

## Research Article

## Teaching Design and Practice of “Automobile Engine Structure and Principle”

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**Abstract:** The integrated education from secondary vocational education to undergraduate education means the integration between secondary vocational education and applied undergraduate education. Secondary vocational students can be promoted to undergraduates by upgrading examination after graduation. Automobile engine structure and principle is a compulsory professional course for undergraduate students majoring in automobile service engineer in Shanghai University of Engineering Science, and also is the core professional course of Shanghai City Science and Technology School. It is only different in teaching emphasis in different stages, but for the moment there are still lots of repetitive contents. By sorting out the knowledge points of the curriculum, designing the course contents at different stages and reforming the teaching methods on the basis of the specific course contents, the teaching effect of automobile engine structure and principle in the integrated education from secondary vocational education to undergraduate education will be greatly improved, so as to cultivate talents and promote the further development of the integrated education from secondary vocational education to undergraduate education.

**Keywords:** vocational education to undergraduate education, professional course of Shanghai City Science and Technology School.

### INTRODUCTION

In 2014, the project of the integrated education from secondary vocational education to undergraduate education was officially launched in Shanghai (Chen, J. 2016). The integrated education from secondary vocational education to undergraduate education means the integration between secondary vocational education and applied undergraduate education. Secondary vocational students can be promoted to undergraduates by upgrading examination after graduation. In general, the schooling length of the integrated education from secondary vocational education to undergraduate education is 7 years that contains 3 years' secondary vocational education and 4 years' undergraduate education. The integrated education from secondary vocational education to undergraduate education is generally a type of major with strong maneuverability and technical skills (such as vehicle maintenance, vehicle detection, etc.). Students need to participate in the interview organized by secondary vocational schools. According to the results of the middle school

entrance examination, the best students will be chosen to study in secondary vocational school. At the end of the third academic year, these students need to take part in unified examination of colleges and universities. In accordance with half of academic performance and half of skill tests, the eligible students will directly study in the university, and the others will obtain the diploma of secondary vocational school.

In January 2016, Shanghai University of Engineering Science, in cooperation with Shanghai City Science and Technology School, has declared the scheme of the integrated education from secondary vocational education to undergraduate education training mode for the major automobile service engineering. The scheme has been unanimously approved by experts in Shanghai Education Evaluation, and the first batch of students were enrolled in September 2016. At present, this scheme is the only one that takes automobile service engineering as the pilot specialty, and it is also a beneficial way to explore the

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cultivation of advanced technical applied talents in automobile service engineering through the implementation of the long-schooling teaching model in Shanghai. Automobile service engineering professional curriculum system of the integrated education from secondary vocational education to undergraduate education focuses on cultivating students' ability. Secondary vocational education and undergraduate education have a clear division of work and integrate mutually. Students need master the cultural basis, focusing on increasing professional practice ability and accumulating operational experience during 3 years in secondary vocational school. Moreover, four years' undergraduate curriculum focuses on training students to master the theoretical basis of the major, from theory to practice, and then get to a higher level of practical ability. Therefore, the entire professional curriculum system requires the advantages of the automobile operation and maintenance major, and university need arrange courses about professional ability and practice (Qihua, M. *et al.*, 2018). The course automobile engine structure and principle is the core course of automobile service engineering in the integrated education from secondary vocational education to undergraduate education, and its construction that sorts out the knowledge points according to different stages has become an important task for the teachers, According to the characteristics of different stages and different teaching contents in different stages, different teaching methods should be adopted.

### 1. The Necessity of Reforming the Curriculum

The course automobile engine structure and principle mainly covers the knowledge of automobile engine structure and automobile engine principle (Qingguo, W. *et al.*, 2016). Now a lot of colleges and universities in China have established automobile engine structure and automobile engine principle in the curriculum of vehicle engineering or thermal engineering. In general, automobile service engineering is set up in the school of automobile engineering. Therefore, these two courses belong to compulsory professional courses of automobile service engineering. The teaching content of automobile engine structure focuses on engine structure, emphasizes on structure and cognitive practice, and does not involves deep theory. The automobile engine principle teaching content focuses on the principle of engine, emphasizes on theory, and requires students to have solid theoretical knowledge and application abilities (Jiarui, C. 2010; Jing, D. 2009).

Automobile engine structure and principle is a compulsory professional course for undergraduate students majoring in automobile service engineering in Shanghai University of Engineering Science, and also the core professional course of Shanghai City Science and Technology School. It is only different in teaching emphasis in different stages, but for the moment there are still lots of repetitive contents. In view of the increasing class hour of secondary vocational schools and colleges, and in order to avoid repetition and some gaps in the teaching content, secondary vocational schools and colleges must focus on the characteristics of students at different stages to sort out the knowledge points of the integrated education from secondary vocational education to undergraduate education curriculum, and construct a curriculum system and teaching method which is suitable for the integrated education from secondary vocational education to undergraduate education after implementing this integrated education.

### 2. Teaching Contents Design

The course automobile engine structure and principle has 32 class hours respectively in secondary vocational education and undergraduate education, and totals 64 class hours. In consideration of the breadth of the automobile engine structure and the depth of the automobile engine principle, it is very important for every teacher to think about how to enable students to master the knowledge of automobile engine structure and principle related to the professional training goal within limited 64 class hours, and effectively cultivate students' engineering and innovation ability. Students in secondary vocational school do not have solid theoretical knowledge, but they possess a certain cognitive ability about structure. With the growth of age, the accumulation of knowledge, students' theoretical knowledge structure has been continuously improved. So, the teachers should comb the course content overall, and divide the teaching content into the secondary vocational and undergraduate stages. The main contents of the course automobile engine structure and principle include the overall structure of the automobile engine, valve train, the crank-rod mechanism, fuel delivery system, cooling system, lubrication system, ignition system, the engine air induction and exhaust principle, combustion principle, engine performance parameters, engine characteristics and engine pollution control. To this end, we should plan the teaching content at different stages in the process of implementing the integrated education from secondary vocational education to undergraduate education, as shown in Tab. 1.

**Tab. 1 Teaching content designed in different stages**

Contents	Secondary vocational education	Undergraduate education
Teaching contents	Overall structure of automobile engine, Basic structure of valve train, Crank-rod mechanism, fuel delivery system, cooling system, lubrication system and ignition system	Engine air induction and exhaust principle, combustion principle, engine performance parameters, engine characteristics and engine pollution control.
Practice contents	Disassembling and assembling engine in a laboratory	Engine principle test

### 3. TEACHING METHOD REFORM

Nowadays, teachers often beam with joy and speak with fervour and assurance in the classroom, but students are so sleepy that they cannot interact with teachers at all (Yongjiang, S. *et al.*, 2012). In order to eliminate this situation and continuously improve the quality of education, the reform of teaching methods is imperative. Teachers should choose different teaching methods in accordance with the course content.

#### (1)Spot Teaching

Since the former part of the course automobile engine structure and principle mainly contains the structure and characteristics of the components of the engine. It is difficult to have a deep understanding of the structure of the parts by using courseware and parts drawings and explaining in the class. Combined with the abundant laboratory resources in Shanghai City Science and Technology School, teachers should organize the students to go to the laboratory to know about the parts during teaching time. At the beginning of the course, vo'okteachers could organize students to go to the laboratory to understand the engine parts, and roughly explain eight parts of the engine. After that, teachers in the classroom, must explain the theory in detail, asks questions about the knowledge of the engine, and deepen the students' understanding of the engine structure. Finally, students are organized to observe and map engine in the laboratory based on the theoretical knowledge they have learned. By this kind of repeated teaching between laboratory and class, students can fully master the structure of engine parts.

#### (2)GROUP DISCUSSIONS

Since the later part of the course automobile engine structure and principle mainly contains the working principle of automobile engine and the influential factors of engine characteristics, and it has relatively deep theories. It would inevitably cause boring class and students lose interest in learning with teachers' explanation merely. When students learn automobile engine principle, teachers can divide the teaching content into different topics, such as engine air induction and exhaust topics, gasoline engine combustion topics, diesel engine combustion topics, engine performance test topics. Teachers can divide the class into several groups. After finishing a topic, a team would be required to combine the learned knowledge, understand the forefront of knowledge about the topics,

consult literature and network and make PPT to explain and solve some questions better within twenty minutes in class. Taking this section as a part of the grades strengthens students' emphasis on the discussion. Practice shows that this method can effectively improve students' learning enthusiasm, exercise students' ability to consult materials, analyze and solve problems, and cultivate students' sense of teamwork and cooperative spirit.

### 4. CONCLUSION

Automobile engine structure and principle is the core professional course of automobile service engineering major of the integrated education from secondary vocational education to undergraduate education in Shanghai University of Engineering Science and Shanghai City Science and Technology School. In order to cultivate and improve students' practical engineering ability and innovation ability, the following points should be achieved:

1. Teachers from these two school should timely communicate that the knowledge points of the course automobile engine structure and principle, which is a professional course of the integrated education from secondary vocational education to undergraduate education, must be neither repeated nor omitted.
2. College teachers organize teachers from two schools to sort out the knowledge points of the courses, and design the teaching contents at different stages reasonably according to students' characteristics and knowledge structure.
3. Teachers should strengthen the interaction between teachers and students, reform the classroom teaching mode. Spot teaching and organizing seminars would deepen students' understanding of automobile Engine structure and principles and train students to solve practical problems flexibly with the theoretical knowledge, engineering ability, innovation ability and teamwork consciousness.

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