

Exploration on Teaching Reform and Construction of the Curriculum of "Integration of Professional and Innovation" in Automobile CAD

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Abstract: In the new era of innovation-driven development, it is particularly necessary for college students to carry out integrated education that combines professional theory and practice with knowledge and skills of innovation and entrepreneurship. The Automobile CAD curriculum is one of the important professional curriculums in vehicle engineering. This curriculum is a professional foundation curriculum that combines practical and application nature. Based on the concept of "integration of professional and innovation", a teaching module with strong practicality and different from traditional classroom teaching is set up to strengthen students' practical ability of innovation and entrepreneurship. Relying on various discipline competitions and teacher research projects, innovation and entrepreneurship, practice cultivation of talents and production learning research are integrated, which increases the interest of the curriculum and enhances the learning initiative of students, so as to continuously improve the quality of curriculum teaching. The author mainly discusses the ideas of curriculum construction from the aspects of teaching content, teaching conditions, teaching methods and assessment methods. Through the new teaching mode, it can achieve good teaching effect and provide a reference for cultivating innovative and application-oriented talents in vehicle engineering.

1. Introduction

With the vigorous development of the automobile industry, the automobile industry requires more and more CAD technology. CAD technology is already an essential skill for students of automobile-related specialties. Many engineering colleges offer related curriculums. Based on the professional certification requirements and concepts of engineering education, the Vehicle Engineering Department of the School of Mechanical Engineering of Shanghai Dianji University has carried out teaching reform and practice of the "Automobile CAD/CAE" curriculum [1]. The vehicle engineering major of the School of Automobile Engineering, Wuhan University of Technology, based on the SPOC (Small-scale Private Online Curriculums) teaching mode, has carried out the construction and research of the "Automobile CAD/CAE" curriculum [2]. Based on

the teaching concept of "innovation integration", our school integrates innovation and entrepreneurship education into the whole process of talent training, and makes Automobile CAD a curriculum that organically integrates professional education and innovation and entrepreneurship education. This innovation has solidly promoted the innovation and entrepreneurship education of our students, deepened the reform of innovation and entrepreneurship education, and improved the quality of innovation and entrepreneurship education in the school. This paper explores and researches the teaching content, teaching conditions, teaching methods and assessment methods, aiming to cultivate innovative and application-oriented talents who adapt to and support the future development of the automobile industry through teaching reform.

2. Teaching content

2.1. Theoretical Teaching Content

This project is guided by the specific tasks of the job positions of automobile enterprises, and sets up scientific, reasonable and practical teaching content. At present, the automobile design and production industry urgently needs compound application talents who understand both CAD design and CAE analysis, and have certain knowledge of parts design process and strong computer application ability.

The content involves seven working modules of CATIA software (drawing sketch, part design, component assembly, curved surface design, generative shape design, sheet metal design and engineering drawing), which is the most widely used work platform in automobile product design working area at present. The teaching contains automobile parts design as the main teaching content, introduces some methods for structural optimization and lightweight design of automobiles, and also incorporates the emerging multidisciplinary technology known as virtual design.

Taking the design of a pair of gear sets in the transmission part of an electric energy-saving vehicle for students participating in some competition as an example, students can use the knowledge learned in the basic curriculum teaching content of automobile 3D design to create a 3D model, use the knowledge of automobile CAE curriculum teaching content to analyze the strength and stiffness changes of gears under extreme working conditions, and check whether the design scheme meets the requirements of use. Finally, the comprehensive knowledge of curriculum teaching content can be used to create engineering drawings to guide production.

2.2. Practical Teaching Content

The Automobile CAD curriculum covers multidisciplinary content and is a comprehensive application of comprehensive and systematic interdisciplinary knowledge. The practical teaching content is combined with engineering drawing, Automobile CAD curriculum design, auto parts surveying and modeling, automobile design curriculum design, automobile manufacturing process curriculum design, automobile design comprehensive training, innovative design experiment, graduation project and other practical training links to cultivate students' professional thinking and practical skills.

2.3. Extracurricular Guidance

The method that students participate in competitions can promote the teaching effect, booster the reform of teaching mode, and strengthen the cultivation of innovative talents' ability [3]. Faculty and students organize and establish 3D design team, relying on relevant competitions and teaching team scientific research projects, realize the cultivation mode of "learning in doing" with

remarkable results.

3. Teaching Conditions

3.1. Curriculum Standards

The cultivation of engineering practice and innovation ability in application-oriented colleges and universities should focus on strengthening post competence [4]. On the basis of focusing on cultivating students' professional quality, it focuses on cultivating students' application skills, fully integrating the professional content required in automobile design and production process, realizing the integrated curriculum content of theoretical teaching and practical teaching, and finally achieving the teaching purpose of effective docking of professional knowledge and the job needs of production enterprises.

3.2. Preparation of Teaching Materials

At present, there are a lot of books about CAD on the market, but there are few books closely related to Automobile CAD. It is quite necessary to customize a set of teaching materials "Automobile CAD Technology" which is suitable for the teaching needs of vehicle engineering major.

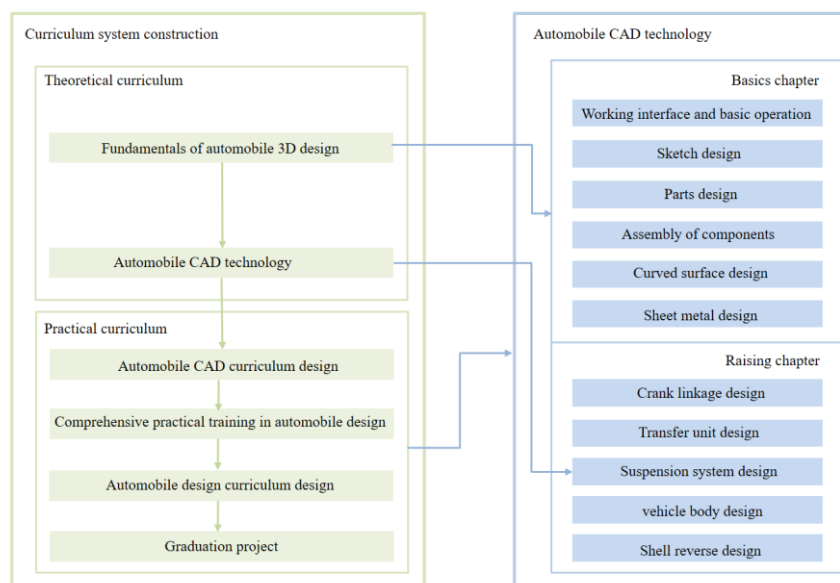


Figure 1: Teaching materials chapters and sessions of *Automobile CAD Technology* are closely related to the curriculum construction contents

In order to achieve better teaching results, the teachers of this major have customized a textbook suitable for the teaching needs of vehicle engineering: "Automobile CAD Technology". As shown in Figure 1, the textbook is based on CATIA software, combined with the design and assembly knowledge content of key parts such as automobile engines, bodies, and chassis, and adopts modular teaching, so that students can master the steps, operations and methods of auto parts design on the basis of learning modeling ideas and processes. For example, the engine module: for the modeling of connecting rods, pistons, crankshafts and other components, sketch editing, sketch creation of feature part design, and on this basis to complete assembly design. Body module: preliminary design, freeform surface design for the exterior surface of the body, and completion of

engineering drawings on this basis. Chassis module: designed around automobile transfer gear, suspension system, AT shell and other components, mainly involving generative shape design, sheet metal design, reverse design and other content.

3.3. Competition and Production Learning and Research Projects

The teaching materials are continuously expanded through competitions and the production, learning and research projects of the team of 3D innovation and entrepreneurship mentors.

3.4. Learning Resources

Another important problem affecting the teaching effect of Automobile CAD curriculum is that in the process of the curriculum teaching implementation, the class hours of the curriculum generally cannot meet the needs of theoretical and practical teaching [5].

In order to solve the above problem, the on-line curriculum of “*Automobile CAD Technology*” in the construction period makes the teaching move from solidification and closing to opening and flowing. Students can realize the professional learning of the curriculum at anytime and anywhere through the Chaoxing Learning Pass Platform. Students can preview through the video operation, shorten the time of learning new knowledge in the classrooms [6], and can exchange questions and answers with the charging teacher in the learning process.

At the same time, students are encouraged to go to bookstores and libraries to select reference books, and on the other hand, search and learn relevant materials through QQ groups and online resources (such as Mufeng. com, Wildfire Forum, China Machinery CAD Forum, Simulation Technology Forum and Baidu Library, etc.), and often check the help documents carried by the software, and try to solve their own questions in the curriculum.

In view of the practical nature of Automobile CAD curriculum, the curriculum adopts the method of teaching in the whole computer room, allowing students to operate a computer and practice while lecturing. When students encounter questions, the teacher will answer questions in a timely manner [7].

3.5. Teaching Team

The members of the teaching team are all teachers of "double teachers and double abilities", most of them are school-level and above level innovation and entrepreneurship tutors. Team members have a strong sense of social responsibility and the spirit of solidarity and cooperation, actively participate in teaching reform, have rich innovation and entrepreneurship guidance ability, and are willing to guide, help and support students in innovation and entrepreneurship.

4. Teaching Methods

4.1. Relevance Teaching

Automobile CAD curriculum is very relevant to mechanical drawing curriculum. Among them, the content of drawing foundation consistent with the chapter contents of projection, basic view, cross-sectional view expression, part drawing and assembly drawing in the mechanical drawing course. In particular, it should be pointed out that students' deep understanding and grasp of the section on drawing methods, dimensioning and tolerance annotation of flat graphics, will directly affect the success or failure and efficiency of their engineering drawings. Therefore, the content of the above chapter of engineering drawings should be taught in one lesson, supplemented by relevant

practical examples. Content related to mechanical drafting can be reviewed by assigning homework to students to reduce the limited class hours occupied by Automobile CAD curriculum [8].

The automobile industry involves a wide range of subjects and rich systems. Therefore, it is required that the teaching of Automobile CAD curriculum should be combined with relevant curriculums (such as mechanical drawing, automobile structure construction and automobile manufacturing process) [9], and various teaching approaches and methods shall be adopted, such as, CATIA 3D modeling and engineering drawing content is combined with Automobile CAD course design, automobile design course design, automobile manufacturing process course design, auto parts mapping and modeling, automobile design comprehensive practical training, graduation project and other training links to cultivate students' professional thinking and practical skills.

4.2. Case Teaching

Automobile CAD curriculum is a typical example of integrating basic theory into software practice, therefore, more time and energy shall be devoted to software operation on the premise that basic theoretical knowledge is clearly taught.

4.3. Error Correction Teaching

The operation of the software requires a lot of practice, and the corresponding error correction ability, so as to achieve a high level of operation. How to improve students' software operation ability in a limited time has become an important topic in front of teachers. A very effective way to solve the above problems is that the teacher deliberately makes some common mistakes usually made by students when explaining the relevant examples, resulting in some undue results. Then, teachers and students strive to analyze and try to solve problems, so as to achieve the purpose of expanding students' horizons and improving their ability to correct errors, thereby improving students' ability to analyze and solve problems [8].

4.4. Multiple Solutions to One Problem

A large number of practices have proved that "Multiple solutions to one problem" is a very effective way to improve the effectiveness of classroom teaching, especially in the teaching of Automobile CAD curriculum. The effective use of " Multiple solutions to one problem" can not only achieve the purpose of strengthening the connection between relevant knowledge of the curriculum to diverge students' thinking, but also achieve the purpose of edutainment and fun to improve students' intellectual curiosity.

4.5. Project Teaching

The curriculum is designed using the Project Teaching Method (PBL). The teacher sets the project tasks and then divides the students into small groups, and asks them to complete the tasks within a set time. In the process of cooperation, students should give full play to the teamwork spirit of members, share resources, help each other and mutual learn, improve together, propose different ideas for solving problems, select the best, and complete project tasks [10].

4.6. Online Teaching

Build the "Chaoxing Learning Pass" online learning curriculum, which includes operation explanation videos and hands-on practice content. On the basis of thorough explanation of relevant

basic theories, it shall be supplemented by a large number of cases practices of auto parts. Encourage students to see, practice and think more to develop students' innovative thinking, improve their subjective initiative, and ultimately achieve the integration of relevant knowledge.

4.7. Practical Teaching

The main characteristic of Automobile CAD curriculum is that it is practical and short of class hours, which determines that besides traditional classroom and experiment teaching, teachers have to make effective use of students' spare time in order to achieve better teaching effect. The effective way is to encourage students to actively participate in the practical subject competition. Such as the National 3D Digital Innovation Design Competition, the National College Students Mechanical Design Innovation Competition, the "Challenge Cup" National College Students Extracurricular Academic Science and Technology Works Competition, Honda China Energy Conservation Competition and other competitions. This not only makes up for the lack of classroom teaching time, but also improves students' engineering application ability.

4.8. Assessment Method

Considering the particularity of this curriculum, this paper plans to take the computer-based test, students' usual grades (including homework and class performance) and the final assignment (the content is: let students choose topics of interest and practical significance, use their spare time to complete the design, and according to the provided template, give the entire design production ideas and illustrations of each stage of design. This move can not only integrate students' interests into the curriculum, but also exercise students' logical thinking and image thinking ability), and evaluate students' final scores according to a certain ratio. Teaching practice shows that this grade evaluation method can not only reflect students' understanding and mastery of Automobile CAD courses, but also mobilize students' learning enthusiasm and exert their subjective initiative, in addition, it can also exercise students' thesis writing skills and abilities.

5. Construction Results

Based on the continuous improvement of Automobile CAD curriculum, the students' learning enthusiasm has been obviously improved, and the engineering application ability has been further strengthened, and good results have been achieved through curriculum learning and practical application.

(1) Students have a good response to the teaching effect of innovation and entrepreneurship curriculum reform, and the teaching evaluation is above excellent.

(2) More students have passed the 3D CAD Certification of National Manufacturing Industry Informatization.

(3) Students make full use of the learned knowledge to participate in various subjects competitions. Students have participated in the National 3D Digital Innovation Design Competition, the Chinese College Student Formula Auto Competition, SAE China Baja Competition, etc., have won many awards.

(4) By participating in various competitions, students have published many papers in public.

(5) The Automobile CAD curriculum is closely integrated with the automobile industry, supplemented by more design case practice of auto parts, which is very useful for the graduation project of students in this major. Many students have won excellent graduation projects at the school level.

(6) Institute builds the innovation and entrepreneurship base for students. Students can obtain the

comprehensive training of automobile practical skills, professional quality and engineering practical ability in the training base, so as to improve the comprehensive quality and innovation ability.

6. Conclusion

The Automobile CAD curriculum construction has distinct characteristics, the professional curriculum teaching is integrated with the elements and resources of innovation and entrepreneurship education, and the curriculum teaching modules and knowledge points setting have pertinence and practicability. The teaching link highlights the basic, research-oriented and cutting-edge nature, makes full use of information technology, assists teaching through online courses, promotes the sharing of high-quality innovation and entrepreneurship resources, and adheres to the combination of in-class teaching and extracurricular teaching. The professional teaching team focuses on cultivating students' ability to integrate theory with practice, and strengthens the organization and guidance of practical activities. The practical teaching session highlights innovative thinking methods and entrepreneurial ideology. These can effectively cultivate students' innovation and entrepreneurship ability in the study of professional curriculum, comprehensively improve the quality of curriculum teaching, and achieve remarkable results. In addition, it plays an important role in promoting the all-round development of students and promoting fuller and higher-quality employment of students.

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