Research on Teaching Reform Guided by the Cultivation of Innovative Ability

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Abstract. This article focuses on the practical problem of students' lack of innovative practical ability discovered during the teaching process, and carries out curriculum reform guided by the cultivation of innovative ability. We will carry out teaching reform on the core course of optical measurement, "Optoelectronic Sensors," from three aspects: continuously updating teaching content, innovating classroom teaching methods, and innovating curriculum practices. Through teaching feedback and analysis of students' learning outcomes, it can be seen that the innovative teaching practice of this course has achieved good results.

Keywords: Curriculum reform; Optical measurement; Innovative ability cultivation

1 Introduction

Innovation is the first driving force for national development, and the ability to innovate in science and technology has become a decisive factor in the competition for comprehensive national strength. In 2021, General Secretary Xi Jinping Emphasized that: “Deeply implement the strategy of strengthening the country through talent in the new era, and accelerate the construction of a world important talent center and innovation highland.”at the Central Talent Work Conference.[1] In the field of national defense and military affairs, technology is the first combat power. To achieve the goal of building a strong military, technological innovation must be the support. Therefore, it is crucial to strengthen the cultivation of innovative talents in military academies. At present, various universities have explored the cultivation of innovative talents, mainly focusing on the cultivation of innovative abilities for undergraduate or graduate students. For example, Faguo Li from the xiangtan university explored a Path to cultivate the innovative research ability of engineering graduate students based on OBE Concept.[2] Mei Fan from Sichuan university studied the method of using large-scale instruments and equipment to promote the cultivation of innovative undergraduate talents.[3] Yong qian from Suzhou University of Science and Technology Explored ways to cultivate innovation ability among science and engineering college students. [4] Dunai from the Research Center in Graphic Technology, Univer-

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sitat Politècnica de València, Camino de Vera s/n, Valenci studied “Education in electric and electronic engineering via students involvement in innovative projects.”[5] Vignola and Cladio from the Engineering Programs, Polytechnic School, Arizona State University studied “Cultivating an entrepreneurial mindset in an undergraduate engineering statistics course using project-based learning”[6] However, there are few reports on the cultivation of innovative abilities among students with weak basic knowledge such as vocational and technical education, but strong hands-on abilities.Therefore, this article aims to address the practical problem of students' lack of innovative practical ability discovered in the process of vocational education teaching, and implement a curriculum teaching reform guided by the cultivation of innovative ability. We will carry out teaching reform on the core course of optical measurement, "Optoelectronic Sensors," from three aspects: continuously updating teaching content, innovating classroom teaching methods, and innovating curriculum practices. Through teaching feedback and analysis of students' learning outcomes, it can be seen that the innovative teaching practice of this course has achieved good results.

1.1 Course Characteristics

Optical measurement technology plays a very important role in aerospace testing and launch missions, as it can achieve stable tracking and real-time measurement of moving targets such as rockets and missiles. And 'Optoelectronic Sensors' is a core foundational course in the field of optoelectronic measurement. It is also the main course for students to understand the history and current status of optoelectronic sensing technology, learn the principles and methods of optoelectronic sensors, and lay the foundation for subsequent courses such as' Optoelectronic Measurement Technology' and 'Fundamentals of Optoelectronic Tracking Measurement Technology'. Through the study of this course, students' professional literacy in aerospace measurement and control positions can be improved, and their ability to analyze and solve related problems in the field of optical measurement can be preliminarily formed. This provides knowledge support for engaging in related professional technical work, and lays the foundation for becoming familiar with modern optoelectronic equipment in future work positions. This course mainly teaches the basic concepts related to optoelectronic sensing technology, light sources, optoelectronic detection devices, and the basic principles and key technologies of optoelectronic image sensors. Through the study of undergraduate courses, students can preliminarily form a knowledge structure in the field of optical tracking and measurement, track the development of cutting-edge science and technology, understand practical equipment, and be able to apply the knowledge learned in this major to analyze theoretical and practical problems in the field of optical tracking and measurement.

2 Problems in the Teaching Process

Optoelectronic Sensors "is an important core course in the field of optical measurement in military vocational education. On the one hand, this course aims to enhance students' autonomy in learning, improve their theoretical knowledge level and hands-on practical ability, and form a new type of combat talent with firm ideals and beliefs and strong professional qualities. On the other hand, it aims to cultivate students' ability to comprehensively apply knowledge and improve their ability to continuously explore and innovate, Enhance students' awareness of preparing for war and serving the army. However, for students in military vocational education, they love operation, enjoy cooperation, are tired of theory, and are afraid of principles. They have a certain fear of learning the knowledge of principles, and their abstract thinking is weak, resulting in weak innovation ability and insufficient innovation motivation. Through discussions and questionnaire surveys, it was found that there are still some problems with teaching implementation in cultivating students' innovative abilities, mainly manifested in: firstly, the teaching content updates slowly and is disconnected from the job; secondly, the teaching methods are single and lack innovation; thirdly, the teaching resources are limited and the attractiveness is not strong.

2.1 Slow Update of Teaching Content and Detachment from Actual Positions

The target of military vocational education is military craftsmen in the army, who are required to understand theory, possess equipment practical operation skills, and have innovative awareness. However, with the continuous updating and upgrading of actual combat equipment in the military, the previous teaching content and actual job positions have become somewhat disconnected. Students cannot apply what they have learned well, their innovative practical abilities are relatively weak, and their innovative awareness is not strong enough, which makes them less suitable for the practical needs of military optical measurement positions.

2.2 Lack of Innovation in Teaching Methods and Single Teaching Methods

At present, the classroom teaching of the Non commissioned Officer School of Aerospace Engineering University has long been mainly based on problem-based, exploratory, and discussion teaching methods, and has been trying innovative teaching methods such as online and offline hybrid teaching, flipped classroom, and round table classroom. However, due to the particularity of military academies, teachers cannot effectively carry out online learning activities in strict militarized environments, Moreover, in situations where students' learning initiative is not strong, their learning outcomes are not good.

2.3 The Teaching Platform is Relatively Limited and Teaching Resources are Lacking

Since the COVID-19 in 2020, the NCAA has actively promoted online teaching. The commonly used online teaching platforms include Tencent Conference, Rainclass, Nailing, etc. However, due to the unique nature of military academies, the utilization of teaching resources is not widespread in the military-oriented management environment. The utilization rate of online learning resources such as MOOC and Military Online in Chinese universities is also not very high, resulting in limited learning channels for students, insufficient attention to cutting-edge scientific and technological knowledge, and weak innovation awareness.

3 Curriculum Reform and Innovative Practice

As the core course of the optical measurement major, the course group of "Photoelectric Sensors" attempts to conduct teaching reform research guided by the cultivation of innovative abilities, analyzing the teaching content, teaching methods, and the use of teaching platforms from three aspects.

3.1 Continuously Updating Teaching Content and Keeping Up with the Times

Considering the characteristics of vocational and technical education students, combined with the talent cultivation goals and teaching outline requirements of this major, the course team has selected the national higher vocational and technical education planning textbook "Optoelectronic Technology and Applications" as the basic textbook, and the national planning textbook "Optoelectronic Detection Technology and Applications" and the experimental guidance book compiled by the research team as auxiliary textbooks. These three textbooks closely follow the development of the optoelectronic technology discipline, and the listed content has been continuously updated, Regularly issuing new versions of books can meet our teaching needs and be suitable for the learning of college students.

In addition, the course team has conducted military research, participated in drills, and collaborated with manufacturers to update practical teaching content. Through practical experience and keeping up with the times, they have introduced practical equipment into the classroom, bringing it closer to practical use. Through cooperation with research institutes, they have tracked authoritative academic journals, participated in academic conferences, comprehensively understood academic trends, introduced cutting-edge technology into the classroom, and updated technical content, which not only helps improve students' practical ability, It also helps to cultivate students' independent thinking.

At the same time, pay attention to the infiltration of ideological and political education. Throughout the entire course teaching, ideological and political education should be permeated throughout the entire process, and ideological and political education should be integrated throughout the entire teaching process, so that the course teaching and ideological and political education can go hand in hand and achieve moral education and talent cultivation. For example, when teaching about the bottleneck problem encountered in the development of microchannel boards, Liu Shulin and others from China Industrial Weapon Group overcame numerous difficulties and independently developed microchannel boards. After decades of development, the performance of microchannel boards developed in China has approached advanced foreign levels, and they have been applied in fields such as the Chang'e Lunar Exploration Project and Beidou Navigation, supporting the development of the aerospace industry and achieving independent and controllable core technologies.

3.2 Adopting Flexible and Diverse Teaching Methods

For the teaching requirements of sergeant vocational education, more attention should be paid to the cultivation of students' innovative and practical abilities. Therefore, in the reform of the course 'Photoelectric Sensors', flexible and varied teaching methods are attempted.

3.2.1 Online and Offline, Blended Teaching Mode.
In theoretical teaching, a mixed online and offline teaching mode is adopted. As shown in Figure 1, before class, students' learning characteristics are fully understood through discussions, research reports, and other methods, taking into account the needs of different students. Teaching objectives are designed according to different students and tailored to their aptitude. Gradientize the teaching process and provide differentiated guidance based on students' mastery of knowledge, so that students at different levels can receive good exercise. In class, through various information-based teaching methods such as simulation, animation, and video, abstract concepts are visually displayed to enhance the charm of the classroom. With combat as the driving force, they can experience the important position of photoelectric sensors in practical combat, enhance their learning motivation, and stimulate students' interest in learning. After class, rely on the rain classroom for extracurricular interactive teaching, strengthen extracurricular supervision, and monitor students' learning status in real-time during the preview and review process, urging them to complete the tasks assigned by the teacher.

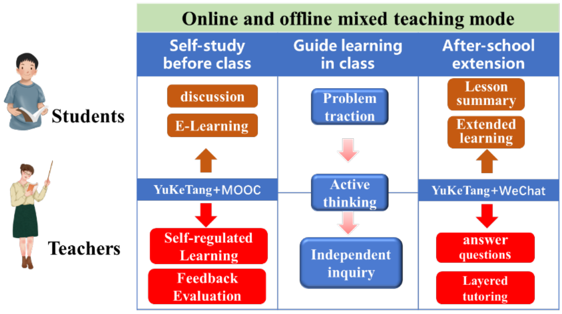

Fig. 1. Online and offline blended teaching mode

3.2.2 Task Driven Teaching, Project-Based Teaching Mode.
In practical teaching, project-based teaching methods are adopted, as shown in Figure 2. Experimental teaching is carried out in a task driven manner, changing the traditional mode of teachers teaching experiments and students repeating experiments

in experimental teaching. This makes classroom teaching more situational and contextualized, and emphasizes the cultivation of students' practical training abilities.

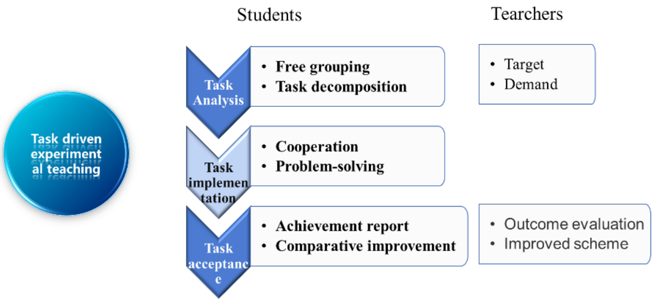

Fig. 2. Task Driven Experimental Teaching

3.2.3 Promoting Learning Through Competition and Enhancing Innovation Ability.

In addition, in terms of cultivating students' innovation ability, we need to reform the teaching mode, integrate technology competitions into teaching, extend the classroom, drive students' learning enthusiasm, guide and encourage students to participate in extracurricular practical activities such as technology competitions and skill training. This not only helps to improve the teaching effectiveness of practical teaching, but also provides time and space for cultivating students' autonomous learning ability, It has laid a solid foundation for the cultivation of students' innovative abilities. [7-8]

3.3 Innovative Practice of Curriculum Characteristics

In the teaching of the course 'Optoelectronic Sensors', efforts are made to practice the characteristic innovation in classroom teaching, as shown in Figure 3. The first step is to track the dynamics of academic frontiers, assist in bringing technological frontiers into the classroom, and introduce rich technological frontiers into the classroom, which can stimulate students' curiosity and thirst for knowledge, and achieve the integration of science and education. The second is goal oriented teaching, with students as the center and learning outcomes as the guide, to cultivate their ability to independently explore and think. The third is to teach students according to their aptitude, implement hierarchical teaching, and help students grow. The fourth is to reform the teaching mode and strive to practice blended teaching. Adhere to a student-centered participatory interactive teaching model, achieve a shift from teaching centered to learning centered, and guide students to actively participate in learning. The fifth is to focus on preparing for war, deepen practical teaching, and explore the practical application of photoelectric sensing principles and technologies in equipment, so that students can understand what it is, what it does, how to use it, and how to use it. They can truly approach the military and cultivate high-quality new military talents who can fight and win battles.

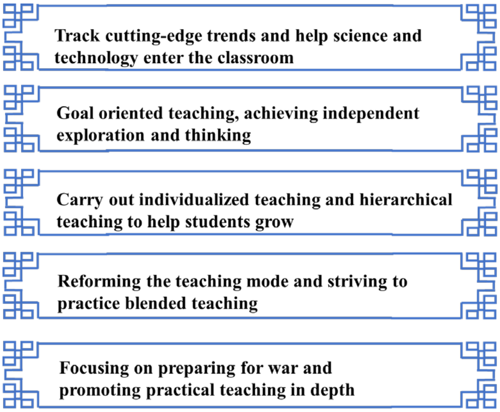

Fig. 3. Innovative Practice of Curriculum Characteristics

By comparing and analyzing the distribution of students' grades before and after the curriculum teaching reform, as shown in Figure 4. The average score of the teaching reform class is better than that of the ordinary class, and the score distribution is significantly moving towards the high score range as a whole. Figure 5 shows the award-winning situation of students participating in scientific and technological innovation competitions after the reform of teaching innovation.

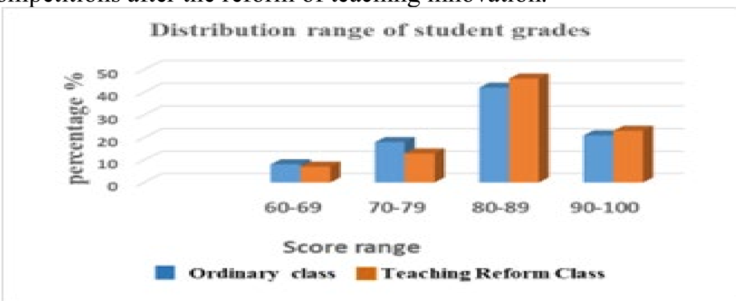

Fig. 4. Score distribution range

Fig. 5. Student Award Certificates

The teaching reform practice of the course "Photoelectric Sensors" can expand students' knowledge, comprehensively improve their professional literacy, cultivate their innovative thinking and ability, thereby enhancing their core competitiveness and meeting the strategic needs of the country for future military personnel training. In addition, the experience of teaching reform in this course can also be promoted and borrowed from other military vocational education courses.

4 Conclusions

The course group of 'Optoelectronic Sensors' focuses on the practical problem of weak innovation ability and insufficient innovation motivation among students at the military vocational education level. It conducts teaching reform research and practice from three aspects: continuous updating of teaching content, innovative classroom teaching methods, and innovative practice with curriculum characteristics, actively promoting the cultivation of students' innovative practical ability, and integrating cutting-edge scientific and technological knowledge into the process of theoretical teaching and innovative practice, Emphasizing the cultivation of students' innovative thinking and ability, adhering to student-centered approach, stimulating their curiosity and imagination, enhancing their interest in learning, greatly activating the course atmosphere, and achieving good teaching results. In the process of experimental teaching, task-driven teaching is carried out, actively promoting students' participation in science and technology competitions and other activities, promoting learning through competitions, enhancing students' ability to learn independently and innovate in practice, and improving the teaching effectiveness of practical teaching.

References

1. J. P. Xi, China government network, 10, 10 (2021).
2. F. G. Li, H. J. Yue, Chinese modern educational equipment, 11, 133-135 (2023).
3. Y. Qian, H. Liu, H. X. Wei, University Education, 03, 126-129 (2023).
4. M. Fan, B. Q. Jiang, Chinese modern educational equipment, 07, 12-16 (2023).
5. L. D. Dunai, A. Prieto, M. Chillarón and J. A. Antonino-Daviu, Education in electric and electronic engineering via students involvement in innovative projects, 41, 1862-1866, (2015).
6. C. Vignola, J. London, R. Ayala and W. Huang, Cultivating an entrepreneurial mindset in an undergraduate engineering statistics course using project-based learning, 1-4, (2017).
7. B. H. Zhang, S. Lu, Education and teaching forum, 51, 45-48, (2022).
8. Z. W. Gao, Chinese educational technology and equipment, 14, 25-26, (2019).