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Exploring the Talent Training System in Robotics Engineering: Integration of Specialization and Innovation

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Abstract: *Robotics engineering is experiencing significant growth amid evolving engineering disciplines, necessitating enhanced student innovation and practical skills. The integration of professional education with innovation and entrepreneurship is becoming a key trend in university talent development. This paper examines the development of the robotics engineering program at Jiamusi University, focusing on the program's objectives, comprehensive curriculum, and robust practical training conditions tailored for local applied universities. By analyzing current practices, it proposes targeted reforms to the robotics practice teaching system and innovative teaching models through a "three-in-one" talent cultivation approach that effectively combines theoretical knowledge, hands-on practice, and creative innovation. These reforms aim to better prepare students for the challenges of the rapidly advancing field of robotics. Additionally, the paper offers insights into building a specialized and innovative education system and practical platform that supports interdisciplinary collaboration and entrepreneurship. By fostering an environment that encourages experimentation and creativity, the proposed system seeks to cultivate a new generation of robotics engineers equipped to meet industry demands and drive future technological advancements.*

Keywords: *Robotics Engineering, Professional and Innovation Integration, Applied Universities, Talent Training System*

1. Introduction

New Engineering Education represents a novel integration of emerging engineering disciplines, innovative educational models, and new concepts in engineering education. Since 2017, the Ministry of Education has formally deployed a series of tasks related to the "new engineering", the construction of the new engineering discipline in response to the new round of global scientific and technological revolution and industrial transformation, serving the national innovation-driven development, "Made in China 2025", "Internet+" and a series of other major strategic missions, one of the core requirements of [1] . On this basis, the construction of new engineering majors should carry out deeper reforms on the basis of traditional engineering majors in order to achieve the goal of cultivating emerging engineering talents, and enhancing students' innovative consciousness and practical operation ability has been the general trend of the development of higher education. Innovation and entrepreneurship education is a great educational practice based on quality education and innovation education, and it is also an innovative reform of colleges and universities driven by "mass entrepreneurship and innovation"[2] . This paper takes robot innovation practice teaching as a platform, practice teaching system reform as a guiding ideology, robotics competition as a basis, to promote the reform of robotics teaching in the field of new technology and new engineering mode research, to build a robot practice teaching platform [3] .

2. Problems in the Process of Practical Teaching of Robotics Engineering in Higher Education Institutions

After the concept of "specialised entrepreneurship integration" was put forward, the higher engineering education, although huge in scale, still failed to meet the expectations, such as the shortage of entrepreneurship education platforms and the incomplete system of practical training courses, etc.[4] ;

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Yu Chaoxia proposed that institutions lacked the correct concept of talent cultivation during the process of bi-innovation education[5] , Xiong Genliang proposed that there was a disconnect between theoretical teaching and practical teaching, and the teaching guarantee was not sound, etc.[6]. Li Ming proposed that the existing curriculum of innovation and entrepreneurship education lacks scientific planning[7] . From a comprehensive point of view, the following problems mainly exist in the construction of "speciality and innovation integration" teaching mode in higher education institutions.

(1) The main problem of the dual-creation curriculum is that the current dual-creation education mainly focuses on teaching general education knowledge and lacks specialised education. The general knowledge foundation generally teaches the basic concepts and theories of innovation and entrepreneurship, which has little relevance and continuity with the speciality, and the knowledge students learn is not specific and systematic, so it is difficult to cultivate innovation consciousness and skill training. Due to the small number of class hours and weak orientation, it is difficult to improve students' learning adhesion. Moreover, since there is no classification guidance according to majors in the process of dual-creation education, the differences in disciplines or individual differences of students will lead to different cognitive levels of students' understanding of innovation and entrepreneurship, and students' sense of acquisition is not strong, which is not conducive to updating students' employment concepts.

(2) Disconnect between theoretical teaching and practical teaching. Due to the quiet emergence of industry 4.0 mode, the systematic research and development and large-scale production of robots are thrown into large-scale materials, while the syllabus and practical links in colleges and universities have not been timely supplemented, greatly lagging behind the application of robotics technology. On the other hand, some college teachers pay too much attention to the teaching of theoretical courses rather than practical training, however, practice is the best way to cultivate students' engineering practical ability and innovation consciousness, and it is an important part of cultivating students to analyse and solve practical problems with knowledge. Under the background of new engineering discipline, it is necessary to integrate theoretical teaching with practical teaching links to stimulate students' learning interest. Therefore, reasonable arrangement of theoretical course teaching and increasing practical courses are also needed to be improved and perfected in the talent training programme.

(3) Some colleges and universities and specialties still nest conservative, outdated and traditional teaching modes into the new specialties, and although changes have been made in the form, the old teaching modes are still used in the curricula. For example, in the teaching process of robotics engineering, course experiments, course design, professional design, innovation and entrepreneurship competitions, graduation design and other practical aspects of most of the original automation professional content, the knowledge system can not be effectively articulated, students will inevitably overlap the practical aspects of the relationship between the design of the content and the practical content of the relationship between the fuzzy or even irrelevant. In addition, many manufacturers produce and sell educational robots mostly for small enterprises to produce and develop, the standard is not uniform, the system openness is low. Secondary development cannot be carried out, which is not conducive to the cultivation of students' practical ability.

(4) The innovation and entrepreneurship education mode is unclear, and the talent cultivation objectives lack quantitative standards. The singular teaching model overlooks process education, preventing students from experiencing the personalization of entrepreneurship and innovation education. The core issue lies in the failure to develop talent cultivation plans based on professional talent training objectives, which in turn weakens the capacity for scientific and technological innovation within professional domains. Therefore, the most fundamental task of "dual-creation" education is to cultivate students' innovative consciousness and ability, and to realise innovation and entrepreneurship in professional characteristics.

3. Robotics engineering "speciality and innovation fusion" model construction

The traditional teaching mode has limitations in the training of talents, and can no longer meet the many needs of enterprises for talents[8] . Therefore, colleges and universities should keep abreast of the times in talent cultivation in accordance with the needs of social employment development, and constantly explore new teaching modes and promote teaching reform. In the teaching mode of speciality-creative integration, it promotes the establishment of innovative consciousness and improves the teamwork ability of students in the process of cultivating students, showing its superiority. In addition, the integration of creativity and social service seem to be two different contents and directions, but in

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fact, they are both separate and united in terms of specific contents. Specialised integration can improve the quality of professional talents training, and high-quality professionals can better serve the local economy, and on the contrary, the strong social service of institutions of higher learning can be better specialised integration with enterprises, so the two are promoting the development of the relationship between each other. The talent training goals are shown in Figure 1.

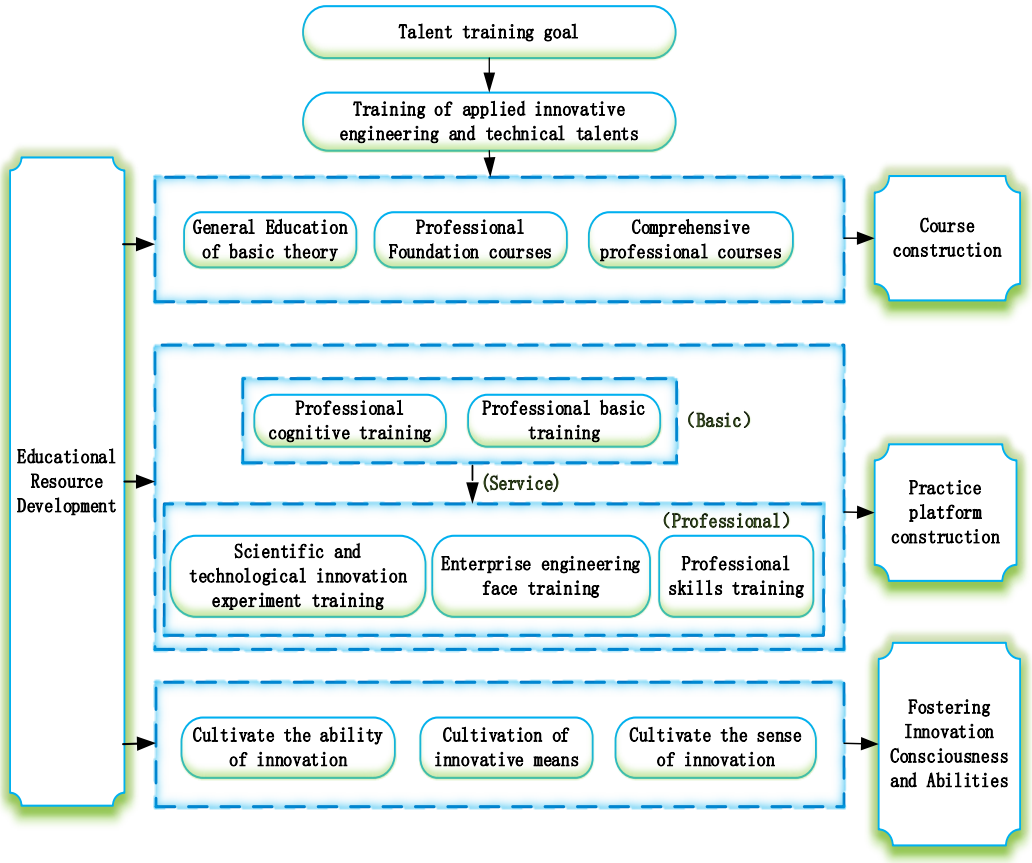

Figure 1: Talent Training Goals.

3.1. Construction of the "Specialisation and Integration" Model in the Light of Professional Needs

The integration of expertise and entrepreneurship in institutions of higher education, i.e. the integration of professional education and dual-creation education, is to take the professional teaching content as the starting point, combine the teaching with the development of the industry and the market demand, so as to stimulate the students' interest in learning and the vitality of innovation and entrepreneurship from the perspective of innovation and entrepreneurship, and to truly grasp the essence of dual-creation. Secondly, by utilizing the essential knowledge and skills required in innovation and entrepreneurship education, this approach explores the connection between anticipated learning content and entrepreneurial innovation, identifies suitable entry points, and subsequently carries out innovation and entrepreneurship activities based on specialized knowledge, ultimately producing innovation and entrepreneurship outcomes that reflect the unique characteristics of the professional field. Robotics engineering is the development direction of national strategic emerging industries, and the major aims to cultivate personalised, diversified and dynamic talents with comprehensive engineering practice ability, which needs to actively buttress and proactively satisfy the numerous demands for talents in the machine industry[9] . On this basis, it is also necessary to gradually complete the curriculum system to make it more flexible; by timely adjusting the teaching content, it can promote the development of students in a more targeted way. In addition, if teachers can make flexible use of course practice, students can gain valuable experience through scientific research practice, and at the same time, many new knowledge, new methods and new technologies can be brought into the classroom, so as to mobilise students' enthusiasm and conscientiousness in science and innovation.

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3.2. Construction of a "Specialised and Creative Integration" Model for Educational Content

With the background of engineering problems, teachers should actively explore the comprehensive curriculum from multiple perspectives, aiming at improving their teaching integration ability and enriching the teaching content through in-depth research on interdisciplinary courses. At the same time, teachers should reform and optimise the teaching mode in real time according to the latest industrial technology and academic theories[10] . In the curriculum, it is necessary to understand the development of the robotics engineering industry, and to cultivate students' innovative consciousness through innovative courses and graduation design and other assessment contents; in the innovation carrier, it is necessary to serve the society through the introduction of new technologies and new processes, and through the innovation team of teachers and students and collaborative innovation; in the service platform, it is necessary to achieve the cross-fertilisation of the existing general education and special education by the integration of specialization and innovation, and to form the characteristics of specialty, and to achieve the innovation through the transformation of achievements and tutoring and training. In the service platform, the cross-fertilisation of general education and special education is achieved through the integration of specialization and creation, the formation of professional characteristics, and the realization of innovation and entrepreneurship through the transformation of achievements and counselling and training, so as to promote the dual-creation education in an all-round way[11] . In the practical teaching of robotics, the teacher assigns design tasks for students at the beginning of teaching, describes the functional requirements of the robot in detail, and guides students to collect learning materials. Students design the robot independently by formulating, modifying and implementing the overall plan. Adhere to the student as the main body, promote students to establish active learning to real, improve the analysis of the problem and the ability to solve it. At the same time, in the whole process, the theory and practice can be combined, theory guides practice, practice consolidates theoretical knowledge. In the teaching process, educators should fully assume a guiding role, emphasizing effective communication with students and fostering a positive and engaging learning environment. Only by stimulating students' intrinsic motivation can their initiative for innovation and enthusiasm for practice be cultivated. In a harmonious and relaxed atmosphere, students can freely reimagine existing knowledge, ignite their passion for learning, boldly ask questions, actively participate in discussions, and engage in repeated experimentation. This can cultivate students' tenacious qualities, enhance their sense of innovation and motivation to learn practical engineering activities.

3.3. Construction of "speciality and innovation fusion" mode under the competition system

At present, the commonly chosen teaching mode for practical sessions in universities is project-driven, but there are many limitations in practice, such as the low degree of integration between teaching projects and production practice, and the teaching effect is not significant[12]. In practice, the Robotics Engineering programme requires students to explore their potentials around their personal strengths and interests. To this end, the school will continue to expand the field of innovation competitions, based on the relevant competition practice platform, add a number of competitions such as Robotics Innovation Competition, Artificial Intelligence Manufacturing Competition and other competitions, to build a more disciplinary characteristics of the competition system. The school will actively expand the depth and breadth of cooperation with enterprises, and co-organise relevant competitions with enterprises, so as to further improve the relevant match between the employment direction and the development needs of the robotics industry, and enhance the entrepreneurial awareness. In the practical teaching and design of robotics, students usually discuss, write and debug programme in groups, then make robots, and summarize the problems arising from the operation after the competition. The process of making robots is used to improve students' team spirit, and there should be two or more groups in each project, which allows inter-group competition and exchange of experience, with a view to achieving continuous progress. Obviously, professional discipline competitions are necessary to cultivate students' ability to consult literature, apply professional knowledge to solve discipline problems, as well as practical operation ability, and teamwork, etc. Therefore, the practical teaching of robotics can cultivate students' teamwork spirit.

4. The Construction of Specialised and Creative Integrated Education System and Platform - Taking the Robotics Engineering Major of Jiamusi University as an Example

The College has a Robotics Centre which integrates basic training, practical training, innovation and entrepreneurship, research and development, a Siemens Advanced Control Laboratory with practical and innovative links, a Dane Software Laboratory and its various basic laboratories for teachers and students

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to carry out innovative activities and scientific research at different levels and among different professions. By providing students with an engineering practice platform, it fosters students' practical ability and enhances their sense of innovation. Specifically, it has the following components:

(1) Robotics competition practice platform.

Based on the competition team of robotics engineering at Jiamusi University, various robot platforms were acquired and fabricated. Such as mobile robots, industrial robots, rehabilitation robots and so on. Through group collaboration, students work together to learn and debug robots, gaining hands-on training in the processes of assembly, debugging, and control, thereby enhancing their awareness and capabilities in robot design and innovation.

(2) Robot control, trajectory planning, and vision practice platforms.

This part relies mainly on the humanoid vision confrontation kit to achieve the ability of students to learn basic components and develop new structures, but also to carry out research in the form of a project. Allow students to get comprehensive training in robot control, trajectory planning, image processing, vision, sensor technology, etc., with the technology in-depth to improve the students to carry out a higher level of design and manufacturing.

(3) Human-Robot Interaction and Medical-Industrial Integration Practice Platform.

This part consists of rehabilitation robots, humanoid robots and so on. Using this platform, students can complete human-robot interaction. This part can combine the professional knowledge of the School of Mechanical and Electrical Engineering, the School of Information Engineering, the School of Science and the School of Medicine, so that students can appreciate that robotics is a product of the cross-fertilisation of multiple disciplines.

(4) Joint school-enterprise training platform.

Establishing partnerships with renowned robotics companies provides students with a high-quality platform and opportunities for joint university-industry training. By involving students in the entire process, from project initiation and technical solution development to hardware platform construction and project implementation, they receive systematic and comprehensive training, laying a solid foundation for their path to innovation and entrepreneurship.

4.1. Emphasis on basic education and the establishment of a teaching model for the integration of interdisciplinary knowledge

Since robotics is highly integrated by the cross of several disciplines, it is necessary to optimise the cross of the curriculum in terms of imparting theoretical knowledge, therefore, the teaching process mainly includes two aspects, on the one hand, establishing the cultivation goal and combining the existing cultivation conditions, formulating the teaching plan and educational objectives, and making reasonable arrangement of the learning content; on the other hand, drawing on the cultivation experience of colleges and universities, and with the help of typical cases of robotics modules, it is that students can easily understand and remember. On the basis of general education, the guidance is fine-tuned in layers and classifications according to professional fields, so that students can understand the concept and process of entrepreneurship and innovation implicitly during the learning process, and plant the seeds of innovation and entrepreneurship. The construction of modularised curriculum system is based on artificial intelligence disciplines and covers the cross association of other professional disciplines, which fully improves the attractiveness and targeting effect of the curriculum.

4.2. Hierarchical Modular Reform of Practical Teaching Mode

In the teaching process, different modules of robotics engineering technology should be summarised, and the teaching content should be reasonably distributed according to the different grades of the students, and the teaching should be divided into two parts: theoretical teaching and practical sessions, and the practical sessions should be divided into different modules and levels. By scientifically segmenting the teaching content in a progressive and hierarchical manner, organized from simple to complex and by different knowledge points, a progressive and hierarchical teaching model is established.

4.3. Project-oriented extracurricular practical teaching model

The laboratory takes landing entrepreneurial practice projects, high-level discipline competition

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entries and other projects as an outlet to test the quality of innovation and entrepreneurship education practice training. Firstly, the laboratory builds a discipline competition group based on the discipline characteristics of the college. Discipline competitions achieve full coverage of majors. The competitions include China University Intelligent Robot Creative Competition, Challenge Cup, National University Students Mathematical Modelling Competition and "Internet +", etc., which have achieved full coverage of disciplines and are all national competitions to enhance students' professional practice ability by "promoting learning through competition". (c) To improve students' professional practical ability by "promoting learning through competition". We do a good job in teaching dual-creation courses, skills training, competition project guidance, on-campus and off-campus entrepreneurial resources docking, dual-creation results transformation, enterprise management consulting and policy and regulation consulting and so on. It provides excellent human resources and innovative talents for the research teams of related disciplines in the school. Additionally, we offer necessary project support, guidance, and training from professional instructors for project teams participating in high-level innovation and entrepreneurship competitions. Furthermore, we provide practical and training support for the development of the school's academic programs.

5. Conclusion

Specialised integration emphasizes the organic integration between talent cultivation orientation, curriculum and practice platform construction, and the multidisciplinary joint innovation and entrepreneurship laboratory mainly takes the targeted excavation, cultivation and guidance of innovation and entrepreneurship projects as the fundamental task, realizes the cross-fertilization of general education and special education, and builds a practice platform oriented to the project to promote the implementation of the project and transformation of the results.This paper puts forward some new ideas through the research on the actual situation and innovative practice education carried by the Robotics Engineering of our school. This paper puts forward some new ideas through the research on the actual situation of innovation practice education and innovation practice teaching reform carried by specialised innovation fusion in our university.

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