

Research on Teaching Path Reform of Distributed Fiber Sensing Technology under Background of Innovation and Entrepreneurship

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Abstract

Under the background of the education of innovation and entrepreneurship, a new teaching path without directly giving professional course is proposed to achieve teaching distributed fiber sensing technology. Then a hidden curriculum system containing "basic teaching", "practical teaching" and "project teaching" has been constructed through the construction of learning atmosphere, the promotion of academic competition, and the flexible implementation of project teaching, so as to guarantee the teaching quality. The result shows that this teaching path reform obtains a good teaching quality of distributed fiber sensing technology.

Keywords

Education of innovation and entrepreneurship; Distributed fiber sensing technology; Teaching path reform.

1. Introduction

In the 21st century, China's innovation and entrepreneurship education starts from scattered distribution to formal pilot. And then to 2012, the Ministry of Education requires in the form of credit hour. Later, under the background of "mass entrepreneurship and innovation", in the decade from 2010 to 2021, the State Council, the Ministry of Education, the Ministry of Science and Technology, the Ministry of Industry and Information Technology, Central committee of the Communist Youth League, Jiangsu Provincial Government, Jiangsu Provincial Education Department and other organizations issued more than 20 supporting policies on innovation and entrepreneurship [1-3]. At the same time, organizations at many levels have held innovation and entrepreneurship competitions such as "Internet +", Create Youth and Challenge Cup. As a local application-oriented university, Changzhou Institute of Technology regards "innovation and entrepreneurship" as one of the school-running characteristics. Combined with Changzhou "532" development strategy [4], it emphasizes starting entrepreneurship in industrial economy, connecting industry in degree education, and strengthening innovation in teaching and education. Thus, Changzhou Institute of Technology has set up the School of Innovation and Entrepreneurship, which is responsible for coordinating the implementation of the teaching activities of innovation and entrepreneurship. In the process of teaching practice, it always takes "entrepreneurship" as the starting point and "innovation" as the foothold.

Distributed fiber sensing technology has the advantages of strong anti-electromagnetic interference, fully distributed, and high sensitivity. Therefore, it has been paid a lot of attentions

in many fields such as health monitoring of large engineering structures and real-time security alarm [5]. Many researchers have devoted a lot of effort to basic physical theory, optical path structure, circuit development scheme, complex demodulation algorithm and other aspects, and achieved a series of research results. This makes distributed fiber sensing technology changing from laboratory research objects into the physical product of industrial economy. Therefore, it makes this type of product needs a large number of technical personnel in the manufacturing, operation and maintenance of the industrial application chain. However, because distributed fiber sensing technology needs deep theoretical foundation and solid professional skills, few local application-oriented universities offer courses for distributed fiber sensing technology. And it is more impossible to incorporate innovative elements into the course. Taking the major of measurement and control technology and instrument in Changzhou Institute of Technology as an example, the original course "optical fiber sensing" was stopped teaching a few years ago, and the optical fiber sensing technology including distributed fiber sensing lost the way in which the professional course is directly taught.

Combined with the background of innovation and entrepreneurship and the requirements of innovation and entrepreneurship education in Changzhou Institute of Technology, this article creatively puts forward a teaching path reform of distributed fiber sensing technology without directly setting up professional courses, and realizes the purpose of innovation education.

2. Constructing A Hidden Curriculum Teaching System

In colleges and universities, making students have the ability to survive and live through the dissemination of knowledge is not only the most basic requirement of education and teaching, but also the cornerstone of students' higher innovation and creativity. In the absence of special courses, we should also realize the teaching of special knowledge. This requires the construction of a hidden curriculum teaching system to achieve the purpose of teaching the basic knowledge of distributed fiber sensing technology with the help of existing curriculum subjects and teaching activities. At the same time, the teaching system of the course should enable students to accumulate innovative ability and create desire on the basis of mastering basic knowledge.

Therefore, according to the teaching need of distributed fiber sensing technology, the hidden course teaching system shown in Figure 1 is constructed.

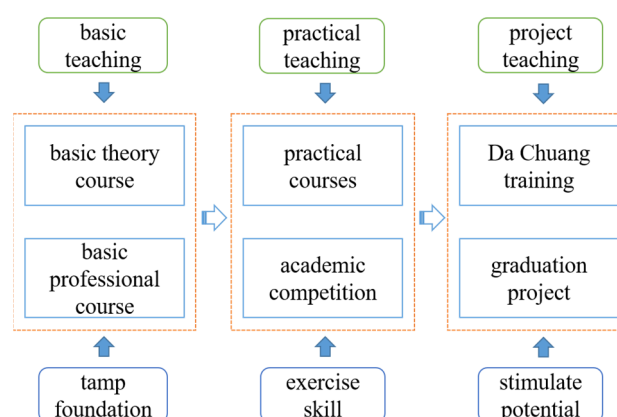


Figure 1. The hidden curriculum teaching system of distributed fiber sensing technology

Next, taking the teaching activities and process materials of the major of measurement and control technology and instrument in Changzhou Institute of Technology in recent years as an example, this article expounds the internal logic of the establishment of the hidden curriculum

teaching system. In Fig. 1, the teaching of distributed fiber sensing technology is reorganized into three parts: "basic teaching", "practical teaching" and "project teaching", and these three parts promote the knowledge understanding and dissemination of distributed fiber sensing technology layer by layer. "Advanced mathematics", "college physics" in general education courses and "linear algebra", "probability theory and mathematical statistics", "engineering mathematics" in professional basic courses constitute the basic theory part of distributed fiber sensing technology, which is the "basic theory course" in Fig. 1. Through the study of these courses, students will master basic mathematical and physical knowledge, which provides a theoretical source for analyzing and solving the technical problems of distributed optical fiber sensing. "Basic professional course" includes "computer language" in general education courses and "engineering drawing", "electrical foundation", "electronic foundation", "signal and system", "engineering optics", "sensor principle and application", "single chip microcomputer principle and application" in professional basic courses. The professional knowledge of optical, mechanical and electrical aspects involved in distributed fiber sensing technology is reflected in these courses. "Basic theory course" and "basic professional course" are mostly concentrated in freshmen and sophomores, laying a solid theoretical foundation for subsequent practical teaching and project teaching.

"Practical teaching" mainly completes teaching activities through two carriers of "practical course" and "academic competition". "Electronic process practice", "electronic technology course design", "single chip microcomputer principle and application course design" and "precision instrument mechanism design course design" in the centralized practical stage applied the previous basic course knowledge to specific practical activities, so as to cultivate students' ability to analyze and solve problems creatively. However, this is mainly intended to deepen the understanding of the basic knowledge. Although it also indirectly exercises the skills that students need for distributed fiber sensing technology, it does not directly face distributed fiber sensing technology. The "academic competition" is the same mission. "Academic competition" is not a mandatory teaching subject for students, but it is indeed a high standard test of the basic courses and practical courses already taken in front. It is a simulation exercise before applying learning results to actual combat, playing a role in promoting, stimulating, consolidating and examining students' learning. Objectively, students who have passed the learning process of "practical course" and "academic competition" will be expected to firmly master the knowledge and the skill needed for distributed fiber sensing technology.

In both "basic teaching" and "practical teaching", teaching does not explicitly involve the distributed fiber sensing technology. But in the "project teaching" stage, it will directly face the distributed fiber sensing technology. "Da Chuang training" which is the college students' innovation and entrepreneurship training and "graduation project" are two important teaching processes. In the choice of questions, each student has the equal opportunity to choose the question of distributed fiber sensing technology. According to the requirement of engineering education certification, it can be considered that the teaching work of distributed fiber sensing technology is implemented for each student. In the specific teaching process, the innovation elements are integrated into it, so as to stimulate the students' innovation potential. Therefore, although there is no direct course of distributed fiber sensing technology, the teaching of distributed fiber sensing technology can also be realized through "basic teaching", "practical teaching" and "project teaching".

3. Main Implementation Measures

3.1. Paying Close Attention to the Construction of Learning Atmosphere

It is clear that the teaching activities related to the concept of distributed fiber sensing technology take place in the "project teaching" stage, and the time is mostly concentrated in the

higher grades. In particular, "graduation project" will be carried out in the last semester of college. Relevant teaching teachers can not control the learning quality of students in the "basic teaching" stage and the "practical teaching" stage. If there is no good measure to ensure the learning quality of students in the first two stages, the follow-up "project teaching" will be difficult to carry out well. Fortunately, the learning atmosphere construction of the School of Optoelectronic Engineering of Changzhou Institute of Technology provides a guarantee for students learning basic courses with high quality in the "basic teaching" stage.

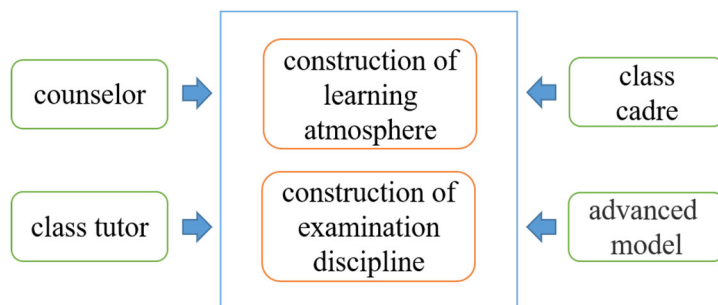


Figure 2. Schematic diagram of learning atmosphere construction system

Briefly speaking, the learning atmosphere is the style of study. The quality of learning atmosphere will affect the quality of learning to a great extent [6-7]. As shown in Fig. 2, the construction of learning atmosphere mainly aims at two aspects. One is the usual atmosphere of "learning", which is to hope that all students can make full use of time, space and other resources to study the course. The other is the discipline of "examination", which is to hope that students will not cheat or violate the examination regulations during the examination, so that the results of "examination" can truly reflect the effect of "learning" to the greatest extent. In order to build a good learning atmosphere, we should give full play to the respective role of counselors, class tutors, class cadres and advanced models. First of all, the counselor is not only the supervisor of students' whole learning career, but also the leader of students' Party construction. They integrate students' Party construction and League construction into the construction of learning atmosphere. Taking general secretary Xi Jinping's important exposition on education as a guide to action, value establishment and people cultivation is placed first in the work of students' Party construction. In the specific implementation process, the publicity and discussion of examination style and discipline are arranged in the Party and Youth League Day activities. When investigating activists who join the Party, we should focus on the learning atmosphere of students. In the class activities, the class tutor emphasized the seriousness of observing the examination discipline, stressed the importance of active and conscientious learning, and put the construction of learning atmosphere in the prominent position of the class administrative construction. The Party and League Construction of the counselor and the class administrative construction of the class tutor are often reflected through student cadres, who are also the member of students and need to learn relevant courses. Therefore, class cadres are both the manager and the managed of the construction of learning atmosphere. In specific practice, we should not only monitor the progress of class cadres in the construction of learning atmosphere, but also focus on whether the class cadres' learning atmosphere plays a positive leading role. Advanced models refer to students with good learning atmosphere and excellent learning effect. Through the establishment of advanced models, students can feel the positive significance of the construction of learning atmosphere. This makes students stimulate their enthusiasm for learning in the depths of their hearts, and makes them lay a solid foundation in the study of basic courses and practical courses.

3.2. Actively Promoting Academic Competition

Academic competition is not only the test of the mastery of professional courses, but also the sublimation of professional course knowledge. Therefore, academic competition can in turn promote students' understanding and digestion of professional course knowledge. Obviously, the academic competition is higher than the professional course knowledge in both difficulty and breadth, and has some innovative elements. In response to the need of innovation and entrepreneurship education, the school of Innovation and Entrepreneurship of Changzhou Institute of Technology uniformly manages the academic competitions of the whole university, and divides all academic competitions into three levels, of which the first level is subdivided into three classes. Fig. 3 is a partial academic competition divided into level 1 and related to distributed fiber sensing technology.

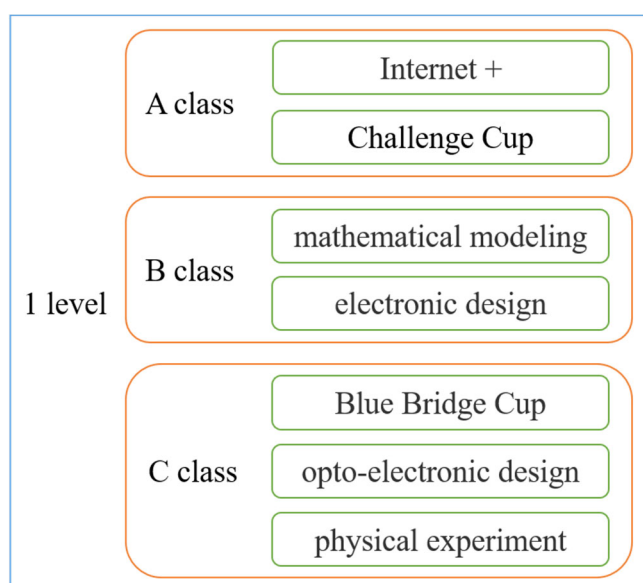


Figure 3. Division of some academic competitions

Internet + and Challenge Cup, as the most influential, the most difficult and the most important competitions, are divided into class A in level 1. As two competitions with a long history and good reputation, mathematical modeling and electronic design are divided into class B in level 1. Blue Bridge Cup, opto-electronic design and physical experiment play a good role in leading and promoting relevant subject, and the number of participants is relatively wide. So they are divided into class C in level 1. This grading method is conducive to students' understanding of various competitions and students' correct selection of competitions suitable for themselves.

3.3. Flexible Implementation of Project Teaching

In the "project teaching" stage, students will face the distributed fiber sensing technology directly, and the teaching teacher is also a professional teacher with the background of distributed fiber sensing technology. Since students have learned and mastered the theoretical knowledge and the basic skill required by distributed optical fiber technology in the "basic teaching" and "practical teaching" stages, students' learning and research on distributed fiber sensing technology are combined in the "project teaching" stage, so as to organically unify the teaching process and scientific research process. This teaching activity closely combined with scientific research requires the participating individuals to creatively complete relevant tasks. Therefore, innovative elements are naturally brought into the teaching process, and innovative education is carried out like "moistening things silently". Taking the Da Chuang training project "single fiber temperature measuring device for multi power equipment" participated by the

students of class 2 of 2020 from the major of measurement and control technology and instruments as an example, the project studies and develops single fiber temperature measurement device according to the need of temperature monitoring for the operation safety of multi power equipment, which is named Raman optical time domain reflectometer. It means that the scientific research and technological development activity is directly implemented in the teaching process of "Da Chuang training", which completely unifies the teaching activity and scientific research activity in time and space. In the process of completing these scientific research tasks, students need to use the knowledge and the skill learned in the "basic teaching" and "practical teaching" stages to carry out a series of activities, such as scheme design, process improvement, test follow-up and so on. The scientific research activity is often an innovation process from scratch. In these activities, students are imperceptibly training their innovation ability in order to complete the corresponding tasks. When they complete these innovative activities, the harvest will make them more motivated and eager to innovate.

For the implementation of Da Chuang project, the instructor first gives the topic and main technical requirements. All students in the class can choose the topic as their own Da Chuang training project. Interested students form an interest group after consultation and ask the instructor who publishes the topic for guidance. When selecting the interest group, the instructor adopts the principle of first come, first served. It means that the first person who requests the guidance from the instructor is selected. Therefore, in principle, every student in each interest group has the same opportunity to participate in the Da Chuang training of distributed fiber sensing technology. However, although every student has the equal opportunity to choose distributed fiber sensing technology as "Da Chuang training" and "graduation project", the topic faced by each student or team may be different. The instructor needs to give different directions for the topic. Therefore, the topic selection scheme shown in Fig. 4 is formulated.

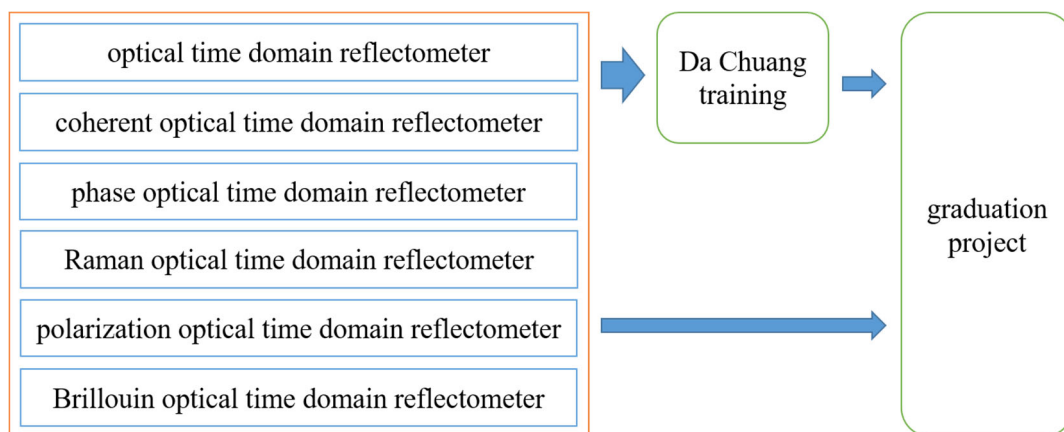


Figure 4. Schematic diagram of topic selection

At present, the distributed fiber sensing technology is mainly time domain reflection technology. The typical reflection technology can be divided into optical time domain reflectometer, coherent optical time domain reflectometer, phase optical time-domain reflectometer, Raman optical time domain reflectometer, polarization optical time domain reflectometer, Brillouin optical time domain reflectometer and so on [8-11]. Students can choose one of the reflectors as the research object of "Da Chuang training" or "graduation project". The grade span of students participating in the "Da Chuang training" is relatively large, but it is generally before the "graduation project". If students feel that they need to conduct in-depth research on reflectometer after completing the "Da Chuang training", they can continue to apply for research on this type of optical time domain reflectometer in the "graduation

project" stage. If students feel that they need to study other type of reflectometers after completing the research of a certain type of reflectometers in the "Da Chuang training" stage, they can choose other types of reflectometers in the "graduation project" stage. At the same time, they are encouraged to choose other topics related to reflectometers as the topic of graduation project.

4. Effectiveness of Teaching Path Reform

Since the teaching path reform is implemented, the professional courses of distributed fiber sensing technology are no longer considered to be set up separately. And the hidden curriculum system of three-stage teaching including "basic teaching", "practical teaching" and "project teaching" has been established, leaving the classroom time of professional courses to students. In the process of teaching path reform, with the promotion of the construction of learning atmosphere, the passing rate of course examination is gradually improving, and students' mastery of knowledge and skill is obviously more reliable, which lays a foundation for the subsequent "project teaching" of distributed fiber sensing technology. At the same time, the improvement of learning atmosphere also promotes the development of academic competition. Taking the electronic type of Blue Bridge Cup competition as an example, the number of applicants has doubled in the past two years. In 2021 alone, it won 22 provincial awards and 7 national awards. On the one hand, the successful development of Blue Bridge Cup competition consolidated the knowledge and the skill learned by students in the previous teaching stage; On the other hand, it also cultivates students' awareness of innovation and confidence in innovative learning. This enables students to integrate scientific research activities into learning activities in the follow-up "Da Chuang training" and "graduation project", which can receive good teaching effect. Taking the Da Chuang training project "single fiber temperature measurement device for multi power equipment" as an example, students designed and developed a set of equipment and materials related to distributed fiber sensing technology, published one paper and applied for software copyright during the "Da Chuang training" stage. In the "graduation project" stage, the number of people who choose distributed optical fiber sensing and related technologies as the "graduation project" is also increasing year by year. Similarly, under the positive guidance and drive of learning atmosphere construction, academic competition and other measures, the quality of graduation project is also improved year by year. In the past year 2021, one person won the excellent graduation project award of Jiangsu Institute of instrumentation.

In conclusion, the establishment and implementation of the hidden curriculum teaching system of three-stage teaching including "basic teaching", "practical teaching" and "project teaching" for distributed fiber sensing technology has effectively promoted the quality of basic courses, practical courses and academic competitions. Subsequently and conversely, the good teaching quality of distributed fiber sensing technology has been effectively acquired.

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