

# Teaching Reform and Practice of 'Automobile Structure' Course Based on OBE and Engineering Education Certification

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**Abstract:** "Automobile Construction" is a core professional course for automotive majors, which has strong theoretical and engineering attributes. At present, the traditional teacher-oriented teaching mode cannot meet the requirements of relevant indicators in engineering education certification, and the traditional teaching method of "teacher-centered" is easy to cause the common problems of low classroom efficiency, low class raising rate and low interaction rate of students. This paper analyzes the characteristics and teaching status of the course, and studies the construction of online and offline mixed courses and teaching reform practice based on the concept of OBE. It mainly includes the overall curriculum design based on OBE concept, the formulation of curriculum learning objectives, the reconstruction of teaching content, the design and implementation of curriculum ideology and politics, the construction of curriculum resources and the implementation of teaching, the formulation of curriculum evaluation system, the calculation and analysis of curriculum goal achievement, and the continuous improvement of curriculum. The empirical results show that the online and offline mixed curriculum construction ideas and methods are conducive to the implementation of "student-centered" teaching methods, the online and offline mixed teaching methods can effectively improve the classroom teaching effect, and the construction of curriculum evaluation system and curriculum objective system can comprehensively and effectively assess the comprehensive quality of students.

**Keywords-**Engineering education certification; OBE; Online and offline mixed teaching; Achievement degree of curriculum objectives; Teaching reform

## 1. Introduction

In June 2016, China officially became the 18th member of the Washington Accord, marking a significant step forward in China's opening up of higher education to the outside world. The quality standards of engineering education in China have achieved international substantive equivalence, and the quality of engineering education has reached international standards. The Washington Accord explicitly proposes to integrate Outcome Based Education (OBE) into the certification standards for engineering education. The OBE concept is the theoretical foundation of engineering education professional certification, and engineering education professional certification is the application and embodiment of the OBE concept in practice. Both core concepts are student-centered, result oriented, and continuously improving educational quality

[1]. In October 2019, the Ministry of Education issued the "Implementation Opinions on the Construction of First-Class Undergraduate Courses", which explained the connotations of "high-order", "innovation", and "challenge", namely "gender equality", and made this content the basic principle of first-class undergraduate course construction. The specific content of first-class undergraduate course construction includes "concept transformation, goal orientation, ability enhancement, method reform, and evaluation reform", This provides a basic basis for the construction of first-class undergraduate courses [2]. Muhammad [3] believes that the overall shift from non-OBE to OBE demonstrates the superiority of the new education system in student learning, subject delivery, and teaching technology. Timpson's [4] research has shown that the current certification process cannot achieve its predetermined outcomes and cannot improve the alignment between student learning and professional expectations. Chan [5] introduced a dynamic OBE model that explicitly incorporates evaluation scores into the OBE matrix, and quantitatively and qualitatively validated it. Correlation comparison shows that the dynamic OBE model achieved higher accuracy, indicating a close correlation between program outcomes scores and actual student performance.

In the context of engineering education professional certification, OBE concept, first-class curriculum construction, and rapid development of automotive technology, the construction of the "Automotive Construction" course is facing new development opportunities and challenges, which inevitably puts higher requirements on classroom teaching. It is necessary to reform traditional teaching to become a "golden course" or "first-class course".

## **2. Analysis of Course Characteristics and Teaching Status**

Automotive Construction is an important compulsory course for automotive majors, which is highly theoretical, practical, and covers a wide range of topics with a wide range of knowledge points, whose aim is to cultivate students' ability to analyze practical engineering problems of complex automotive structures using basic knowledge such as mechanics, and power electronics, and to strengthen their engineering application abilities.

In the actual process of curriculum teaching, there are problems such as a large number of knowledge points, insufficient class hours, weak connection between theory and practice, inability to meet the requirements of cultivating applied talents for both genders, outdated teaching concepts, insufficient integration of information technology and teaching, and disconnection between knowledge transmission and curriculum education, which ultimately lead to passive learning, decreased learning interest, serious phenomenon of playing with mobile phones in the classroom, and low classroom leadership rate outstanding issues such as unwillingness to participate in classroom teaching activities. In terms of course assessment and evaluation methods, teachers are still accustomed to using a final exam paper and regular attendance as students' learning outcomes, lacking evaluation of process and implicit knowledge.

Based on the characteristics of the above courses and the current teaching situation, this course introduces the OBE concept, the classroom teaching concept of "student-centered and teaching led, and relies on Chaoxing Learning to carry out online and offline hybrid curriculum construction and classroom teaching reform, in order to create an efficient classroom for students to learn independently and teachers to teach efficiently.

### **3. Teaching Reform of the Automotive Construction Course Based on OBE**

#### **3.1. Introduction to OBE**

The OBE concept is an advanced educational philosophy, namely outcome-oriented education, also known as goal-oriented education or demand oriented education. It is a curriculum system construction concept that is result oriented, student-centered, and adopts a reverse thinking approach [6]. Under the OBE, teachers need to clarify teaching objectives and expected learning outcomes, and design course content and teaching methods in reverse based on outcomes to guide students to achieve expected outcomes. The application of OBE in engineering education professional certification helps to promote the construction of new engineering disciplines, providing a theoretical basis for engineering education professional certification and the construction of new engineering disciplines.

#### **3.2. Overall Course Design Based on OBE**

In order to cultivate applied talents who can be engaged in automotive product structure design, used car performance appraisal and price assessment, accident vehicle damage survey, automobile fault diagnosis and repair, automobile maintenance and other jobs, based on the OBE concept, graduation requirements and advanced requirements of the course, this course restructures the teaching content and actively integrates ideological and political elements. And carry out the integration design relying on information technology to complement the inside and outside of the course, the deep integration of online and offline, at the same time, develop a diversified and process-based curriculum assessment evaluation and goal achievement evaluation. The overall course design process under the OBE concept is as follows: Following the OBE concept to determine the hierarchical course learning objectives that integrate knowledge, ability and quality. Secondly, reconstructing the teaching content, excavate the ideological and political elements from the five levels of state, spirit, personality, intelligence and scientific view, and integrate them into the teaching content. Then, combing teaching resources, online and offline mixed teaching design and implementation. Finally, developing a diversified, process-based and intelligent curriculum evaluation system and curriculum goal achievement evaluation system.

#### **3.3. Course Learning Objectives**

Based on the OBE teaching concept, top-down and reverse design is adopted, combined with the job requirements of the automotive industry and enterprises, the advanced requirements of the course and the characteristics of students [1], this course reflects the student-oriented, and focuses on the cultivation of students' knowledge, ability and quality. Students are able to remember and accurately recall the main components of a car, understand the relationships between the various components of a car, and be able to analyze and explain how a car works.

In terms of ability training, students can apply the knowledge of engine construction to analyze and solve the actual complex engineering problems faced by automobile marketing, maintenance, accident vehicle inspection and damage determination, product design and manufacturing.

In terms of value shaping, students are trained to have the spirit of excellence in automobile power craftsman, students have patriotic feelings, national confidence, road confidence and

national consciousness, students have the engineering awareness of health, safety, green environmental protection and sustainable development of the automobile industry and the awareness of domestic automobile brand innovation.

### **3.4. Reconstruction of teaching content**

Based on the principles of learning output and problem orientation, and adapting professional direction to the needs of the automotive industry, according to the course learning objectives, the teaching content is integrated and optimized into nine modules and 27 questions, aiming to stimulate students' interest in learning and cultivate their ability to analyze complex structural engineering problems in automobiles using basic knowledge such as mechanics, mechanics, and power electronics. At the same time, the selection of course teaching content emphasizes the "four combinations", which are combined with the knowledge and skills required for the job positions those students will engage in after graduation, course ideological and political education, era development, and virtual simulation technology.

### **3.5. Overall Design and Implementation of Course Ideological and Political Education**

According to the Guiding Outline for Curriculum Ideological and Political Construction in Colleges and Universities, teachers seek the integration point of curriculum ideological and political education with a view to the objectives of curriculum ideological and political construction, the specialty characteristics of the discipline and the cultivation of students' professional quality. In addition, from the five levels of national, spiritual, personality, intelligence and scientific view, we will explore the national sentiment, health, safety, environmental protection and sustainable development concept, the spirit of craftsmanship, the innovation consciousness of domestic independent brands, Marxist epistemology and methodology and other relevant moral education elements. Then, we will design the presentation mode, collect teaching resources for processing and collating, and compile cases.

### **3.6. Course resource construction and teaching implementation**

This course adopts a hybrid teaching mode of "MOOC+SPOC", relying on information technology tools such as the "Super Star Platform" on the computer end, "Learning Pass" on the mobile end, Tencent Meeting, WeChat, etc. to deeply integrate with the course teaching. At the same time, the "AEEA" teaching mode is integrated throughout the entire process of online and offline hybrid course teaching, creating a modern classroom empowered by modern information technology.

In terms of teaching resource construction, this course relies on the Chaoxing platform to construct SPOC resources based on the main line of course and chapter guidance, task points, topic discussions, auxiliary learning materials, expanded reading, unit test. In order to enrich SPOC video resources, we will use the high-quality resources of "Automotive Construction" from the MOOC platform of Chinese universities.

In terms of course teaching implementation, the entire teaching is divided into three stages: before class, during class, and after class. In the first stage, students engage in online self-directed learning before class. In the second stage, offline classroom teaching during class. Teachers use the learning app's screen casting function to carry out interactive teaching in the classroom, including attendance, selection, topic discussion, in class practice, and voting, guiding students

to actively think. At the same time, students report and explain the questions raised before class based on pre class preparation materials and PPTs. In the third stage, students use the Learning Platform to complete extended reading and homework after class, apply the knowledge they have learned to solve new industry problems.

### 3.7. Course assessment and evaluation system

OBE emphasizes course assessment and evaluation, which is one of the main measures for continuous improvement of courses. To reform the curriculum learning evaluation method that mainly focuses on assessing students' knowledge memory, understanding, and mastery, with final written exams as the main form and teacher assessment as the main body, this course adopts a multi-dimensional, diversified, and hybrid curriculum evaluation system based on the Chaoxing platform. The final grade in this course is a percentage system, using a combination of formative evaluation (accounting for 60%) and outcome evaluation as assessment methods.

### 3.8. Calculation and Analysis of Course Goal Achievement and Continuous Improvement

The expected achievement of course objectives is mainly based on factors such as classroom performance of students during the teaching process, feedback from after-school teaching, quality of homework completion, and difficulty level of final exams. The subjective expected achievement is determined by the course teacher after comprehensive judgment and thorough discussion by the course team, and the expected achievement degree of this course goal is shown in Table 1.

**Table 1** Degree of expected achievement of curriculum sub-objectives

	objective 1	objective 2	objective 3	Overall objective
Expected achievement degree	0.75	0.75	0.70	0.78

There are two methods for evaluating the achievement of course objectives: direct evaluation and indirect evaluation, or a combination of the two. This article adopts the direct evaluation method, and the evaluation results serve as the basis for continuous improvement of course objectives.

Based on the student's assessment results, the ratio of the average score of the assessment content supporting the course objectives to the target value is used to obtain a direct evaluation value of the achievement of the course objectives.

The direct evaluation formula for the achievement of course objective n is as follows [7]:

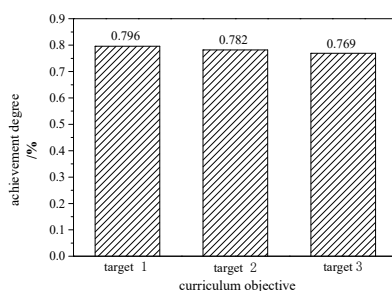
$$C_n = \sum(A_m \times B_m) / \sum(A_m \times O_m) \quad (1)$$

In above formula,  $C_n$  represents the direct evaluation value of the achievement of the nth course objective, n is the number of assessment stages for the nth course objective ( $n=1, 2, 3, \dots$ ), and  $A_m$ ,  $B_m$  indicates the percentage of the nth course objective and the mth assessment stage in the overall assessment, the actual score of the student in the assessment stage m of the nth course objective, respectively, while  $O_m$  is the target score of the nth course objective assessment stage m.

The evaluation results of course goal achievement should be applied to the continuous improvement of course teaching, including teaching design, teaching content, teaching methods,

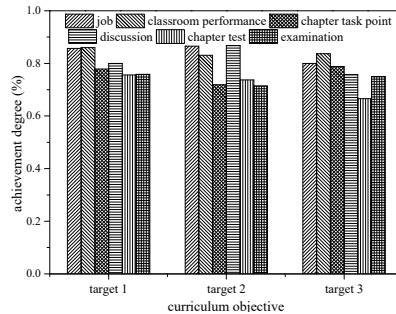
assessment methods, and teaching resources. The evaluation of the degree of achievement of course objectives is the basic indicator for judging the achievement of talent cultivation goals. The evaluation and analysis results directly affect subsequent continuous improvement and are one of the key links to ensure the quality of talent cultivation [8].

The implementation of the teaching process of this course includes different assessment stages such as discussion, homework, task points, chapter tests, in class tests, mid-term exams, and final exams. The evaluation of the achievement of the course objectives is the scores of each assessment stage as data for evaluation. The evaluation of the course objectives is the weighted sum of the contributions supporting each stage of the course objectives, which is the degree of achievement of the course objectives. According to calculation method of the Formula 1, the distribution of achievement degree of the sub objectives in the automotive construction course is shown in Fig.1. It can be seen that from the Fig.1 the achievement of course objectives 1 and 2 are both above 0.75, and the achievement of objective 3 is above 0.7, indicating that the achievement of each sub objective has reached a good level. In fact, the order of course objective 1-3 is exactly the same as the teaching progress, indicating that students have always maintained a good level of learning enthusiasm.



**Figure 1.** Sub-target achievement degree of course assessment

The achievement degree of each evaluation stage in course assessment is shown in the Fig. 2. It can be seen from Fig. 2 the achievement degree of chapter tests and exams (mid-term and final) is close to the expected value in Goal 1. The reason is that chapter tests belong to online self-learning and use extracurricular time to complete the task. Students lack self-learning ability and cannot fully grasp the knowledge points. In addition, the content in this course is too much and too complex, making it relatively difficult for students to fully grasp the structural systems of various types of cars. So the next step in course improvement is to further streamline and condense the content. In goal 2, the achievement degree of chapter task, chapter tests, and exam is less than the expected value of 0.75. The main reasons for the above situation are as follows: The effectiveness of self-directed learning on the front line of class is not very good, and most students lack the habit of self-directed learning. Secondly, the basic theories and knowledge of mathematics, mechanics, machinery, materials and heat learned in the early stage are not solid enough, and the ability to apply these knowledge to analyze and explain the working principle of vehicle system, mechanics and other complex engineering problems is still relatively lacking.



**Figure 2.** Achievement degree of each evaluation stage in course assessment

The evaluation results of achieving course objectives will be used for continuous improvement in the subsequent teaching process. In response to the problems and shortcomings identified in the evaluation of course objectives, the teacher will analyze the specific reasons and provide improvement suggestions in this teaching summary. Subsequent teachers should address previous issues and suggestions, implement improvement plans in the teaching plan, and implement them in the teaching plan.

#### 4. Conclusion

In the context of engineering education certification, based on the OBE concept, the teaching reform and practical application of the "Automobile Construction" course were carried out. The course learning objectives, teaching content, ideological and political design, course resource construction and teaching implementation, teaching effectiveness evaluation, course goal achievement and continuous improvement were introduced. In the practice of curriculum and teaching reform, results oriented and relying on the Chaoxing platform, SPOC courses have been built, achieving deep integration of courses and information technology. A relatively reasonable curriculum assessment and evaluation system has been developed, achieving course goals and continuous improvement, enhancing the effectiveness and efficiency of classroom teaching, and laying the foundation for building first-class courses.

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