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Exploration of Teaching Reform in Unmanned System Courses Based on the OBE Concept

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Abstract: In response to the problems existing in the teaching of unmanned systems courses, such as being confined to traditional teaching models and insufficient focus on practical application, this paper proposes to guide the teaching with the OBE concept, carry out the teaching goal planning of unmanned systems application based on the OBE concept, innovate teaching methods, reconstruct course content, revitalize the teaching process, improve the evaluation model, and stimulate learning motivation to enhance the quality of course teaching and achieve the teaching goal of "knowledge + ability." This has a certain reference value for the reform practice of unmanned systems courses.

Keywords: OBE concept; Unmanned systems courses; Teaching design

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1. Introduction

The outstanding performance of unmanned systems in recent local wars has drawn much attention [1]. With the continuous innovation and development of the combat concepts, deployment patterns, and application models of unmanned systems, new challenges have emerged for teaching in military academies. Military academies are established for war and thrive in war. Cultivating combat-ready talents is the core mission of military academies. To achieve this goal, teaching in academies should further approach the battlefield and focus on practical application. Unmanned systems courses aim to enable students to apply their professional basic knowledge, gain a deep understanding of the combat environment, combat targets, combat modes, and combat effectiveness, and achieve the training goal of being close to the battlefield and practical application.

Due to the insufficient connection between the unmanned systems course teaching and practical application and the lack of close alignment with the battlefield, some problems have gradually emerged, such as the lack of practical application teaching, the rote learning of textbook theories, and the neglect of cultivating students' practical application abilities. These issues have restricted the development of students' initiative, analytical, and problem-solving abilities. To improve teaching quality and enhance the effectiveness of student ability cultivation, some universities have gradually adopted the OBE (outcome-based education) concept to address

these problems. OBE is generally understood as "results-oriented education," which emphasizes diversified teaching and evaluation models, and focuses on learning outcomes as evaluation indicators. It advocates active and differentiated teaching design.

OBE is an education model oriented towards students' learning outcomes, emphasizing the subjectivity of students in the educational process and the measurability of educational results [2–5]. The OBE concept includes six core elements: student-centered, outcome-oriented, continuous improvement, diversified evaluation, backward design, and alignment integration. These elements are interrelated and together form a complete OBE framework. To address the challenges faced by unmanned systems courses, the OBE concept can be introduced to design the teaching goals of unmanned systems courses based on the OBE concept, with the main goal of enhancing operational application capabilities and the output of students' active application as the driving force. This aims to explore new paths for the in-depth practical application and close alignment with the battlefield of unmanned systems courses.

2. Design concept

To improve the teaching quality of unmanned systems courses and enhance the effectiveness of student ability cultivation, the teaching goals of unmanned systems courses are designed based on the OBE concept. The teaching design is centered around the expected learning outcomes of "understanding principles, analyzing problems, and applying knowledge," with application ability output as the teaching driver. The overall teaching goal is set as "professional knowledge + application ability," and sub-goals are designed for each teaching link, including course construction, teaching implementation, and teaching evaluation. Teaching content is configured based on students' learning outcomes, and the teaching model is continuously improved through feedback on learning outcomes. Diversified, multi-modal, and multi-faceted teaching methods are comprehensively utilized [6,7]. The design concept mainly includes the following six core elements.

2.1. Student-centered

All teaching activities and course designs should revolve around the needs and interests of students, paying attention to individual differences and providing personalized learning support to stimulate students' interest and motivation in learning. The teaching approach should shift from mainly imparting textbook theories to students and students' passive learning to mainly active student engagement and supplemented by theoretical instruction.

2.2. Outcome-based approach

Outcome-oriented means focusing on the learning effect, clarifying educational goals, and ensuring that students possess specific knowledge and skills upon completion of their studies. Design challenging learning tasks to help students achieve expected learning outcomes. According to the talent demands of the military for the unmanned systems field, the training goal of being able to command and apply will influence the entire teaching process. The teaching design and implementation of the entire course should be centered around this goal to achieve timely output and meet standards based on ability, and to cultivate high-quality professional application talents for national defense construction.

2.3. Continuous improvement

Regularly assess students' learning outcomes and teaching quality, and promptly adjust teaching strategies and course designs to enhance educational effectiveness. Pay attention to students' learning progress, promptly

identify problems, and take effective measures for improvement, emphasizing continuous feedback on the learning process and results. The OBE concept establishes comprehensive evaluation requirements for teaching goals, requirements, and processes. Divide the entire unmanned systems course into learning stages and evaluate each student's learning outcomes at each stage to understand their attainment of expected application goals. Use the evaluation results to improve the teaching implementation process in the next stage. Finally, conduct a comprehensive application evaluation and feed the results back into other related courses or the training process of the next batch of students to form a virtuous and sustainable improvement cycle.

2.4. Diverse evaluation

The entire course, in line with the OBE concept's principle of diverse evaluation, adopts multiple evaluation methods and tools to comprehensively assess students' learning outcomes and abilities. Evaluation focuses on students' knowledge, skills, attitudes, and values, providing comprehensive feedback and valuable guidance.

2.5. Backward design

The OBE concept emphasizes backward design, constructing the curriculum system and teaching process through this method to enhance teaching efficiency and quality. For unmanned systems courses, start from the expected learning outcomes and design the curriculum and teaching strategies in reverse. Clearly define students' learning goals, design learning tasks and activities that align with these goals, to ensure students achieve expected learning outcomes, master relevant knowledge of unmanned systems applications, and enhance their job competitiveness and potential for development in the military.

2.6. Alignment and integration

The OBE concept emphasizes alignment and integration, ensuring the alignment and integration of educational goals, course design, teaching evaluation, and students' learning outcomes. The coherence and consistency among various teaching links should be ensured to enhance the overall effectiveness of education.

3. Ability development

In response to some issues revealed in the teaching of unmanned systems courses, relying on teaching and research platforms and other environments, and based on the foundation of practical application analysis, integrate combat application scenarios, exercises, and debriefings, to achieve the goal of cultivating students' knowledge structure, planning and analysis, command and decision-making, and emergency response capabilities. The generation of comprehensive application abilities generally includes basic knowledge and skills in unmanned systems, combat theory, combat simulation and experimentation, application analysis, application innovation, command and decision-making, and emergency response capabilities.

4. Teaching design

Teaching design for unmanned systems courses based on the OBE concept should center on the cultivation of application abilities, allowing students, knowledge, specialties, and battlefields to be integrated into the entire teaching process, making learning an exploration activity, fully mobilizing students' initiative, tapping their innovative potential, and enhancing their ability to apply knowledge. Teaching objectives should be specific and measurable, and closely related to the future career needs and learning development of the trainees. The needs

of trainees can be analyzed through means such as surveys, tests, and interviews to determine their learning foundation, interests, learning habits, and future job requirements, so as to determine appropriate teaching content and methods. Methods such as case teaching, mission-driven teaching, and cooperative learning can be selected to stimulate the trainees' interest and motivation in learning. At the same time, effective teaching strategies such as personalized learning and flipped classrooms should be formulated to meet the learning needs of different trainees. Through the design and practice of new concepts and ideas in teaching, trainees can quickly integrate into classroom activities and participate in teaching experiences, thereby quickly mastering the course system of unmanned system application.

4.1. Objective design

A thorough understanding and mastery of the overall teaching objective of unmanned system courses based on the OBE concept is essential. This objective not only includes the imparting of knowledge but also the internalization of knowledge and the cultivation of abilities. The design of teaching objectives based on the OBE concept is a systematic and continuous process that requires in-depth analysis of trainee needs, clear definition of teaching objectives, formulation of teaching strategies, design of teaching activities, and setting of evaluation standards. Only in this way can the effective realization of teaching objectives be ensured, and the core abilities and knowledge levels of trainees be improved. The focus should shift from teaching-centered to learning-centered, with an emphasis on trainee performance and evaluation. Trainees should master the basic principles, methods, and general strategies of unmanned systems, deeply understand the key and difficult points involved in this type of course, actively participate in the practical application of unmanned systems, and meet the requirements of this type of course for trainees' unmanned system application abilities, achieving flexible application and reasonable utilization of unmanned system professional knowledge.

4.2. Course design

The design of unmanned system courses based on the OBE concept focuses on the design of course content, teaching implementation, and teaching evaluation.

4.2.1. Reconstruction of teaching content

The teaching content of unmanned system courses based on the OBE concept needs to be constructed based on the expected learning outcomes of trainees. According to the teaching content, it can be divided into modules such as basic theoretical knowledge and application practice. Set unmanned system application tasks and problems that are closely related to the battlefield to enhance the practicality of trainees' learning. Set course content driven by tasks, allowing trainees to actively participate in course practice as the "creators" of application ideas. While completing course tasks, trainees can understand the principles of each knowledge point and the extensive connections between them, and apply theoretical knowledge to solve practical problems.

4.2.2. Innovative design of teaching mode

When implementing unmanned system courses based on the OBE concept, diversified teaching methods should be adopted to enrich teaching links. According to the characteristics of unmanned system courses, a combination of online and offline teaching methods can be used, implementing diversified teaching methods such as case analysis, combat scenarios, group discussions, simulation exercises, and comprehensive drills. Before class, an online teaching mode can be adopted to select professional course resources and guide trainees to conduct

personalized autonomous learning. During class, common problems encountered by trainees in self-study can be addressed through methods such as case introduction and group discussions, combined with case analysis to complete the internalization of knowledge. After class, based on real-time status information of trainees, guide them to complete knowledge expansion and transfer through simulation exercises and comprehensive drills. In addition to the required practical links in the plan, encourage trainees to participate in diversified practical teaching to promote the coordinated development of course teaching and practical teaching, as well as knowledge imparting and ability cultivation.

4.2.3. Design of teaching evaluation and feedback

When implementing the teaching of unmanned systems courses based on the OBE concept, diversified teaching methods are adopted to enrich the teaching process. According to the characteristics of unmanned systems courses, a blended online and offline teaching approach can be used to carry out diversified teaching methods such as case analysis, combat scenarios, group discussions, simulation exercises, and comprehensive drills. Before class, an online teaching mode is adopted to select course resources with professional characteristics and guide students to conduct personalized self-study. During class, common problems raised by students in their self-study are addressed through case introductions and group discussions, and knowledge internalization is achieved through case analysis. After class, based on the real-time status information of students, they are guided to complete knowledge expansion and transfer through simulation exercises and comprehensive drills. Besides the required practical sessions in the plan, students are encouraged to participate in diversified practical teaching to promote the coordinated development of course teaching and practical teaching, as well as knowledge imparting and ability cultivation.

5. Notes to emphasize in the teaching design

The teaching design of unmanned systems courses based on the OBE concept should be student-centered and pay attention to the following points.

5.1. Emphasizing knowledge reserves

Unmanned system courses attach great importance to the reserve of professional basic knowledge. During the learning process, students will be inspired by this knowledge. The teaching design should start from the students' professional knowledge reserves. Students' professional knowledge reserves are multi-faceted. Some knowledge is not in line with the application connotation, and some theories still need to be applied and elevated. The teaching design should make full use of students' professional knowledge reserves as the basis for the teaching design of unmanned system courses.

5.2. Emphasizing multiple combinations

The teaching design of unmanned system courses based on the OBE concept advocates that students gain inspiration through problem analysis, task setting, and discussion. This requires the teaching design to pay attention to the combination of knowledge and problems, tasks and discussions, etc., and emphasize the integration of theoretical knowledge and application scenarios when analyzing problems and setting tasks. This approach enables students to focus on tasks, conduct extensive and in-depth discussions, and fully mobilize their enthusiasm for active learning.

5.3. Emphasizing inspiring thinking

The teaching design based on the OBE concept should emphasize guiding students to think about how to independently learn knowledge and improve application ability. It should leave room for students to think and be conducive to students' exploration of unmanned system applications. Instructors should provide direct or indirect guidance to students and implement creative teaching. Due to the dynamics of application scenarios, which can lead to different results, instructors should guide students to think from multiple perspectives and analyze and solve problems in different scenarios.

5.4. Emphasizing innovative thinking

Unmanned system courses do not follow the traditional methods and emphasize innovative applications. Therefore, the teaching design based on the OBE concept should emphasize inspiring students' innovative thinking, creating application scenarios or tasks that are compatible with the course connotation, and stimulating students' inspiration and innovative consciousness. The dialectical unity of innovative thinking and application emphasizes that the design of application-oriented courses is not to design applications freely, but requires instructors to change their concepts, abandon traditional teaching models, and at the same time emphasize that students consciously conduct innovative thinking training in the created scenarios and tasks.

6. Conclusion

Unmanned system courses focus on cultivating students' planning and application abilities, innovative application abilities, and innovative thinking. The OBE concept has many advantages and can effectively enhance teaching effectiveness and cultivate students' comprehensive qualities. The implementation of teaching based on the OBE concept requires instructors to make more efforts and spend more time to ensure the achievement of teaching goals and the realization of students' learning outcomes. This paper proposes a teaching design for unmanned system courses based on the OBE concept, with the goal of cultivating students' abilities, students as the main body and application as the leading factor, and with the driving force of stimulating learning enthusiasm and innovative application methods. Starting from the teaching design, aiming at the goal, and carefully designing, students can actively explore and independently construct knowledge to analyze and solve problems in application practice, ensuring the match between what students have learned and their application abilities.

Disclosure statement

The authors declare no conflict of interest.

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