

# ***Research on the Teaching Reform of Electrotechnics in Robotics Engineering Based on IEET Engineering Education Certification***

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**Abstract**—In order to improve the learning effect of electrotechnics for students majoring in robotics engineering, teachers strengthen the cultivation of students' core abilities, so as to lay a good foundation for their professional courses. The educational concept of student-centered emphasizes learning, interaction, and the combination of theory and practice based on the concept of IEET engineering education certification. An electrotechnics course integrating knowledge, theory and practice is designed. Teaching reform promotes the growth of students as the center, and gives full play to the basic role of curriculum teaching in the process of cultivating students. The teaching idea, method, means and even the whole teaching process are reformed and designed. In addition, we modularized the course content, and also carried out the construction of teaching resources and teaching team. It improves students' practical ability and innovation consciousness fundamentally. It has certain significance to cultivate the applied talents for production, service and management.

**Keywords**—Ability training; Teaching reform; Electrotechnics; Robotics engineering; IEET

## I. INTRODUCTION

The teaching reform of electrotechnics course is carried out in reform and design of teaching concept, method, means and evens the whole teaching process. The modular setting of course content, construction of teaching resources and construction of teaching team are carried out to fundamentally improve students' practical ability and innovative consciousness. The goal of teaching reform is to achieve students' core competence. The main research contents are as follows: designing teaching contents flexibly; research teaching methods, regular teaching discussion; take the ability training as the core, take the achievement as the guidance, renewal teaching idea; improve the course assessment method, pay attention to process assessment, implement multiple assessment mode; lay a solid foundation and strengthen the construction of experimental courses; demonstration guidance, project-driven, accelerate curriculum construction and continuous improvement.[1-4]

The application of teaching reform in robot engineering enables students to acquire solid theoretical knowledge and

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Key platform and major project cultivation and construction project of Guangdong Province in 2017, No. 2017GXJK219, and Higher education and teaching reform project of Guangdong Province in 2017, No. 2017002JXGG

strong basic skills training. After years of teaching reform in electrotechnics, it has aroused the enthusiasm and interest of students, improved the quality and efficiency of teaching, and cultivated the ability of students to solve complex engineering problems. The series of electrotechnics textbooks edited by the teaching team are promoted and used in Beijing institute of technology, zhuhai and other universities. Meanwhile, the team communicates with other universities to realize resource sharing. [5-7]

## II. REFORM MEASURES

### A. Flexible design of teaching content

The educational objectives and core abilities of the robot engineering major were clarified, which was reflected in the development of the teaching syllabus of electrotechnics course. this course can cultivate students with basic knowledge of mathematics, science, and mechanical engineering ability; it has the use of measuring tools and instruments for testing and experiment ability, and can design the program analysis, engineering problems with professional knowledge and practical skills; develop students' ability to design and manufacture components using computer software. Teachers design teaching contents according to teaching objectives. Modular teaching is implemented in this course. The content of electrotechnics course is divided into four modules: circuit analysis, motor and control, analog circuit and digital circuit. Each module has its own system. Each module is equipped with engineering examples to cultivate students' comprehensive quality and knowledge application ability. Modular teaching can improve the transparency of teaching content and flexibility of learning, and the teaching level is clear. Modular teaching emphasizes the close combination of theory and practice in the process of teaching, and through the organic combination of teaching content, the redesign of teaching process and the constant updating of teaching means, it cultivates students' comprehensive quality and ability.

### B. Teaching discussion and exchange

The project team will hold regular course seminars (Shown as Fig.1.), summarize and reflect, and fill in the final course analysis and evaluation form. Teachers understand the existing problems in the teaching process

and the development trend of the major, and timely adjust the teaching content and methods to meet the needs of professional development, so that students can apply what they have learned. In the process of teaching, we emphasized the effectiveness of teaching and learning of the harvest, how in the limited class to let the students grasp the learning content faster, the construction of knowledge, we paid more attention to cultivate the students' thinking method in the electrotechnics classroom, excavate the potential of students active learning and constantly give students to think for a certain time, and encourage students to participate in the teaching interaction and discussion.



Fig. 1. Course seminar

*C. Update the teaching concept*

Teachers pay attention to the cultivation of students' awareness of research-based learning and autonomous learning, to build a scientific, reasonable and effective knowledge system. The learning process of electrotechnics includes Task, Team, Talking, Thinking and reflection. Learning outcomes include the improvement of knowledge, ability and quality. Under the theory of constructivism, students' initiative is emphasized and learning is completed through teaching interaction. Through training students' independent learning ability and independent thinking ability, students' ability to solve complex problems can be cultivated, and their creativity and innovation ability can be improved. The reform included various innovation competitions and other activities into the extension of teaching, and guided students' extracurricular groups to make various relevant works in the laboratory.

*D. Focus on process assessment*

Assessment methods include assessment of learning, emphasizing assessment for learning to promote more meaningful learning. We pay attention to the diversification, effectiveness and operability of assessment forms. Thus strengthens to the student basic knowledge, the innovative thought and discovers the question, the solution question ability examination.

This course focuses on process assessment. In the teaching process, we implement diversified classroom assessment by means of chapter quiz, small project design and innovative experimental production. In addition, students' self-assessment should be adopted to strengthen their active learning awareness. We also increased the

proportion of the usual results, the experimental project assessment, improve the proportion of experimental results in the overall evaluation results. At the same time, some problems in the teaching process will be found in the process evaluation, and the teaching content and teaching method can be modified and reformed in time.

*E. Strengthen the construction of experimental courses*

Teachers strengthen the use of "scientific research tools" and strengthen the construction of laboratory hardware. To cultivate and strengthen students' ability of innovative thinking, research methods and experimental operation through innovative course contents. In the experimental class. We adopt the methods of "speaking before practicing", "speaking while practicing" and "practicing before speaking" according to the experimental content to increase the interaction between teachers and students and mobilize students' subjective initiative in learning. On the basis of some basic experiments, the experiment is specially equipped with "selected content", using the German Fischer creative group model as the experimental platform of electrotechnics to develop innovative experiments(Shown as Fig. 2.). At the same time, some small improvements are made to the experimental equipment to make it easier to operate and save components.(Shown as Fig.3.)



Fig. 2. Experimental work based on the creative model of Fischer

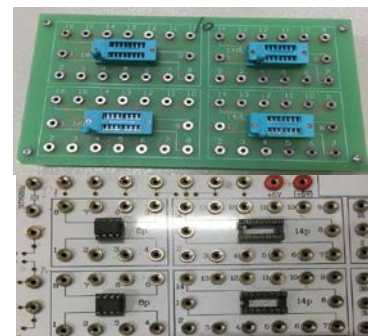


Fig. 3. Improvements of experimental equipment

*F. Curriculum development and continuous improvement*

Led by projects, teachers' teaching and research ability has been improved. We have optimized and integrated the electrical engineering curriculum system and teaching contents. The project team has compiled modular teaching materials for electrical engineering, published a systematic

teaching reform paper, and guided students to participate in scientific research and related discipline competitions. Students' learning situation is investigated by means of electrical engineering course learning questionnaire, etc. Teachers make course analysis and evaluation every semester, and make continuous improvement. In the future work, we plan to upgrade the course construction from the single course construction to the overall course system construction in the form of course group, so as to promote the overall level of course construction.

III. EFFECTIVENESS AND IMPACT OF THE REFORM

This project is aimed at the implementation of students majoring in robot engineering in grade 2017. It has achieved ideal implementation results, achieved the expected core competence and completed all the expected results.

A. The construction of curriculum system

Through the curriculum reform, the modular curriculum was set up, the syllabus and the teaching calendar were updated, and the creative combination model of Fischer was added as an innovative experimental platform to cultivate students' innovative consciousness and improve their practical ability.(Shown as Fig.4.) And through classroom teaching and three-dimensional teaching resources, students understand the latest trends in electrical technology development.

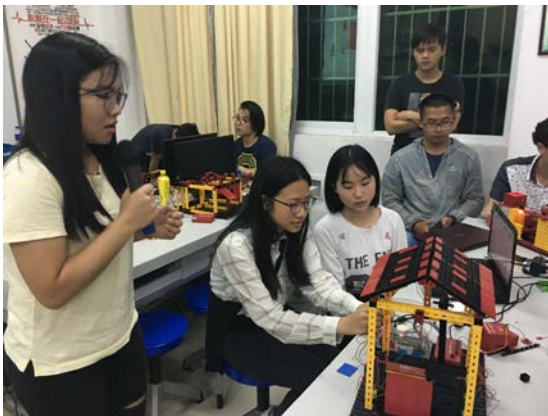


Fig. 4. A team experiment

B. Three-dimensional teaching resource construction

We have built three-dimensional teaching resources of electrotechnics, including auxiliary learning system, electronic teaching plan, network courseware, improved the production of multimedia courseware, added video, animation, pictures, analog circuit simulation program iCircuit application, improved the construction of online study question bank, and completed the construction of test question bank. At the same time, we have strengthened the construction and development of high-quality teaching resources and optimized the teaching contents of circuit analysis, motor and control, analog electronic circuit and digital electronic circuit. We have completed the self-compiled experimental textbook "electromechanical

experiment instruction book", added comprehensive and design experimental projects, opened electrician related laboratories, and added motor control experimental projects of the creative combination model of Fischer from Germany as an innovative experimental platform.

C. Textbook construction

The textbooks we have compiled include circuit analysis, motor and control, analog electronic circuit, digital electronic circuit and electromechanical experiment instruction, which have been published by chemical industry press. Electrical control and PLC application and electronic process practice were published and issued by northwest polytechnic university press, and the textbooks were promoted nationwide

D. Excellent teachers

The teaching team of electrical engineering is led by senior professors, including provincial outstanding teachers, overseas doctors and many other outstanding teachers. The team pays attention to the combination of the old, middle and young. The knowledge structure, echelon structure and age structure are reasonable. It is a teaching team with obvious discipline advantages, curriculum advantages, talent advantages and teaching and research advantages. (Shown as Fig.5.)



Fig. 5. Some members of electrotechnics course teaching team

The construction of the teaching team has its own characteristics. In the process of construction, the teaching team pays attention to teaching reform, strengthens the construction of courses and teaching materials, and constantly improves teaching methods (Shown as Fig.6.). Progress has been made in curriculum reform, teaching materials, teaching methods, team building and exchanges and cooperation. A teaching team with high teaching level and a team of experimental instructors have been basically established. The team attaches great importance to the training of young teachers, equips them with tutors, and makes detailed training plans to enable them to grow rapidly in teaching and scientific research. Two of the young teachers in the team were selected into the provincial "one

hundred and ten" talent training plan. In the basic skills competition for young teachers held by the school in recent years, one team member won the first prize, one won the third prize and one won the excellence award. Four members of the team were selected as visiting scholars of the ministry of education, one of whom went to Taiwan for a half-year research and study, and two of them went to Malaysia for research and study. The electrical engineering teaching team adheres to the teaching reform and practice. During the teaching process, it is diligent in summarizing teaching experience and actively sorting out teaching results. Since 2009, it has applied for 12 university-level teaching reform projects, 3 provincial-level teaching reform projects and 2 university-level high-quality courses.



Fig. 6. The teacher who supervised the experiment

#### E. Remarkable achievements in teaching and research

In the process of teaching reform, teachers' teaching research and scientific research work are promoted to improve their teaching research and scientific research ability, and related achievements are made. Members of the project applied for more than 20 teaching and research projects, and published more than 30 papers, including 9 papers on teaching reform and 24 patents. Teachers guide students to successfully apply for many projects such as "climbing plans" of Guangdong province and innovation and entrepreneurship plans for college students.

#### F. Carry out network teaching

Teachers make use of the school's network teaching platform resources to improve the utilization of the students' network platform. We have uploaded the teaching syllabus, teaching calendar, experimental instructions, courseware, problem bank and other resources of electrical engineering on the Internet. On the platform, teachers and students regularly discuss topics, upload and correct homework, and answer questions online.

#### G. Students' awareness and ability of scientific and technological innovation

The teaching reform drives the discipline competition, enhances the student to participate in the scientific research ability. Through relevant competitions, teaching and learning are promoted through competitions, and students are instructed to make a series of electronic products, and participate in some relevant competitions, so as to improve their knowledge of electrical engineering. In the past three years, I guided my students to participate in China education robot competition, China university intelligent robot creative competition, national college students mechanical innovation design competition and other competitions. My students won 16 national awards. Guided students to participate in Guangdong mechanical innovation design competition, "challenge cup" Guangdong university students extracurricular academic science and technology works competition won 20 provincial awards.

#### H. Impact of reform and result promotion

This project was applied in the course of electrical engineering of 150 undergraduates in 3 classes of 2017 grade robot engineering, and the application effect was good. It laid a good foundation for the study of professional courses, met the requirements of the school for application-oriented personnel training, and played a demonstration role in improving the quality of personnel training in our school. Through the questionnaire analysis of electrical engineering courses, students generally believe that electrical engineering courses will be helpful to learn other courses in the future.

The project team applied for the 2016 university-level excellent course project of "electrician and electronic technology", which promoted the construction of high-quality courses. The 2017 higher education reform project in Guangdong province: the research and practice of promoting the construction and development of professional connotation and improving the quality of professional talent training with professional evaluation and certification as the starting point.

The achievements related to the teaching reform were published on the website of the network teaching platform of Zhuhai College of the Beijing institute of technology, applied in various majors of the college of industrial automation, and promoted to other mechanical related majors of other colleges.

#### I. Innovation of the project

This study adheres to the idea of "emphasis on construction, process, effectiveness and innovation" and applies the idea of engineering education certification. We focus on the teaching process, attach importance to the cultivation of students' core ability, and strengthen students' independent learning ability. Teachers carry out modular teaching and pay attention to the application of engineering examples. In terms of experimental teaching, we use the

creative combination model of Fischer as an innovative experimental platform to cultivate students' innovative consciousness and improve students' hands-on ability. The project team will hold regular course seminars, summarize and reflect, and investigate students' learning situation by means of electrical engineering course learning questionnaire, so as to continuously improve the teaching reform project.

#### IV. FOLLOW-UP CONSTRUCTION PLAN OR APPLICATION PROMOTION PLAN

The reform of electrotechnics has been continuously improving the construction of three-dimensional teaching resources and improving students' self-learning ability. Further reform should be carried out to integrate electrical engineering knowledge into other professional courses, such as basic control engineering and engineering testing technology. More emphasis should be placed on the application of knowledge to deepen the concept of "course group". Through the re-planning and design of courses, the gap between the original courses is filled, the repetition between the original courses is deleted, and students can better grasp the relationship between one course and other courses as well as the whole course group, so as to improve the overall teaching effect.

The research on modern teaching methods, the exploration of flipped classroom and hybrid teaching methods based on Internet, the construction of teaching resources such as MOOC and Micro classes, and the increase of learning and communication opportunities with students through various channels. The reform curriculum examination way, more scientific reasonable appraisal student's study achievement. The teaching content should be appropriately modified to meet the needs of social development. Systematic theoretical knowledge and tedious mathematical derivation and demonstration should be deleted as much as possible, and some "application examples" combining theoretical knowledge with engineering practical application should be added to guide students to understand the application of knowledge in life and production.

We have established effective team cooperation mechanism to promote teaching discussion, exchange of teaching experience and development of teaching resources.

To further promote the combination of the old and the young in teaching, carry forward the role of transmission, help and lead, strengthen the training of young teachers. We pay attention to the exchange and cooperation with the electrical engineering teaching team of other colleges and universities to share the achievements of teaching reform.

#### V. SUMMARY

This project comprehensively reformed the teaching content, teaching means, teaching mode and other links of electrical engineering, focused on the effectiveness of the teaching process, and implemented the mode of "teaching, learning and doing" integration. Curriculum construction is a long-term dynamic process. In addition to college level promotion, incentive system and mechanism should also be established to improve the quality consciousness, innovation consciousness and participation consciousness of teachers and students, improve the initiative and consciousness of teachers and students to participate, and continuously improve the level of electrical engineering curriculum construction. The team insisted on holding courses and seminars, and carried out summary and reflection, continuous improvement.

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