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Research on the Reform of Core Courses in Robotics Engineering Major Under the Background of Integration of Production and Education and Integration of Science and Education

Chunlong Yue*
Henan University of Animal Husbandry and Economics, Zhengzhou 450046, Henan, China

**Author to whom correspondence should be addressed.*

Abstract: Under the background of the in-depth advancement of the strategies of integration of production and education and integration of science and education, the core courses of robotics engineering major need to break through the limitations of traditional discipline orientation and turn to a reform direction driven by the dual wheels of "industrial demand + scientific research innovation". However, there are still problems such as disconnection from industrial needs and insufficient transformation of scientific research achievements. Based on this, this paper will focus on analyzing the necessity and existing problems, and explore the reform paths of core courses in robotics engineering major under the background of integration of production and education and integration of science and education, aiming to cultivate compound engineering and technical talents in the robotics field who not only master core technologies but also have innovative potential.

Keywords: Integration of production and education; Integration of science and education; Robotics engineering major; Curriculum reform; Compound talents

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1. Introduction

With the in-depth penetration of robotics technology in fields such as intelligent manufacturing, high-end equipment, and people's livelihood services, the industrial demand for compound engineering and technical talents has shown explosive growth. The advancement of the strategies of integration of production and education and integration of science and education has provided a new opportunity and clear direction for the reform of core courses in robotics engineering major. Against this background, traditional teaching concepts and methods can no longer meet the needs of integrating industry and technology into the curriculum system. It is necessary to break the constraints of traditional discipline orientation, take industrial demand as the anchor and scientific research innovation as the engine, and promote the deep coupling of curriculum content with industrial technology evolution and scientific research achievement transformation [1], so as to realize the seamless connection between the talent training process and industrial development, scientific research practice, and thus cultivate high-quality talents who not only master the core technologies in the robotics field but also have engineering practice ability and scientific research innovation potential.

2. Necessity of reforming core courses in robotics engineering major under the background of integration of production and education and integration of science and education

2.1. Conducive to resolving the lagging contradiction between curriculum content and job requirements

As the core field of intelligent manufacturing, the robotics industry is iterating rapidly with the characteristics of technological integration, functional intelligence, and diversified application scenarios. Cutting-edge technologies such as artificial intelligence, digital twin, and multi-modal perception are deeply integrated with the robot body, promoting the dynamic upgrading of industrial requirements for talents' knowledge structure and skill system [2]. Under the background of integration of production and education, the reform of core courses has become an inevitable path to resolve this contradiction. Establishing a dynamic linkage mechanism between curriculum content and industrial technology development can integrate the latest industry technical standards, production processes, and project cases into the curriculum system in real time, promote universities and enterprises to co-build teaching resource databases, and realize the precise docking of curriculum content with job requirements [3]. At the same time, reconstruct teaching units based on real industrial projects, allowing students to directly contact practical industrial problems in curriculum learning, cultivate their engineering practice ability and technology application ability, and ensure that talent output keeps pace with the technological iteration of the robotics industry.

2.2. Conducive to breaking the barrier between scientific research achievements and teaching resource transformation

As an interdisciplinary and cutting-edge engineering major, the scientific research activities of the robotics engineering major contain rich teaching value and are an important carrier for cultivating students' innovative ability. Under the background of integration of production and education and integration of science and education, constructing a mechanism for transforming scientific research achievements into teaching resources can directly decompose teachers' scientific research projects into modular teaching topics, develop research-oriented training projects and case databases, and allow students to gradually experience the whole process of proposing, analyzing, and solving scientific research problems in curriculum learning [4]. In addition, promote the opening of scientific research platforms to undergraduate students, encourage students to participate in scientific research projects as research assistants or members of innovation teams, and integrate scientific research thinking, methods, and skills into all links of the curriculum teaching. This can not only enrich the depth and breadth of curriculum content but also stimulate students' sense of innovation and cultivate their scientific inquiry ability.

2.3. Conducive to optimizing and improving the talent training system

Under the dual background of integration of production and education and integration of science and education, the reform of core courses needs to optimize the talent training system, shift to a student-centered and competence-oriented teaching model, and implement teaching methods such as project-based teaching, inquiry-based teaching, and interdisciplinary integrated teaching. Guide students to carry out collaborative group learning around real engineering problems or scientific research topics, and independently construct knowledge systems and improve comprehensive abilities in the process of solving problems [5]. At the same time, it is necessary to build a practical teaching system, allowing students to exercise engineering practice ability and innovative thinking in practice, thereby stimulating students' learning initiative and innovative enthusiasm, realizing the essential transformation from knowledge transmission to ability training, and cultivating innovative engineering and technical talents who meet the needs of high-quality development of the robotics industry [6].

3. Existing problems in the teaching of core courses in the robotics engineering major

3.1. Outdated teaching content

At present, the core curriculum system of the robotics engineering major is mostly built based on traditional disciplinary logic, showing obvious disciplinary orientation characteristics, which are significantly disconnected from the technical needs of the rapid development of the robotics industry. Among them, outdated teaching content is the most important influencing factor. The robotics industry is in a period of explosive growth in technological integration and intelligence. Cutting-edge technologies such as artificial intelligence, digital twin, multi-modal perception, and collaborative robot control are deeply integrated with the robot body, promoting the continuous upgrading of industrial requirements for talents' knowledge structure and skills [7]. However, the existing core curriculum content still focuses on traditional disciplinary knowledge, emphasizing classical theoretical derivation and single technical module explanation, and insufficiently covers the latest industry technical standards, core application scenarios, and engineering practice needs.

3.2. Single teaching model

Under the traditional teaching model, the teaching of core courses in robotics engineering majors generally adopts a one-way indoctrination teaching model where teachers explain and students passively learn, which fails to effectively stimulate students' active learning awareness and innovative thinking. At the same time, in the teaching process, teachers mostly focus on textbooks, emphasizing the systematic transmission of theoretical knowledge, and insufficiently explaining the application scenarios, practical value, and innovative extensions of knowledge. There is a lack of teaching design to guide students to think deeply and explore independently, resulting in difficulties in establishing effective connections between theoretical knowledge and engineering practice [8]. In addition, teaching methods are too single, and teachers have insufficient development of diversified teaching methods, making it difficult to effectively stimulate students' learning interest and enthusiasm.

3.3. Weak practical teaching links

The practical teaching links of core courses in the robotics engineering major are obviously weak, and the degree of collaborative integration with scientific research activities and industrial practice is insufficient, making it difficult to effectively cultivate students' engineering practice ability and scientific research innovation potential. On the one hand, the internal practical teaching resources are limited, and the training content is mostly verification experiments, completing preset operation processes relying on simple robot experimental platforms, lacking simulation of real engineering scenarios and training in solving complex problems [9]. On the other hand, the construction of practice bases is mostly superficial cooperation, and students' internships are mainly composed of visits and auxiliary work, making it difficult to deeply participate in the development of real enterprise projects and production practice. They cannot improve the core skills required for positions in practice, resulting in the failure to effectively improve students' engineering practice ability and innovative ability.

4. Reform paths of core courses in robotics engineering major under the background of integration of production and education and integration of science and education

4.1. Optimize the curriculum system to realize the in-depth integration of industrial needs

The curriculum system is the foundation of talent training and the development of integration of production and education. It is necessary to break the traditional disciplinary curriculum structure and establish a modular and project-based curriculum content system based on the core competence requirements of the robotics industry and driven by the integration of production and education and integration of science and education. Firstly, establish a dynamic matching mechanism between curriculum modules and industrial job capabilities, carry out in-depth cooperation with leading enterprises in the robotics industry, jointly draw core job capability maps, and decompose the knowledge, skills, and literacy required for positions into quantifiable teaching units [10], and set up core curriculum modules such as basic robot motion control, intelligent perception and data processing, and robot system integration and debugging accordingly.

Secondly, integrate the latest industrial technical standards, production processes, and typical project cases into the content of each module. For example, transform cutting-edge industrial content, such as the application of digital twin technology in robot debugging and collaborative robot safety specifications, into curriculum teaching units to ensure the precise docking of curriculum modules with job requirements [11]. Finally, construct a dynamic update mechanism for modular courses, regularly track the progress of industrial technology evolution and scientific research achievements, iteratively optimize the content of curriculum modules, ensure the unification of the curriculum system with industrial development and scientific research innovation, and realize the in-depth integration of industrial needs.

4.2. Build a high-quality teaching team to enhance teaching effectiveness

Teachers are the key support for the reform of core courses and an important force for promoting the implementation of the integration of production and education. In order to better cultivate high-quality talents, it is necessary to break the limitation of traditional university teachers' single teaching and build a high-quality teaching team. Firstly, establish a regular mechanism for teachers' enterprise practice, requiring core course teachers to regularly participate in practical activities such as project development and technical research in robotics enterprises, accumulate front-line industrial experience, and guide them to transform practical experience into teaching resources, training projects, or teaching cases [12].

Secondly, increase talent recruitment efforts, expand the top teaching team of robotics engineering major, and use a flexible talent introduction mechanism to hire senior engineers, technical directors, etc. from robotics enterprises as part-time teachers to teach course modules such as cutting-edge industrial technology topics and robotics engineering practice case analysis, sharing real enterprise project experience and technical application insights. At the same time, they can participate in links such as curriculum syllabus formulation, training project design, and student practice assessment to ensure that teaching content is closely connected with industrial reality [13]. Thirdly, establish a collaborative lesson preparation and teaching research mechanism for cross-border teaching teams, and promote knowledge integration and teaching experience sharing among teachers from different backgrounds through regular teaching exchange meetings, joint lesson preparation meetings, and other activities to form an educational synergy, thereby strengthening teachers' professional abilities and enabling them to give full play to their educational advantages.

4.3. Innovate teaching models and implement new diversified teaching paradigms

To effectively implement the teaching model of integration of production and education in the teaching of robotics engineering major, it is necessary to organically combine the practicality of professional teaching with the systematicness and progressiveness of curriculum teaching, and construct a new teaching model paradigm. Specifically, on the one hand, fully implement project-driven teaching, take real industrial projects or scientific research micro-topics as teaching carriers, decompose curriculum teaching content into a series of progressive project tasks, and guide students to complete the whole process of project demand analysis, scheme design, practical operation, achievement display, and reflection and improvement in groups [14]. In the process of project implementation, teachers, together with enterprise experts and researchers, act as instructors, helping students solve theoretical and practical problems encountered in the project through problem guidance, process feedback, and other methods, and cultivating students' engineering practice ability and team cooperation ability.

Secondly, introduce situational simulation teaching methods, build highly realistic robot teaching scenarios relying on technologies such as virtual reality and digital twin, such as simulating industrial robot production line integration scenarios and robot fault diagnosis scenarios, allowing students to carry out high-cost and high-risk training operations in a virtual environment to improve the proficiency and safety of practical skills. At the same time, situational simulation can be used to restore scientific research experimental processes, allowing students to intuitively understand complex scientific research principles and technical application logic [15]. Finally, deepen inquiry-based learning design, set open-ended questions or research-oriented inquiry tasks in curriculum teaching, and guide students to actively explore solutions through literature review, independent experiments, group discussions, and other methods, cultivating students' independent learning ability and innovative thinking.

4.4. Establish a diversified evaluation system to measure the curriculum teaching effect

Establishing a diversified evaluation system is an important guarantee for the reform of core courses. It is necessary to break the limitation of traditional single summative theoretical assessment and construct a comprehensive evaluation system combining knowledge, ability, and innovation. Firstly, in the evaluation process, teachers should focus on examining students' knowledge accumulation and application in curriculum learning, as well as their understanding depth and comprehensive application ability of core knowledge through classroom interaction, homework completion quality, and phased tests, reducing the assessment of rote memorization content. Secondly, establish an evaluation index system for practical ability, quantitatively evaluate students' performance in training projects and enterprise internships from dimensions such as standardization of practical operations, efficiency of problem-solving, and quality of project achievements. At the same time, introduce enterprise technical experts to participate in practical ability assessment, measure students' practical skill levels according to actual industrial standards, and ensure the objectivity and practicality of evaluation results.

Finally, set up innovation evaluation indicators to comprehensively evaluate students' innovative ideas, scheme design, and achievement transformation in curriculum projects, scientific research exploration, and discipline competitions. Encourage students to submit innovative achievements such as innovative design reports, scientific research papers, and patent applications, and incorporate them into the curriculum evaluation system to stimulate students' innovative enthusiasm. In addition, establish a feedback and application mechanism for evaluation results, and use evaluation data as an important basis for optimizing curriculum content, adjusting teaching methods, and improving talent training programs, forming a closed-loop education system. This can not only focus on students' knowledge mastery but also attach importance to the cultivation of practical ability and innovative potential, and comprehensively and objectively measure the teaching effect of core courses and students' comprehensive literacy.

5. Conclusion

In summary, under the background of integration of production and education and integration of science and education, the reform of core courses in robotics engineering major is a key measure to adapt to industrial development and cultivate innovative talents. By optimizing the curriculum system, building a high-quality teaching team, innovating teaching models, and establishing a diversified evaluation system, we can promote the dynamic connection between curriculum content and technological iteration, scientific research achievements, provide solid talent support for the high-quality development of the robotics industry, and help the in-depth integration of vocational education and industrial innovation.

Disclosure statement

The author declares no conflict of interest.

References

[1] Xiong Y, 2025, Exploration and Practice of Talent Training Model for Robotics Engineering Major Based on the Integration of Production and Education and Collaborative Education. Proceedings of National University Education and Teaching Research Achievements of Beijing University Electronic Information Professional Group and Ministry of Education Electronic Information Professional Virtual Teaching and Research Office, School of Intelligent Manufacturing, Jiangxi University of Applied Science; School of Electronic Information Industry, 464–469.

[2] Wang X, Yu X, Liu C, 2024, Exploration on the Talent Training Path of Integration of Production and Education for Robotics Engineering Major in Emerging Engineering. Technology Wind, 2024(30): 66–68.

[3] Liu Z, Tang L, Sun F, et al., 2024, Reform and Exploration of the Training Model of Physics Courses for Robotics Engineering Major Under the Background of Emerging Engineering. Neijiang Science & Technology, 2024, 45(10): 147–148.

[4] Wang Z, Chen Q, Li X, 2024, Exploration and Practice of Immersive Teaching in Experimental Teaching of Robotics Engineering Major. China Modern Educational Equipment, 2024(19): 41–44.

[5] Lei J, Qian D, Rao J, et al., 2024, Practice of Multi-Curriculum Linkage Comprehensive Experimental Teaching for Robotics Engineering Major. Journal of Higher Education, 2024, 10(30): 11–14 + 18.

[6] Wang Z, Zhang D, Zhang Z, et al., 2024, Research on the Teaching of Engineering Practice Courses for Robotics Engineering Major Based on OBE Concept. Popular Science & Technology, 2024, 26(05): 140–143 + 147.

[7] Jiang Y, Deng S, Zhang X, et al., 2024, Research on the Teaching Reform of Robotics Engineering Major Under the Background of Emerging Engineering + Industry College. Equipment Manufacturing Technology, 2024(06): 21–25.

[8] Pan Q, 2024, Exploration on the Teaching Model of Integration of Production and Education in Universities Under the Background of Emerging Engineering—Taking Robotics Engineering Major as an Example. Equipment Manufacturing Technology, 2024(02): 87–89.

[9] Liu H, Lan Y, Shang Q, et al., 2023, Research on the Joint Training of Outstanding Engineers for Robotics Engineering Major Through Integration of Production and Education. Electronic Components and Information Technology, 2023, 7(03): 226–230.

[10] Jiang B, Liu Y, Li G, et al., 2023, Approaches to Talent Training for Robotics Engineering Major Based on In-depth Integration of Production and Education. Journal of Hubei Polytechnic University, 2023, 39(01): 64–67.

[11] Sun Q, Wang J, Yao G, et al., 2022, Research and Application of Talent Training Model for Robotics Engineering Major Based on Integration of Production and Education. Industry and Information Technology Education, 2022(06): 28–32.

[12] Shang X, Ji H, Wu H, et al., 2022, Exploration on the Collaborative Education Model of Integration of Production and Education for Emerging Engineering Majors Under the Background of Professional Group—Taking Robotics Engineering Major of Beijing Union University as an Example. Science & Technology and Innovation, 2022(11): 49–51.

[13] Zhang J, Wang S, 2021, Exploration and Practice of the Integration of Production and Education Model for Robotics Engineering Major Under the Background of Emerging Engineering. Journal of Higher Education, 2021, 7(33): 15–18.

[14] Ning B, Yan B, Lu S, et al., 2021, Analysis on the Construction of Industrial Robot Training Projects in the Integration of Production and Education Bases Under the Background of Emerging Engineering. Technology Wind, 2021(23): 91–92.

[15] Li L, Zheng L, Ma F, et al., 2021, Research on the Construction of Practical Teaching System for Robotics Engineering Major Through Integration of Production and Education. Research in Higher Education of Engineering, 2021(04): 88–92.

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