



Teaching Reform and Exploration of “Engineering Testing Technology” Under the Background of Provincial First-Class Undergraduate Course Construction

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Abstract. “Engineering Testing Technology” is a multidisciplinary course with strong theoretical and practical aspects, and it is an important knowledge section for our school to cultivate talents in composite application-intelligent manufacturing testing technology. Based on the construction of the first-class undergraduate courses in the province, relying on the intelligent manufacturing innovation training center of the college, this course focuses on establishing the teaching content on the real engineering background, independently constructs intelligent manufacturing testing cases, and continuously integrates the innovative achievements of teachers and students into the teaching content, effectively improves students’ practical skills in the application of testing techniques. The team compiles its own teaching materials, restructures, and optimizes the course structure and content, combines external references and internal links, builds rich and high-quality course teaching resources, and adopts online and offline mixed teaching methods to deeply integrate classroom offline learning and online learning. Strictly controls the quality of mixed teaching, takes students as the center, and implements the “five links” of teaching-guiding, learning, doing, evaluating, and expanding. The course adopts two teaching evaluation methods, formative and resultant, to realize students’ independent and efficient learning and improve the teaching effect of the course. In the past three years since the implementation of the teaching reform, students’ comprehensive knowledge has continued to improve, and the quantity and quality of innovation and entrepreneurship achievements have both improved, which has a good demonstration and promotion role in similar institutions.

Keywords: Composite Application · Intelligent Detection Technology · Engineering Case · Blended Teaching

1 Introduction

“Engineering Testing Technology” is a provincial first-class undergraduate course (online and offline mixed teaching), and is the core course of our school’s mechanical design, manufacturing and automation major (a provincial first-class undergraduate major). It is also a professional core course or direction course for a total of 8 majors

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in our university, including Intelligent Manufacturing Engineering, Robot Engineering, Materials, and Shipbuilding. About 400 students study the “Engineering Testing Technology” course every year. Based on the construction of the first-class undergraduate courses in the province, relying on the intelligent manufacturing innovation training center of the college, this course focuses on establishing the teaching content on the real engineering background, independently constructs intelligent manufacturing testing cases, and continuously integrates the innovative achievements of teachers and students into the teaching content [1]. Improve students’ practical skills in the application of testing techniques.

2 Analysis of Learning and Teaching

Engineering testing technology course is very theoretical and has high requirements of practice for it involves multiple disciplines, which covers a wide range of knowledge. There are no other signal courses in the mainframe major. The content taught in the traditional classroom starts from the classification of signals, to the Fourier series, Fourier transform and its properties, and the dynamic and static characteristics of the test system [2]. For Mathematical theoretical knowledge, students generally feel boring and difficult to learn when they first encounter this course, resulting in low interest in learning and confusion, which leads to poor teaching effects and other problems. The teaching mode focuses on the explanation of theoretical knowledge in books. The content of books lags the development of the times, the practical links are weak, and the combination of theory and practice is not closely related to the learning effect. Far from enough. Based on the above analysis of academic situation and teaching pain points, the teaching reform of engineering testing technology course is imperative, the optimization and renewal of teaching content, the diversified development of teaching methods, the diversified improvement of teaching methods, the strengthening of practical links and the comprehensive assessment methods Improvement is imminent.

3 Key Issues to be Solved by Teaching Innovation Reform

During the epidemic period in the first half of 2020, this course began to build asynchronous SPOC courses and carry out online teaching based on the resources of MOOC courses in Chinese universities. After the resumption of school in the second half of 2020, online and offline hybrid teaching based on asynchronous SPOC courses began. In the teaching practice of nearly six semesters in three years, I have constantly explored the reform methods and means of online and offline hybrid teaching, and encountered some difficulties and problems.

1. On the one hand, the engineering test technology course is based on the integral transformation as the mathematical basis and applies signal analysis and processing knowledge to the theoretical teaching part; on the other hand, the engineering testing part is based on sensor technology as the core [3]. Online and offline mixed teaching methods are used to balance the deep integration of theory and practice, so as to stimulate students’ interest in learning, improve students’ practical ability and innovative thinking, and carry out personalized training.

2. The course of engineering testing technology clearly insists on carrying out teaching activities centered on students. How to carry out efficient and feasible teaching design in online and offline mixed teaching methods, guide students to change from passive learning to active learning, and make full use of existing online teaching resources. Closely link before class, in class, and after class to realize students' independent and efficient learning and improve the teaching effect of the course [4].

3. The teaching innovation and reform of engineering testing technology courses will inevitably put forward higher requirements for teachers. How to improve teachers' professional skills and information technology level, and cultivate social practice double-qualified teachers with high professional quality are also key problems to be solved.

4 Teaching Innovation Reform Measures

4.1 Hybrid Overall Teaching Design, Deeply Integrating Online and Offline Teaching Links

Guided by the course objectives of engineering testing technology, using modern information technology and network resources, the blended teaching is carried out based on the deep integration of online learning and offline classroom, and the teaching content design, teaching form design, online teaching resource design, teaching Evaluation design [5]. The blended teaching design always insists on being student-centered and attaches great importance to students' learning subject status. Teachers transform from learning leaders to learning guides, extend learning from the classroom to outside the classroom, and handle the collaborative relationship between students and teachers, online and offline, and inside and outside the classroom.

4.2 The Team Self-compiled Teaching Materials, Reconstructed and Optimized the Course Structure and Content

The teaching team of the school edited and published the 13th Five-Year Plan textbook "Engineering Testing Technology" for electromechanical majors in applied undergraduate colleges, timely adjusted and optimized the course structure and teaching content, correctly handled the increase and decrease, and ensured the basicity of the course content Combined with advancement. In addition, fully relying on the newly-built intelligent manufacturing engineering training innovation center of the college, intelligent warehousing and logistics equipment, industrial robots, five-axis CNC machine tools, etc. are formed to form intelligent detection technology knowledge applied in intelligent manufacturing production line equipment, and timely update the knowledge system and teaching content of this course., allowing students to keep up with the pace of modern intelligent detection technology [6].

4.3 Combining External References and Internal Links to Build Rich and High-quality Course Teaching Resources

In the process of exploring and practicing the online and offline mixed teaching mode, make full use of the MOOC learning platform of Chinese universities, build an asynchronous SPOC course on the basis of the national excellent course “Engineering Testing Technology”, record the MOOC according to the content of the school’s teaching materials, and make courses Video and chapter test questions to create online teaching resources that are more suitable for applied talents in our school [7]. At present, the asynchronous SPOC course resources include 10 lectures of national excellent courses, 10 lectures of MOOCs recorded by the teaching team of our school, 20 sets of chapter test questions, and more than 400 question banks.

4.4 The “Five Links” of Student-Centered Teaching Strictly Control the Quality of Hybrid Teaching

The implementation process of the online and offline mixed teaching design of the course “Engineering Testing Technology” can be divided into five links: guidance, learning, practice, evaluation, and extension [8]. Among them, “guiding” is problem-oriented and releases learning tasks online; “learning” is online learning. Learning videos and in-depth learning in classrooms; “doing” is to complete online tests such as MOOCs and Rain Classrooms, and determine offline completion plans and implement skills enhancement; “evaluation” includes flipped classrooms for group presentations, results display, and mutual evaluation and self-evaluation; “Expansion” is to expand and innovate in combination with innovation and entrepreneurship. Strictly implement the “five links”, cultivate students’ independent thinking, independent learning and self-management abilities, change students’ ideological attitudes and learning logic, master course theoretical knowledge and engineering practical ability, and meet the ultimate goal of cultivating talents.

4.5 Combination of Formative Evaluation and Result Evaluation, Diversified and Comprehensive Course Assessment

The assessment of this course adopts the combination of formative assessment and result assessment. The total score of the course is 100 points, and the course assessment score is 60 points and above to pass the grade. The specific assessment items of the course include usual grades, major homework practice projects, and final exams. The usual results include attendance, flipped classroom performance, and online learning activity (mainly including online learning time, participation in question discussions, and online testing) [9]. This sub-item accounts for 30% of the total score. The major homework project includes hands-on practice, research reports, and results presentations. It will be assessed and summarized through offline and online, intra-group self-evaluation and inter-group mutual evaluation. This sub-project accounts for 20% of the total score. The final exam is a closed-book final paper-based test, which mainly assesses the basic theoretical knowledge and application of engineering testing technology [10]. The paper score accounts for 50% of the total course score.

5 Results of Teaching Innovation Reform

5.1 Students' Learning Ability and Learning Effect are Significantly Improved

After nearly three years of teaching innovation practice, the main role of students has been fully utilized in the course teaching, and the combination of formal learning and informal learning, systematic learning and fragmented learning, and independent learning and collaborative learning has been realized. The teaching innovation reform of this course will be implemented in 2020 for professional organizations such as 17th, 18th, 19th, and 20th grades in electromechanical, intelligent manufacturing, robotics, materials, and shipbuilding. A total of more than 1,500 students participated in online and offline hybrid teaching. Mode of learning. Practice has proved that the hybrid teaching mode combining online and offline is welcomed by students and has achieved good teaching results. In the questionnaire survey at the end of the semester, most students agree with the new teaching mode, and the satisfaction rate reached 90%. The "Engineering Testing Technology" class has received a teaching score higher than 90 points from the supervision and students for three consecutive years.

5.2 "Double Entrepreneurship and Innovation" has Achieved Fruitful Results, and both Employment and Postgraduate Entrance Examinations have Gained

The reform and implementation of this course has greatly improved the students' ability to practice and make objects. In the past three years, students have participated in the National Mecha Competition, Engineering Training Competition, Mechanical Innovation Design Competition, Challenge Cup and other electromechanical subjects involving testing technical knowledge. The competition has won more than 50 provincial and national awards. Among them, the National Mecha Competition won the first prize in the Central Division after three years of hard work. Automatic high-efficiency coin screening machine", "Bionic fluttering bird", "Bionic ship cleaning gecko", provincial second prize works "Smart bed", "Multifunctional crutches", "Bionic inchworm tree climbing device", etc. are all based on engineering testing technology. The study of the course improves the application ability, practical ability, and innovation ability of testing technology, and lays a solid foundation for the smooth postgraduate entrance examination and employment. Students are employed in the machinery industry in the province, the Yangtze River Delta, and the Pearl River Delta region, and most of them quickly grow into the backbone of enterprise technology, most of the students apply for design or research and development positions. The reputation of professional education has been fully recognized by the society, and the comprehensive ability and professional quality of graduates have been highly evaluated by employers.

5.3 Industry-University-Research Cooperation Collaboratively Educates Talents, and Gathers the "New Team" of Double-Qualified Innovative Practical Teaching

Give full play to the role of the innovative practice teaching team as a guide, old teachers lead young teachers, strengthen exchanges and cooperation with enterprises, participate

in horizontal topics, scientific research feeds teaching, and cultivates applied testing technical talents. He has successively cooperated with an automation company, a high-tech company, and a CNC Co., Ltd. to build a teaching staff, training practice base, talent training plan, courses, and classrooms, and jointly undertake the training of testing technical personnel. Many teachers in the teaching team have presided over and participated in 6 provincial-level scientific research projects in recent years, and the funds for hosting and participating in horizontal projects have reached more than 500,000 yuan. Outstanding Individuals in Educating People, Activists in Three Educations, Personalized Education Innovation Award (Collective), Practical Educating Team Award, Advanced Practical Educating Individuals, Top Ten Project Potential Mentors, etc.

6 Conclusions

After three years of teaching practice improvement, the course “Engineering Testing Technology” has gradually realized the full-time teaching mode of abandoning the traditional sensor course teaching “teacher teaches and students listen”. Relying on the existing rich and mature online teaching resources and platforms, the course implements a hybrid teaching mode combining online and offline. It is the combination with informal learning, the combination of systematic learning and fragmented learning, the combination of independent learning and collaborative learning. Practice has proved that the hybrid teaching mode combining online and offline is welcomed by students. In the questionnaire survey at the end of the semester, most students agree with the new teaching mode very much, with a satisfaction rate of 90%.

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