

The Teaching Implementation and Effect of “Scientific and Technological Innovation Practice Activities of Vehicle Engineering Specialty” under the Background of “New Engineering”

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Abstract—The demand for "new economy" construction makes colleges and universities must speed up the promotion of "new engineering", training a large number of vehicle engineering technology innovation talents has become an urgent task for the development of the automobile industry. Taking the course of scientific and technological innovation practice of vehicle engineering as an example, this paper focuses on training students' innovative practical ability on the basis of paying attention to the training of students' innovative thinking. In the course of teaching, through the combination of teaching resources and the integration of existing high-quality hardware and software platforms, studying the characteristics and rules of the current industrial development, improving teaching methods and assessment methods, and increasing practical training. This teaching method, which constantly optimizes the course, has effectively explored the cultivation of students' scientific and technological innovation ability and practical ability. This course reflects the multi-disciplinary characteristics of vehicle engineering projects and focuses on the talent service-oriented area, which enables students to apply the methods of engineering management and economic decision-making to relevant engineering practices, and provides certain reference and basis for the further revision of vehicle engineering professional talent cultivation plan.

Keywords—new engineering; scientific and technological innovation practice; teaching implementation; results

I. INTRODUCTION

At present, developed countries are actively promoting the development of "new economy" and seizing the commanding heights of the industrial and technological revolution on the level of national strategy. Introduction and development of new technologies such as industry 4.0, sharing economy, virtual reality and artificial intelligence are surging [1]. In the face of

the new round of development strategic opportunities facing China, the ministry of education as early as February 18, 2017 organized universities to hold a higher engineering education development strategy seminar, put forward the concept of new engineering, the concept of new engineering is also a change in the concept of engineering talent training. The meeting made it clear that the construction of " new engineering " will play a very key role in accelerating the cultivation of talents and successfully realizing the transformation of China's industrial and technological fields from catching up and following to running. The automobile industry must also comply with such major national strategies as " innovation-driven development", "made in China 2025", " Internet + ", "network power" and "One Belt And One Road" [1], to break the long-term backward situation of China's traditional automobile industry technology. In the current new energy and unmanned driving technologies, we hope to break through the core and key technologies, build first-mover advantages and occupy the strategic commanding heights in the future global automotive innovation ecosystem. Talent is an indispensable resource to promote the growth of the new economy, colleges and universities shoulder the important task of cultivating national higher talents. Engineering education and industrial development are closely linked and mutually supported. It has become an urgent problem for higher education to break through the previous passive acceptance of knowledge by students and meet the requirements of " new engineering " construction on talent cultivation.

Scientific and technological innovation practice of vehicle engineering major is a compulsory course for students majoring in vehicle engineering, accounting for 0.7 of the weight in the course system. It is required to reflect the cultivation of students ' innovative thinking, innovative ability and engineering practice in the course teaching. There are many pre-courses involved in this course, including

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engineering drawing, engineering material A, mechanics of materials, theoretical mechanics, principles of mechanics, principles of the automobile and automobile design, etc, which require students to be able to integrate many knowledge points and apply them flexibly. Meanwhile, with the rapid development of automobile technology, new knowledge and content of automobile-related technology are emerging constantly. How to train students' innovative thinking and innovative ability in teaching to achieve the training goal of vehicle engineering major, it is necessary to discuss the teaching implementation and achievements of the course.

II. THE CHARACTERISTICS OF THE CURRICULUM AND EXISTING PROBLEMS

The course "scientific and technological innovation practice activities of vehicle engineering major" was opened in the seventh semester. By this time, students have already acquired the most basic and professional knowledge. Prior to this course, the pre-course examination is usually completed by a written examination, which leads to the lack of horizontal connection with pre-course knowledge among students, not to mention the mastery of each other. Therefore, how to effectively carry out teaching needs to consider the following aspects.

A. *The applicable teaching materials are relatively inadequate.*

The teaching of this course needs the organic combination of several links. On the basis of fully grasping the two characteristics (students have the innovative ability and certain practical ability), one is to enlighten and train students' innovative thinking, and the other is to reflect the assessment of students' practical ability in teaching according to the characteristics of the major. Due to the compilation and publication of teaching materials that need a certain amount of time[2], as well as the constant summary of innovative thinking and emergence of new technologies, teaching materials suitable for college students, especially students majoring in vehicle engineering, are very scarce, which affects the development of teaching to some extent.

B. *The teaching method is relatively single.*

In teaching, teachers teach in class. Due to fewer class hours and insufficient interaction with students, students cannot be effectively mobilized to participate in class. At the same time, too large a proportion of teachers and students choose courses, so that teachers cannot fully grasp the learning progress of students, especially the students' innovative thinking can not be effectively enlightened and cultivated.

C. *Students are in a passive state.*

The primary purpose of the teaching implementation of this course should be focusing on training students' ability of scientific and technological innovation. However, students are limited by limited resources, which leads to a situation of inactive or even rigid think. Therefore, students cannot make use of existing knowledge to conduct creative thinking but rely on teachers to specify the direction of innovation. This passive state is not conducive to students' own development and does

not meet the requirements of training objectives. Therefore, this situation must be changed through teaching reform.

D. *Students lack the ability of innovative thinking and do not understand the significance of innovation*

The training of creative thinking ability is a complex process. There is no corresponding course of training students' innovative thinking in the advanced courses, which has caused a lot of trouble for the teaching of the courses. However, the assessment target of the courses is that students can use the innovative thinking mode to improve existing auto parts or create new structures. For students, it is necessary to expand their thinking scope in various ways and break through the stereotypical thinking pattern. However, there is no theoretical class hour in the teaching plan. Facing the problems of insufficient class hours and uneven comprehension ability of students, how to comprehensively cultivate innovation ability in the implementation process of teaching has become a difficulty in teaching. On the other hand, various systems of automobiles have been basically mature after more than one hundred years of development. It is easy to form in the minds of students who are just beginning to learn automobiles that automobiles have evolved and formed without further innovation, or that beginners are unable to surpass the impression of predecessors, thus causing more troubles to the development of teaching. Innovation is not only the soul of national development but also the foundation of students themselves. How to make students understand the important significance of innovation for the country and for their own development is also an urgent problem to be solved in teaching.

E. *The assessment method cannot reflect the innovation and practice process*

A course paper at the end of a class can only reflect students' writing ability to a certain extent. Class of the course paper can only to a certain extent, reflect the students' writing ability, can not fully reflect students' ability to acquire new knowledge, innovation ability and the corresponding practical ability, and lack of objective evaluation of the students is not conducive to stimulate students' learning enthusiasm. At the same time, the grades in feedback do not improve the quality of teaching archives, it is necessary to explore and establish an effective assessment of the whole process of monitoring the way.

III. TEACHING IMPLEMENTATION OF THIS COURSE

According to the teaching plan, scientific and technological innovation practice activities of vehicle engineering major is a compulsory course, with a weight of 0.7 in the matrix table of the course system. It is an important course that requires students to master the knowledge points of the pre-course and train the ability of innovation and practice. Therefore, in view of the above problems, it is necessary to make a careful exploration, through the implementation of the curriculum, to enable students to acquire the following three aspects of ability: Ability to analyze and improve complex engineering problems of vehicles with reference to literature, and to obtain effective conclusions; Able to grasp the multi-disciplinary characteristics of vehicle engineering projects and apply engineering

management and economic decision-making methods to relevant engineering practices; Understand the requirements of technological progress for knowledge and ability, have a certain self-learning ability and lifelong learning awareness. In the course teaching, the following aspects are explored.

A. Timely supplement the new knowledge of automobile technology and make up for the shortage of teaching materials

The major vehicle engineering has two directions: automobile design and automobile electronics. The chassis platform modular technology, the new material and forming technology of the automobile body, the safety engineering technology and the intelligent technology of automobiles are developing rapidly in the future. In the teaching process, students are required to master relatively solid basic knowledge, and meanwhile, the introduction of relevant new technical knowledge points can inspire students' enthusiasm for innovation, so that students can track the development of cutting-edge industries at school, and lay a solid foundation for improving the adaptability and competitiveness of posts.

B. Building a teacher-led team and change the single classroom teaching mode

Considering the major direction of teachers themselves and the teacher-student ratio, in the teaching reform, the single classroom teaching is changed into after-class tutoring, and the teaching mode is changed from a single teacher to a teacher-guidance team tutoring at the same time. The teacher guidance team equipped with the course is composed of different titles, teaching ages and degrees, and a provincial famous teacher participates in the guidance, which makes the knowledge structure and teaching ability of the teacher guidance team more reasonable. Students can choose from teachers according to their own professional direction, subject direction and scientific research professional direction. The teacher-student ratio tends to be reasonable, and it is no longer limited to the limited classroom teaching practice. Students can enter the scientific research laboratory or open laboratory of teachers to communicate fully with the instructor, which improves the teaching effect.

C. Changing the passive into the active, and actively guide students to strengthen their own innovation ability training

Institute has for students to use the server as the core of the design of the platform, built a small car processing center, wire cutting, small bench lathe, co2 protection welding machine, profile cutting machine, hand arc welding machine, inverter dc argon arc/hand arc welding machine, 200 mm bench grinder, drill press, welding platform, etc. The automobile traffic experiment center has established a complete and open laboratory of automobile structure, automobile electronics, engine, automobile test, automobile performance, automobile test, etc., with the openness of the laboratory reaching 100%. Provide the necessary conditions for the development of curriculum teaching in hardware and software, greatly stimulate the enthusiasm of students to use existing conditions to carry out scientific and technological innovation activities. Predominantly virtual subject status changed in the past,

students can act according to their own interest to participate in the teacher's scientific research, laboratory or other national provincial students participating in the project, offered to innovation direction and to formulate the corresponding subject, combining with the characteristics of the requirements of the project and to carry out scientific and technological innovation activities, in the actual training, cultivate their innovation ability.

D. Transforming students' innovative achievements through multiple channels, and get through the credit recognition channel

Since 2007, the school of automobile and transportation has established a number of innovative platforms for college students to participate in China formula fuel automobile competition, China formula college electric vehicle competition, China intelligent automobile competition, China Baja automobile competition and China Honda automobile energy-saving competition. The number of students participating in the competition has basically covered 50% of the students, and the proportion is increasing year by year. Students have made innovations in the application of automobile chassis, automobile bodies, automobile materials and automobile electric control. According to relevant documents of the college, students who participate in the team can summarize these innovative achievements and form related papers or apply for related patents, which will be recognized in this course. On the one hand, these measures greatly encourage students to participate in the work of the team, and on the other hand, summarize the innovation formed in the work, which is conducive to the inheritance of the work of the team. Some students can also summarize the scientific research results formed by applying for the innovative projects of the school or participating in the scientific research projects of teachers, and get innovation credits after passing this course.

E. Cultivating students' innovative thinking ability

Break through the traditional teaching methods in teaching, and rationally use a variety of teaching methods, such as group discussion and the flipped classroom. By explaining the characteristics and causes of various innovative thinking, the students will be inspired to develop their logical thinking ability and master and apply the corresponding methods and skills, such as the deductive method, inductive method and analogy method. Putting the automobile into the background of the Internet era for innovation greatly expands the vision and forms a large-scale innovation in the human-vehicle-road-environment mode. Students focus on thinking about how to guarantee the safety of human beings to the maximum extent in the human-vehicle-road-environment environment.

F. Teaching students in accordance with their aptitude in the course to inspire students to track cutting-edge industry trends

In today's Internet age, the car is no longer a simple means of transportation. The car is developing towards the electric and intelligent driverless direction, and it is just a node on the Internet. The automobile knowledge taught to students in the course system is still in the traditional basic knowledge, which

is seriously out of line with the development of the automobile industry in terms of automobile chassis, body and electric control, as well as manufacturing technology. Innovation not only requires the application of innovative thinking but also requires the creation of innovative design concepts. In teaching, students are required to update their knowledge. Firstly, students should read at least 20 journals published in the last year. The second is to explore the latest application of new technology in the network, to inspire their own. On the other hand, given that the major of vehicle engineering has two directions (automobile design and manufacturing and automobile electronics), the knowledge students have is quite different. In the teaching, students in these two directions are inspired to teach according to the different professional knowledge they have. Students in the direction of automobile design and manufacturing are guided to focus on the innovation of automobile body and chassis structure and manufacturing technology, and students in the direction of automobile electronics are guided to focus on the innovation of automobile electronic control. Secondly, considering students' different degrees of professional knowledge, we will give targeted guidance to maximize students' ability to combine classroom knowledge with the dynamic development of the industry for effective innovation.

G. Applying the methods of engineering management and economic decision-making to the relevant engineering practice

In the process of innovation, students should not only be instructed to compare the working principle and structural scheme applied with the original working principle and scheme, but also fully consider the application of new materials and new technologies. The content of "automobile design" and "automobile manufacturing technology" learned in professional courses will be comprehensively applied and consider the manufacturing process, formulate reasonable process step, choose appropriate material, using economic processing methods and use of the reasonable processing equipment for processing, the whole process of product development and manufacture of rational planning, have relatively large economic benefit. It breaks through the current situation that students are limited to "innovation" on paper and makes the innovation achievements more practical.

H. Tracking the innovative process of students in an all-round way, so that the assessment results can reflect the real learning situation

Change the past results from a single test paper session, students are required to complete a paper according to the requirements of scientific papers, making the student of automobile design provide 3d models and engineering drawings of typical parts of the corresponding subject when they complete the course paper, making the student of automotive electronics complete the course paper and provide the corresponding circuit diagram and circuit simulation, and take project management and economic decisions into consideration. A course website has been built, through which teachers and students can exchange information in time, and teachers can track students' progress through online and offline

ways. Teachers comprehensively evaluate students' ability to consult materials, write summary, design and drawing, project management and other abilities, and give results that reflect students' innovation ability.

IV. CONCLUSIONS AND DEFICIENCIES

A. Progress made in the current stage

1) The requirements of the implementation of new engineering construction in specific course teaching are clarified. At the same time, according to the requirements of engineering education certification of vehicle engineering major for the personnel training program, a new teaching program is formulated to comprehensively standardize the whole teaching process. The achievement of the course has been improved year by year, and the teaching materials have been certified by experts.

2) Interdisciplinary integration is one of the most important features of the construction of new engineering majors. In the process of teaching implementation, we should pay attention to guiding students to carry out scientific and technological innovation at the knowledge intersection of multiple disciplines, meeting the new requirements of new engineering teaching.

3) Encourage the students to explore topics in a variety of real engineering environments during the course. By enlightening and developing students' thinking, we have achieved one problem per person, some students put forward innovations in all sorts of contests, such as Chinese college students in formula car series, the smart car competition) in the implementation, Contribute to the improvement of competition performance.

4) A long-term mechanism has been established to encourage students to take an active part in innovative activities. The achievements of students who participate in various forms of innovative activities can be submitted in this course and obtained corresponding credits after the summary.

5) Through course teaching, students are systematically trained to break professional thinking inertia. The combination of classroom theoretical knowledge and practice enables students to carry out innovation and innovative thinking, and students have basically mastered the innovative thinking methods such as deductive method, inductive method and intellectual stimulation method, achieving better results

B. Conclusions and Deficiencies

Due to the wide scope of knowledge of the pre-requisite courses involved in this course, it needs to be further summarized to try to find a way to integrate students' existing knowledge in teaching. In teaching, it is necessary to further strengthen the application of autonomous, heuristic and exploratory teaching modes, and further explore some outstanding problems such as the lack of innovative ability of some students.

ACKNOWLEDGMENT

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