Thoughts on the Teaching Design of Underwater Unmanned Vehicle Technology Courses

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Abstract. With the development of underwater unmanned vehicle (UUV) technology, UUV has become an indispensable platform for underwater exploration, operation and combat in the future. In order to train students of related majors, UUV technology courses are of great significance in improving students' theoretical level of unmanned equipment, interest in unmanned marine operation, and future employment practice ability. In order to reasonably construct the UUV technology courses, this paper has considered the teaching objectives of the course from the perspective of overall and multiple classification objectives, designed the teaching content around the UUV technology module and the UUV technology professional expansion and practice module, and given the design suggestions on teaching strategies and ideological and political aspects of the course.

Keywords: underwater unmanned operation · Underwater unmanned vehicle technology · Teaching design · personnel training

1 Introduction

Underwater Unmanned Vehicle (UUV) is a kind of powered, non manned aircraft that can dive underwater for a long time, work and navigate with its own energy, remotely control or autonomously control, perform operations or tasks by configuring mission loads, and can be recycled and reused [1]. It can not only complete civil tasks such as marine survey and resource exploration, but also carry out different types of military operations. With the rapid development of UUV technology, UUV has gradually become an indispensable platform for underwater exploration, marine operations and maritime operations in the future [2]. UUV technology courses are the basic courses for students of related majors, which have a profound impact on laying the theoretical foundation of students' unmanned operation, stimulating students' research interest in the field of marine unmanned operation, and training students' comprehensive application ability in future jobs.

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2 Design of Teaching Objectives for UUV Technology Courses

2.1 Overall Objectives

This type of course should be a professional technical course for students of marine unmanned related majors. By learning this type of course, students can fully understand the basic composition, functional principles and technical development of UUV common systems, and be familiar with the technical application of UUV in the field of marine operations [3]. To enable students to form the concept and thinking method of ocean oriented unmanned operation, improve their independent learning and innovation ability, and lay a necessary foundation for the study of follow-up courses and future employment.

2.2 Classification Objectives

Knowledge and Skill Objectives
Familiar with the basic concept, development process and technical development trend of UUV; Familiar with the main uses and typical models of UUV at home and abroad; Understand the mature technologies of general UUV system, energy system, propulsion system, control system, navigation system, communication system, payload system and deployment and recovery system, and understand the development trend of various technologies in the future; In combination with the needs of marine unmanned operation, we have a deep understanding of the characteristics and capabilities of UUV technology in practical use.

Process and Method
Through classroom teaching, students can systematically learn the concept, use and related technologies of underwater unmanned vehicles, and help students to strengthen their understanding and mastery of key and difficult knowledge; Through comprehensive operation and independent learning, the trainees can deepen their understanding of underwater unmanned vehicles, expand their knowledge and improve their ability to learn new knowledge; Through classroom discussion and after-school guidance, the students can consolidate and deepen their understanding of knowledge, train their ability to ask questions, find problems, and solve problems by comprehensively using various knowledge, and cultivate their innovation awareness.

Emotional Attitude and Values
Through understanding the development history of UUV and the current application status in the field of marine unmanned operation, stimulate the interest in learning marine unmanned operation equipment, correct the learning motivation, and develop a realistic and pragmatic scientific attitude; Learn the technical application of UUV in the field of marine unmanned operation, understand the importance and progressiveness of UUV in the field of marine unmanned operation, and establish a sense of professional pride; By comparing and studying the typical models of UUV at home and abroad, we can rationally understand the development level of UUV in China, fully understand the importance of UUV in the field of marine unmanned operation, and enhance our sense of mission and responsibility.

3 Design of Teaching Ideas for UUV Technology Courses

This type of course closely focuses on the training requirements of "building morality and cultivating people", with the content from simple to deep and the form gradually, so that the students can have a basic understanding and grasp of the new operating platform of UUV, and lay a necessary foundation for employment and learning of subsequent courses [4].

3.1 Teaching Content Design

The teaching content of this course can be set in modules according to different teaching needs, including two parts: general UUV technology module and UUV technology professional expansion and practice module.

Universal UUV Technology Module
No matter what field UUV is applied in, it is an application expansion on the basis of universal UUV. Ocean exploration UUV means that sonar, camera and other detection loads are added on the basis of universal UUV. Submarine pipeline operation UUV is also an addition of manipulator and other equipment on the basis of universal UUV, which is always the same. Therefore, no matter what specialty students are engaged in in the future, they should first have a basic grasp of universal UUV technology. The general UUV technology module will explain the composition, functional principle and other contents of each subsystem around the general UUV, so that students can fully understand UUV. Universal UUV includes multiple subsystems such as overall system, support system, energy system, propulsion system, control system, navigation system and communication system. The teaching content of each subsystem is mainly designed as follows:

Overall Technology
The overall UUV is the comprehensive integration of various subsystems, which determines the overall shape and main characteristics of the UUV, and is a concentrated reflection of the overall performance and bearing capacity of the UUV [5]. The overall technology includes five aspects - overall appearance, overall structure, system composition, overall layout and overall performance, with the system composition and overall layout as the key content. The system composition can be visually explained by contacting human organs during teaching, for example, the function of energy can contact the human heart, and the ability to control the system can contact the brain, so as to deepen the impression of students. Among them, the general layout is taught with different examples of UUV equipment.

Support System Technology
In addition to its own considerations, the supporting mother ship support system shall also be considered in the development and use of UUV [6]. The support system includes command and control system, integrated support system and deployment and recovery system, and the deployment and recovery system is the key content. Different types of deployment and recovery technologies are taught in combination with different deployment and recovery platforms.

Energy and Propulsion System Technology
The energy and propulsion system are the two most basic systems of UUV, representing the "heart" and "legs" of UUV respectively. These two technologies can be combined. In terms of content, students are required to master the function of propulsion system, the classification, composition and characteristics of thrusters; Understand the structure and propulsion mode of propulsion motor and integrated propulsion device; Master the functions of energy system and the working principles of lithium ion battery and aluminum semi fuel cell; Understand the requirements of the energy system, the composition, advantages and disadvantages of typical batteries.

Control and Navigation System Technology
The control system is the "brain" of UUV, while the navigation system is a "part of the brain". The two rely on each other. The control system relies on the navigation system to provide the position, and the navigation system receives the command from the control system. For these two parts of technology, students should understand the function, performance and requirements of the UUV control system; Master the composition, principle and function of multi-layer control system; Master the principles, advantages and disadvantages of each navigation mode; Understand the basic composition and application of each navigation mode.

Communication System Technology
Like a "neural network", the communication system connects UUV with external communication terminals, which is an important technical means for UUV to receive command center control instructions and return its own status information and surrounding environment data. For this part of technical content, the trainees are required to master the functions of communication system and the classification of communication methods; Understand the principles, advantages and disadvantages and typical applications of different communication methods.

UUV Technology Professional Expansion and Practice Module
After learning the general UUV technology module, students should learn the application of UUV technology in different professional fields in combination with different directions of use. Universal UUV can achieve professional application expansion by carrying mission loads in different marine unmanned operation fields. The mission load of UUV can be roughly divided into ocean exploration equipment, ocean measurement equipment and underwater operation tools. For example, when UUV is applied to ocean unmanned detection, it is necessary to carry a detection type load to detect targets underwater, and the acoustic detection technology, optical detection technology, route planning technology and other contents involved are the teaching contents of the specialty in this module.

After teaching the expanded teaching content of the UUV technology specialty, the actual UUV platform can be used to carry out simulation practice teaching with different task loads. With the help of the physical platform, the technical preparation is carried out, and the students operate by hand to deepen the students' personal experience and intuitive understanding of UUV technology; By simulating the operation application environment (swimming pool or simple pool can be used), the use scenario of ocean operation can

be designed to enable students to deeply understand the expanding application ability of UUV technology in professional fields.

3.2 Design of Teaching Strategies

This class of course first outlines the introduction of new knowledge, then expands the content, explains the two modules in detail, and adopts the teaching strategy of one method as the main and multiple methods as the auxiliary, so as to achieve better teaching results.

The theoretical content of the general UUV technology module and the UUV technology professional expansion and practice module is mainly teaching method, combining discussion method, demonstration method and cooperative learning method. The teaching contents of these three modules lay particular emphasis on the theoretical basis. As for the system structure and technical principles of the universal UUV technology module, more time should be used to carefully teach, so the teaching method is mainly used. Among them, the comparative teaching is mainly used for different types of knowledge points in the same category. For example, when teaching the key technology of three propellers belonging to the same propeller, the three structures Explain the similarities and differences in characteristics, so as to deepen the students' understanding and avoid memory confusion of similar contents. For the key technologies that directly affect the use of actual operations, after teaching the key points of knowledge, the discussion method is used to consolidate the trainees' cognition. Through the trainees' mutual discussion and the teachers' summary and answering questions, the trainees' understanding of the impact of these key technologies on operations is deepened.

In addition, video, animation and physical demonstration (demonstration method) are used in class, and learning groups are formed after class to search network materials (cooperative learning method) independently and cooperatively to enhance the learning effect of the content taught in class, especially for the learning of the content of typical UUV equipment at home and abroad. Due to the limited time in class and the large number of typical models in various countries, Therefore, students are required to have a thorough understanding of this part by using cooperative learning after class.

The practical teaching content of the UUV technology professional expansion and practice module is mainly implemented in the way of grouping students after the presentation by the instructor. In terms of UUV equipment manipulation and software manipulation, the instructor will focus on the demonstration, and then the students will practice repeatedly. If there are too many students and too few equipment, the method of group implementation can be adopted. After full operation, the two groups can exchange different equipment to continue to operate. During the operation process, the trainees shall timely guide and explain the wrong operation, and make necessary questions according to the operation process of the trainees to guide them to think and summarize.

4 Design of Ideological and Political Teaching Ideas for UUV Technology Courses

4.1 Ideological and Political Mainline Design

As a new means in the field of marine operations, UUV has been paid more and more attention by countries. The United States' UUV Master Plan focuses on the development and use of UUV. Faced with this kind of emerging operation platform, students are bound to be full of interest, and full of expectations and doubts about the development level of China's UUV technology [7]. How to correctly and objectively guide the students' emotional cognition is the key point of ideological and political education in this type of curriculum. The main line of ideological and political design of this type of course is to stimulate the students' interest in scientific research and exploration of UUV technology through the guidance of professional knowledge content, and build up the students' full pride in China's UUV in the field of marine unmanned operation. In each teaching schedule, students will be inspired to carry out relevant classroom ideological and political work in combination with the professional knowledge content of the current class.

4.2 Mining of Multi-dimensional Ideological and Political Elements

Around the ideological and political main line, three dimensions of ideological and political elements are excavated, namely, professional quality, struggle spirit and confidentiality responsibility.

Professional Quality
As the main talents used in the cutting-edge fields in the future, most of the professional students will be engaged in relevant industries in the future. In the face of this "sophisticated" emerging industry, it is particularly important and a prerequisite for the curriculum teaching to enhance the students' interest in scientific research and exploration, their sense of identity and pride in their own posts. For example, the professional quality element is introduced through the deeds of Jiang Xinsong, the father of China's Underwater Unmanned Aerial Vehicles and CAE Member. In 1985, Academician Jiang developed China's first underwater robot. Jiang Xinsong is patriotic, dedicated and selfless. He once said, "Life is always limited, but it is my long cherished wish to let the limited life send out more light and heat, and make life more meaningful. I only talk about the quality of life, not the quantity of life, and live and die!" Through Academician Jiang's deeds, the students can understand the leader of China's underwater unmanned system, and instill in the students Academician Jiang's professional spirit of loyalty and dedication.

The Spirit of Struggle
The application of underwater unmanned vehicles to marine unmanned operation is different from the traditional manned operation mode, which will bring new difficulties and challenges. In teaching, students should be inspired to be prepared for danger in times of peace, cultivate and encourage students to be fearless and forge ahead bravely.

At the same time, students should be guided to clearly understand the development level of China's existing equipment and technology, avoid blind confidence, and objectively view the status of China's unmanned technology in the world. For example, in the "Navigation System" teaching content of the technical module, we introduced the great achievements of China's "Beidou Satellite Navigation System", which is at the leading level in the world and derives the "Beidou Spirit". In the face of foreign technical blockades everywhere, we did not fear difficulties and dangers, and developed our own navigation system, so that our navy would not be subject to others in future operations. With the support of such a powerful navigation system, we should establish a strong belief in struggle and carry forward our determination to not fear any difficulties.

Confidentiality
Keeping secrets is an industry norm that all industries should pay attention to at present. Many cases of loss of secrets have brought painful lessons. As personnel engaged in such "sophisticated" technologies, they should always be vigilant about the red line of confidentiality, and keep the existing national equipment and technologies absolutely confidential. Therefore, improving the confidentiality awareness of students is also an important element of the ideological and political thinking of such courses. For example, when explaining the Russian typical equipment "Poseidon" in the teaching content of "Typical Equipment at Home and Abroad", by introducing the case that "the United States inferred that Russia was developing a new type of weapon based on a picture released by Russia alone, which forced Russia to publish the Poseidon Plan", it warned the students that the leakage of secrets was accidental, and they should strictly abide by the confidentiality provisions when taking up their posts in the future to avoid the leakage of secrets.

5 Conclusion

Deeply thinking about the teaching design of underwater unmanned vehicle technology courses can enable students to deeply understand the theoretical knowledge necessary for ocean unmanned operation, as well as the ability and quality necessary for engaging in related industries in the future. So as to enhance the students' interest in learning, improve the students' learning effect, enhance the scientific spirit of integrating theory with practical application, the concept and thinking method of ocean oriented unmanned operation, improve the ability of independent learning and innovation, and lay a necessary foundation for the study of follow-up courses and future employment.

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