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Research on the Construction of a Computer Curriculum System Integrating AI and Unmanned Systems

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Abstract: With the rapid development and iteration of artificial intelligence and unmanned system technologies, intelligent unmanned equipment has become a core application carrier in the fields of intelligent manufacturing, smart security, aerospace, and other areas. The demand of society for interdisciplinary and technically skilled talents in computer science continues to increase. Traditional computer curriculum systems have problems such as isolated courses, outdated content, weak practical training, and disconnection between industry and education, making it difficult to meet the talent cultivation requirements for the intelligent development of unmanned systems in the new era. Centered on the deep integration of AI and unmanned systems, this paper clarifies the core objectives of curriculum system construction and proposes construction methods from six dimensions: module design, course development, experimental design, teaching models, content updating, and industry-education co-construction. It analyzes the educational outcomes of curriculum construction, aiming to improve the training system for intelligent computer science talents, enhance students' engineering practice and innovation capabilities, and provide a reference for the reform of computer science education in universities.

Keywords: artificial intelligence, unmanned systems, computer curriculum, curriculum system construction, talent cultivation

1. Introduction

Against the background of the digital economy, unmanned system industries, such as unmanned aerial vehicles, unmanned vehicles, and unmanned vessels, have developed rapidly. AI technologies, including perception, intelligent decision-making, and automatic control, have become key pillars in the research, development, and application of unmanned systems. At the same time, they have put forward new requirements for the cultivation of computer science professionals in universities. In order to adapt to the demand for industrial talents and promote the transformation and upgrading of computer science education, the construction of a new curriculum system integrating AI and unmanned systems has become an urgent necessity. On this basis, a systematic exploration of the objectives, implementation methods, and educational outcomes of curriculum construction is helpful for cultivating interdisciplinary intelligent engineering and technical talents in universities.

2. Objectives of the Construction of a Computer Curriculum System Integrating AI and Unmanned Systems

The construction of a computer curriculum system integrating AI and unmanned systems is proposed based on the educational requirements of higher education in the new era and the development needs of intelligent industries. The overall core objective is to cultivate interdisciplinary, application-oriented, and innovative computer science talents, thereby comprehensively optimizing the traditional talent cultivation structure of computer science (Long & Huang, 2024).

This curriculum construction overcomes the shortcomings of the traditional computer curriculum, such as single and fragmented teaching. It integrates interdisciplinary knowledge from multiple fields, including artificial intelligence, automatic control, machine perception, embedded development, and unmanned system engineering, and constructs a modern curriculum system characterized by interdisciplinary integration, the integration of theory and practice, and the connection between industry and education. The construction of the curriculum system takes the cultivation of students' core

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competencies as its main line. While consolidating students' basic theoretical knowledge and programming abilities in computer science, it makes up for students' insufficient understanding of cutting-edge technologies, enabling them to systematically master the core technical principles of AI algorithm application, unmanned system perception, path planning, and intelligent decision-making. Reforms have been carried out in terms of optimizing the talent cultivation model, strengthening the proportion of practical teaching, and removing the barriers between theoretical learning and engineering applications, with the aim of cultivating students' skills in solving practical problems in unmanned system engineering.

3. Methods for the Construction of a Computer Curriculum System Integrating AI and Unmanned Systems

3.1 Establishment of basic theory and introductory modules

AI and unmanned systems constitute an interdisciplinary field involving multiple disciplines, including computer science, artificial intelligence, automatic control, sensor technology, and mechanical engineering, which places higher requirements on students' comprehensive knowledge base. Traditional computer curricula lack targeted interdisciplinary foundational training, and students have an unclear understanding of the logic of unmanned system architectures and AI technology applications, making it difficult for them to undertake subsequent advanced courses (Wu et al., 2025). Therefore, constructing systematic basic theory and introductory modules is the first foundation for constructing the new curriculum system. It can establish an overall knowledge framework for students and consolidate the foundation for interdisciplinary learning.

Universities need to integrate and optimize the original general education courses and professional foundational courses based on the talent cultivation program for computer science professionals, add core modules such as AI and Introduction to Unmanned Systems, and organize the modular and systematic basic theoretical knowledge system. The module content should take suitability for students with no prior knowledge as its main line and cover the classification of unmanned systems, hardware composition, operating principles, fundamentals of artificial intelligence, fundamentals of machine vision, and fundamentals of intelligent control. When explaining core basic concepts such as the principles of embedded systems, instructors can reduce complex and obscure theoretical derivations, while greater attention can be paid to understanding principles, the interconnections among different areas of knowledge, and explanations of practical application scenarios (Li & Sun, 2025).

At the same time, the teaching content of existing computer foundation courses should be reconstructed by combining basic knowledge such as C programming, Python programming, computer networks, and operating systems with unmanned system application scenarios, thereby achieving a connection and linkage between foundational courses and cutting-edge courses. In terms of the module structure, the principle of progressive teaching should be followed, and the teaching content should be divided into levels of "basic cognition-principle learning-scenario-based introduction" to adapt to students' cognitive patterns at different stages of learning.

At the same time, evaluation standards for module teaching should be clearly defined, with mastery of basic theories, industry awareness, and knowledge application abilities serving as the core evaluation indicators. The traditional single written examination-based evaluation model should be abandoned to ensure that students firmly master the basic content of interdisciplinary fields, establish a solid knowledge foundation for subsequent advanced courses such as perception and decision-making programming, simulation experiments, and project practice, and address the problem of discontinuity in students' interdisciplinary learning.

3.2 Development of perception and decision-making programming courses

Perception and decision-making are key technologies for realizing the independent operation of unmanned systems and are also the central content of computer teaching integrating AI and unmanned systems. Traditional computer programming courses mainly focus on writing basic code and lack targeted teaching in intelligent algorithms, autonomous decision-making, and environmental perception, making it impossible to adapt to the job requirements associated with the intelligent development of unmanned systems.

Therefore, the targeted development of specialized courses in perception and decision-making programming is an important measure for improving students' core professional competencies and aligning with industrial technology requirements. Universities need to reconstruct the programming curriculum system according to the requirements for core technologies in the unmanned systems industry, so that traditional programming courses can be upgraded toward specialized programming courses in AI perception and intelligent decision-making, thereby transforming programming education from basic syntax to intelligent applications (Feng & Zhang, 2025).

The course content should take the development and design of core functions of unmanned systems as its main line and cover image recognition in machine vision, data processing in environmental perception, information fusion in multi-sensor systems, and path planning algorithms. Core technical content should include obstacle avoidance decision-making algorithms and intelligent following algorithms. These contents mainly use Python and C++ as programming languages to explain deep learning and reinforcement learning, as well as methods for applying machine learning and other AI algorithms to unmanned systems.

3.3 Simulation and real-machine collaborative experiments

Experimental teaching is the core of cultivating engineering practical skills among computer science students. However, unmanned system hardware equipment is expensive and subject to considerable wear and tear, and real-machine experiments involve relatively high risks. To achieve this goal, a three-dimensional experimental system combining simulation and real machines can be constructed, with the aim of finding a balance among teaching costs, experimental safety, and teaching outcomes, thereby comprehensively improving students' actual engineering operation skills.

Universities need to establish a virtual-real integrated experimental teaching platform and construct a full-process virtual simulation experimental environment by integrating mainstream unmanned system simulation software such as MATLAB, ROS, and Gazebo. At the same time, real-machine experimental equipment such as unmanned aerial vehicles, intelligent vehicles, and embedded development boards should be provided, and a two-level experimental model of "simulation pre-experiment and real-machine practical verification" should be established (Han et al., 2022).

The experimental content should be designed in different levels. At the basic cognition stage, simulation experiments should be conducted mainly to enable students to complete basic experimental operations such as unmanned system modeling, algorithm simulation, scenario simulation, and program debugging on virtual platforms. Students can become familiar with equipment operating logic and experimental procedures, thereby avoiding equipment damage and safety problems caused by operational errors in real-machine experiments. After students have acquired basic operational and algorithm debugging abilities, they can move on to real-machine practical experiments, transferring the algorithm programs that have been debugged through simulation to physical unmanned equipment for real-machine debugging, functional testing, troubleshooting, and other practical experiments. This approach addresses the shortcomings of purely simulated experiments being disconnected from actual operating conditions (Wei, 2023).

At the same time, a group-based experimental mechanism should be established, and simulation equipment and real-machine equipment should be reasonably allocated to ensure that every student can participate in practical training. In addition, a progressive experimental course structure should be designed, with the difficulty of experimental projects gradually increasing from basic equipment debugging and simple algorithm verification to comprehensive experimental projects such as complex autonomous navigation and intelligent obstacle avoidance. Students should be trained in problem troubleshooting, equipment debugging, and engineering implementation, enabling simulation-based teaching and real-machine teaching to complement each other.

3.4 Interdisciplinary project-driven teaching model

The curriculum integrating AI and unmanned systems is highly practical and interdisciplinary. Single classroom-based theoretical teaching and fragmented experimental teaching cannot effectively cultivate students' ability to integrate multidisciplinary knowledge to address complex engineering problems. Project-driven teaching relies on real engineering projects as its carrier and can effectively connect theoretical knowledge with practical skills, enhance students' comprehensive application abilities and teamwork capabilities, and therefore has become a core teaching model suitable for the new curriculum system.

Universities need to break through course barriers and disciplinary barriers, abandon the approach of teaching each course independently, and implement integrated teaching driven by interdisciplinary projects (Guo, 2023). Knowledge points from multiple courses, including programming and development, perception algorithms, intelligent decision-making, hardware debugging, and simulation experiments, should be integrated to design a comprehensive unmanned system project that is consistent with actual industrial conditions. The content may involve comprehensive engineering projects such as the development of obstacle avoidance systems for small intelligent unmanned vehicles, the design of UAV-based image acquisition and recognition systems, and the research and development of autonomous path planning systems.

The complete project development process should be used as the teaching thread throughout the entire course, enabling students to complete the entire development process in teams, including requirements analysis, solution design, algorithm programming, simulation debugging, real-machine implementation, and outcome acceptance. During the teaching process, teachers should no longer primarily serve as knowledge transmitters, but rather act as project instructors and facilitators, providing targeted guidance on problems encountered by students during project development, such as algorithm debugging, equipment adaptation, and function optimization. Teachers should guide students to independently consult materials, conduct team discussions, and optimize their solutions.

At the same time, a project evaluation mechanism should be established, with project completion quality, technological innovation, team contribution, and problem-solving ability serving as core evaluation indicators to replace traditional written examination-based evaluation. Through training based on a complete engineering project, students can integrate multidisciplinary knowledge and become familiar with the development process of unmanned system engineering, thereby effectively cultivating their engineering thinking, innovative thinking, teamwork ability, and other competencies, and narrowing the gap between university teaching and enterprise project development.

3.5 Dynamic updating mechanism for cutting-edge technologies

Artificial intelligence and unmanned system technologies are evolving at a very rapid pace, and their technology update cycles are relatively short. This has resulted in the continuous emergence of new technologies, new algorithms, and new equipment within the industry. At the same time, however, the content of traditional higher education curricula tends to be fixed and updated slowly. Since textbooks and teaching syllabi remain unchanged for long periods, there is a disconnect between the knowledge acquired by students and cutting-edge technologies in the industry, making students face challenges related to technological lag and insufficient job adaptability after graduation (Cai & Lin, 2023).

Establishing a regular dynamic updating mechanism for cutting-edge technologies is key to ensuring the advancement of the curriculum system and its alignment with industrial development needs. Universities should establish a dynamic curriculum content iteration mechanism and form a curriculum development team composed of professional teachers, enterprise engineers, and industry experts. They should regularly conduct research on unmanned systems, trends in the technological development of the artificial intelligence industry, technical requirements for enterprise positions, and the latest industry technology standards.

Each year, the teaching syllabus, courseware content, practical training projects, and textbook content should be dynamically optimized. Outdated theoretical knowledge and technical content should be removed in a timely manner, while cutting-edge technologies such as large-model-based intelligent control, multi-unmanned-device collaboration, high-precision perception and positioning, and intelligent cloud-based scheduling should be incorporated.

3.6 Co-construction and sharing of an industry-education integration case repository

Industry-education integration is the most important means of connecting university teaching with industrial job requirements. However, most teaching cases in traditional computer courses are virtual and simplified and lack support from actual enterprise engineering scenarios. As a result, students have an insufficient understanding of actual project development standards, technical difficulties, and application scenarios in the industry, and their engineering adaptability is relatively weak.

Through the joint construction and sharing of a university-enterprise case repository, industrial resources and educational resources can be deeply integrated, thereby enhancing the practicality and pertinence of curriculum teaching. Universities need to actively connect with enterprises related to intelligent unmanned systems, establish long-term university-enterprise cooperation mechanisms, and jointly develop teaching case resource repositories with enterprise engineers and technical research and development personnel.

Enterprises can provide actual teaching resources based on real unmanned system engineering projects, including project development cases, engineering technical difficulties, practical job scenarios, and project debugging logs. Universities can screen, optimize, and adapt enterprise cases according to teaching syllabi and students' cognitive patterns and transform them into standardized teaching cases suitable for classroom and practical training. The case repository covers three major categories: basic practical training cases, comprehensive project cases, and cutting-edge innovation cases, covering the entire field of perception, decision-making, control, and collaborative development of unmanned equipment.

4. Outcomes of the Construction of a Computer Curriculum System Integrating AI and Unmanned Systems

4.1 Enhanced project implementation capabilities

The innovative computer curriculum structure integrating AI and unmanned systems has reshaped the teaching framework of theory and practice, significantly increased the proportion of practical teaching, and completely addressed the shortcomings of the traditional computer teaching, which is centered on theory and places insufficient emphasis on practical operation. It has improved students' engineering practice and implementation capabilities in various aspects.

Systematic foundational module teaching, specialized programming courses, virtual-real integrated experiments, and engineering project training enable students to systematically master the technical system covering the entire development process of unmanned systems. Students become proficient in core practical skills such as intelligent algorithm programming, equipment debugging, functional development, and troubleshooting. They can flexibly apply theoretical knowledge of AI algorithms, computer programming, and intelligent control to actual unmanned system development scenarios and independently complete the development and debugging of perception, decision-making, and control functions of small unmanned devices.

At the same time, regular practical training based on real enterprise cases and project training enables students to become familiar with industry engineering development standards and project processes and accumulate real engineering practice experience. This effectively solves the problems of weak practical abilities among traditional students, the disconnection between theory and practice, and the inability to implement engineering projects. Overall, the construction of the curriculum system significantly enhances students' engineering thinking and practical implementation capabilities and significantly improves their job adaptability and employment competitiveness.

4.2 Improvement of innovation and collaboration competencies

The new interdisciplinary and project-based curriculum teaching model effectively breaks the constraints imposed on students' thinking by traditional single-classroom teaching and comprehensively improves their innovation capabilities and teamwork competencies. The integration of cutting-edge technologies from multiple fields in interdisciplinary curriculum content broadens students' professional horizons, enables them to combine AI cutting-edge technologies to optimize and innovate unmanned system development solutions, and encourages them to independently explore new algorithm applications, functional designs, and development models, thereby continuously developing their innovative thinking and independent inquiry abilities.

At the same time, with group projects serving as the driving force throughout the entire process, students continuously participate in team-based development during project design, code writing, debugging and optimization, and outcome integration. Through team division of labor, communication and discussion, and collaborative problem-solving, students' awareness of teamwork, communication abilities, and collaborative problem-solving awareness are effectively cultivated.

Compared with traditional teaching models, the new system is no longer confined to the learning of individual knowledge but places greater emphasis on the cultivation of comprehensive competencies. It enables students to develop the ability to take initiative in innovation and strong collaborative competencies through practical operation and exploration, which is consistent with the core competency requirements for interdisciplinary and innovative technical talents in the intelligent unmanned systems industry.

5. Conclusion

This paper focuses on a systematic study of the construction of a computer curriculum system integrating AI and unmanned systems. It establishes the goal of cultivating interdisciplinary and innovative talents and constructs a complete curriculum development system from the dimensions of curriculum module design, specialized course development, experimental system design, teaching model innovation, technology updating, and industry-education co-construction. It demonstrates that curriculum construction has significant effects on improving students' engineering capabilities and innovation and collaboration competencies.

In the future, universities need to continuously deepen the development of industry-education integration, dynamically optimize curriculum content and teaching models, continuously improve modern curriculum systems characterized by intelligence, interdisciplinarity, and practical orientation, and continuously provide high-quality interdisciplinary computer science professionals for the intelligent unmanned systems industry.

Conflict of Interest

The author declares that she has no conflicts of interest in this work.

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