase classroom interest	74.3%	24.3%	1.3%
Improve team cooperation ability	83.8%	14.9%	1.3%
Improve autonomous learning ability	85.1%	13.5%	1.3%
Improve engineering practice ability	78.4%	21.6%	0%
Improve the ability to analyze and solve problems	74.3%	24.3%	1.3%

innovation ability and teamwork ability have been significantly improved. In the past three years, students have participated in various subject competitions and won more than 20 provincial and ministerial awards.

5   Conclusion

Smart education, which deeply integrates modern information technology with education and teaching, is an inevitable trend of education development in the information age [7]. Under this background, the teaching reform of automobile electrical and electronic technology course is carried out with the support of modern information technology, the diversified teaching resources are built, the blended teaching model based on collaborative knowledge construction is constructed, and the diversified course assessment and evaluation system is innovated. The teaching reform has effectively enhanced the practical ability and independent learning ability of students and improved their innovation consciousness and comprehensive quality.

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