The Research on the Implementation Path of Innovative Talents in Computer Majors Based on the Integration of Specialization and Innovation

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Abstract. Entrepreneurship education in universities can only be truly effective when it is based on professional education and fully integrated into the development of professional education. By implementing integrated education that combines professionalism and entrepreneurship throughout the entire process of talent cultivation, the essence and charm of entrepreneurship education can be fully showcased. This study builds a multi-level three-dimensional creative integration curriculum system of "combination of general and professional", and implements the practical teaching method of "three divisions and five rings, project-driven, and using the analytic hierarchy process to build an evaluation index system for innovation and integration innovation ability, construct an evaluation model for innovation ability based on deep neural network, and form a closed-loop feedback teaching mode, which deeply integrated innovation and entrepreneurship education and professional education, and proposed a set of effective innovative talent training models for computer majors. By conducting practical explorations in computer-related majors, this training model has greatly ignited students' interest in learning, enhanced their initiative in learning, established a sound growth system, fostered an innovative spirit, and developed their innovative abilities. As a result, the rates of students pursuing further education and employment have continuously increased.

Keywords: Integration of Specialization and Innovation, Curriculum System, Practical Teaching, Deep Neural Network, Evaluation of Innovation Ability

1 Introduction

The current trend in undergraduate talent training and curriculum reform in international higher education is the integration of specialization and innovation. This involves incorporating entrepreneurial concepts, knowledge, and skills into the training process of specialized knowledge, creating compound innovative talents who understand specialized knowledge and possess entrepreneurial abilities [1]. Promoting the deep inte-

G. Guan et al. (eds.), *Proceedings of the 2023 3rd International Conference on Education, Information Management and Service Science (EIMSS 2023)*, Atlantis Highlights in Computer Sciences 16,
https://doi.org/10.2991/978-94-6463-264-4_31

gration of specialization and innovation is a crucial breakthrough to promote the comprehensive reform of higher education. However, achieving this integration for the whole and combining majors remains a hotspot and difficult point in higher education reform [2-3]. Currently, most colleges and universities adopt implementation modes such as the dual innovation curriculum system, dual innovation training programs, and business incubation to promote specialization and innovation[4]. However, these modes encounter several problems, such as the inadequacy of public basic courses for entrepreneurship, limitations in in-depth dual-innovation elective courses, and the inability of dual-innovation training projects to form a stable system [5].

To address these common issues and achieve better integration, this paper aims to integrate specialization and innovation, highlight the characteristics of specialized courses, and improve the quality of talent training. Using the computer science major of Hebei Agricultural University as an example, this research has developed an effective implementation path for innovative talent training in computer majors. This path includes the construction of a multi-level and three-dimensional curriculum system that combines general and professional education, the implementation of practical teaching modes that are project-driven and competition-led with three divisions and five links, the application of diversified teaching methods that integrate specialization and innovation, the creation of a "double qualification" teacher team that combines specialization and innovation, and the exploration of the implementation path for the integration of specialization and innovation in colleges and universities.

2 The implementation plan for innovative talent training path based on integration of specialization and innovation consists of several elements.

2.1 The "Hierarchical progressive, Dual-line parallel, Multi-level and Three-dimensional" specialization and innovation integrated curriculum system.

This System aims to integrate innovation and entrepreneurship knowledge, ability, awareness, and spirit into specialized courses. This system involves adjusting the curriculum, exploring entrepreneurship education resources within specialized courses, and optimizing talent training programs[6].

By integrating the core competencies of innovation into the training goals of specialized talents, a curriculum system that combines general and specialized education is created. The system is hierarchical and progressive, dual-line parallel, multi-level, and three-dimensional. It consists of general education training, empowerment training, and project practice. The system is designed to promote the two main teaching lines of "innovation" and "entrepreneurship" in parallel, with both lines embodied in the general and professional education courses, professional and creative integration courses, and independent learning courses.

In this system, general education courses are used to cultivate innovative interests, specialized courses are used to develop innovative knowledge and abilities, and self-learning courses are used to promote innovative practical abilities[7]. The three types of

courses are set up in a crisscross manner, establishing a new intra-curriculum design mechanism for the education of "integration of expertise and innovation." This system aims to promote the gradual improvement of students from innovation and creativity to entrepreneurship.

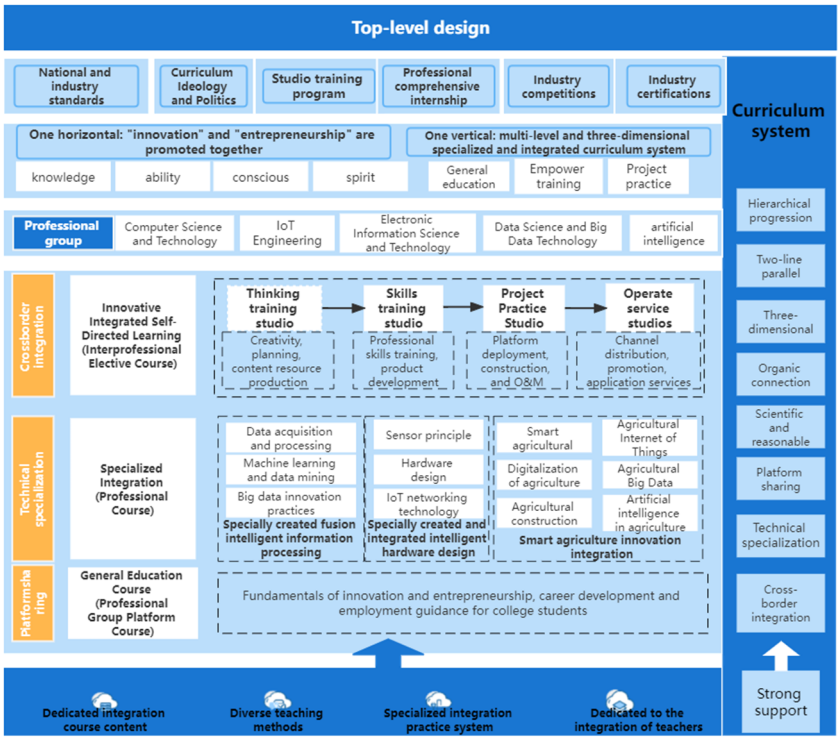

Fig. 1. Specialization and innovation integrated curriculum system

Figure 1 illustrates the curriculum system of specialization and innovation integration. In this system, the general education course is open to all students, and compulsory and elective courses of general education in innovative education are offered. For instance, in the first year, students can take the "Fundamentals of Innovation and Entrepreneurship" course to gain knowledge and develop innovative ideas based on the innovation and entrepreneurship thinking model.In the specialization and innovation integrated courses, teachers should combine specialized courses with innovation and entrepreneurship teaching objectives. This can be achieved by analyzing typical work tasks of the course, integrating innovative and entrepreneurial thinking into specialized courses, and converting real projects reflecting specialized training goals into teaching cases. By doing so, specialized and innovative thinking habits can be cultivated.For example, our school's characteristic course "Introduction to Smart Agriculture" combines information technology with agricultural production. Students can learn about

advanced technologies such as the Internet of Things, Big Data, and Artificial Intelligence used in digital agriculture. Practical application case teaching is also used to cultivate students' specialized interests and pride, laying a solid foundation for the cultivation of innovative talents for rural revitalization. Additionally, the "Specialization and innovation Integration Independent Learning Course" is a specialized development course that introduces specialized talent training programs. It includes setting up "Specialized Comprehensive Internship" as a precursor to graduation internship and graduation design. This teaching link helps bridge the gap between theory and innovative practice. Students can choose to enter various innovative studios with distinct themes based on their interests and personal career planning. They can also participate in targeted training camp activities, which enable them to develop the ability to enter enterprise internships.Through the development of these three different types of courses, the curriculum system of specialization and innovation integration is constructed. This system is designed to be layer-by-layer progressive, organically connected, scientific, and reasonable[8].

2.2 The practical teaching model of integration of innovation, creativity and entrepreneurship with "three mentors, five circles, project-driven, and competition guidance".

This teaching model is based on the CDIO philosophy and emphasizes learning engineering technology through student initiative, practice, and organic connection between the curriculum[9]. The three teachers involved in this teaching model are school tutors, enterprise tutors, and senior "student teachers". The teaching process is project-driven and consists of five learning links from project preparation to project application. In the project implementation process, we simulates an enterprise echelon structure and creates an integrated environment of enterprise-style work and learning. Through four specialized activities of "thinking training, skill learning + practical operation + project practice + achievement incubation", the teaching model cultivates students' vocational core competencies and improves their innovation and entrepreneurship ability. The model also explores new forms of practice such as "Innovation Studio" and "Innovation Bootcamp" to incubate innovation and entrepreneurship teams, promote the transformation of works to products, and develop high commercial value product series.

About the implementation of the "four progression" model. In the first semester, students begin as apprentices in the studio, where they receive systematic skills training, engage in virtual projects, and study exemplary cases. Through this process, they gradually develop basic professional qualities, gain confidence, and acquire specialized role recognition and an understanding of innovation. In the second semester, students join project teams and become team members. They participate in project simulations, enhancing their specialized role recognition and gaining experience in innovation. In the third and fourth semesters, students receive core skills training in the studio. The training progresses from basic skill-building to advanced core skill development for projects, enabling students to experience the job docking process and transition from beginners to becoming main contributors to the studio's work. Innovation is further

emphasized during this period. In the fifth and sixth semesters, students form innovation and entrepreneurship teams and incubate projects, promoting the transition from "works" to "products." Through this process, they develop products with high commercial value and complete the transformation from students to professionals. Overall, the "four progression" model is designed to facilitate a comprehensive learning experience for students, enabling them to develop skills, knowledge, and attitudes required for professional success.

We prioritize competition as a means to foster learning, innovation, and teaching. To achieve this, we transform winning projects from college student entrepreneurship competitions, innovative design competitions, and specialized skills competitions such as "Internet +", "Challenge Cup", "Create Youth", and "Electronic Design Competition" into specialized course practice projects. By doing so, we establish an innovative talent training model that is guided by competitions, which helps to cultivate students' practical ability.

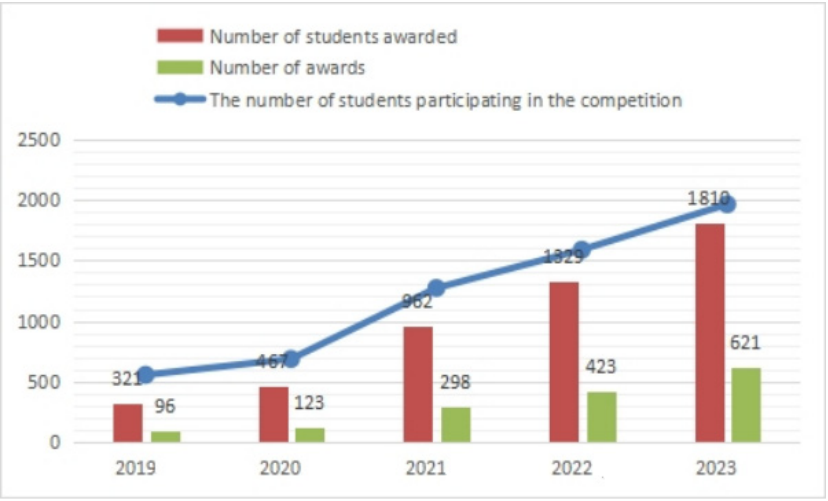

Fig. 2. The Students participation data in the last five years

Regularly-held training and competitions have become an integral part of cultivating students' practical ability and innovation skills. Participation in intramural competitions has reached over 95% of the total number of students in the major, covering a wide range of students. Figure 2 statistics the college students' participation in competitions and awards in the past five years. From the figure, it can be seen that since the implementation of specialized and integrated education in 2020, both the number of parameters and the number of awards have increased significantly from 2021 to 2023. This approach increases the opportunities for students to engage in practical exercises and improve their practical ability.

2.3 An evaluation system for innovative ability of students in integrated education combined with deep neural networks.

The ultimate goal of creative and integrated education is to improve students' innovation ability, so an evaluation model of students' innovation ability based on deep neural network is constructed to form a closed-loop education model and generate a feedback mechanism[10]. The content of this model evaluation is the innovation ability of students. Firstly, the analytic hierarchy process is used to construct the evaluation index to form a complete hierarchical analysis evaluation system of students' innovation ability. First-level indicators, second-level indicators and corresponding weights are determined in Table 1.

Table 1. Evaluation Index of Innovation Capability

First-level indicator	weight	Second-level indicator	weight
Activity after class	0.16	After class practice index	0.55
		Task completion index after class	0.45
normal performance index	0.25	usual test index	0.6
		Classwork Index	0.4
classroom activity	0.21	classroom speech	0.4
		group discussion	0.3
		Interactive index	0.3
End-of-semester challenge for major homework completion	0.38	Work Roadshow Explanation Index	0.45
		Completion Index of Major Works	0.55

After completing the hierarchical system of innovation ability indicators, the deep neural network model is used to determine the students' innovation ability. The secondary evaluation indicators are used as input, and the students' grades and data are used as the training database to obtain the evaluation of students' innovation ability through training. First of all, according to the position of different layers, the whole neural network can be divided into the following three layers: input, hidden and output. The first and last layers are the input and output layers, and the middle ones are all hidden layers, which are connected to each other. Each neuron in the i-th layer in the hidden layer is connected to each neuron in the next layer. In addition to the first layer and the last layer of the deep neural network, there can be many layers in the middle, and many parameters will be derived, so the linear relationship w and bias b must establish rules[11-12].

By analyzing the mixed teaching data in creative fusion teaching, some students' innovation ability is predicted and verified. The verification data has a total of 400 samples, and 30 training samples and 10 test samples are generated according to the grades of midterm assignments and unit tests. The number of iterations was initially set at 1500, and the classification analysis of qualified and unqualified, as well as the regression analysis of 10 divisions, 5 divisions and 1 division were carried out, and the results are shown in Table 2.

Table. 2. Data related to prediction and evaluation results

correlation coefficient	Hierarchical Evaluation Results
Eligibility judgment	99.618
10 intervals	98.824
5 intervals	95.238
1 intervals	91.531

The correlation coefficients of the prediction results of the hierarchical evaluation model based on the deep neural network are all higher than 90%, which has good predictive computing ability, and can accurately evaluate the students' innovative ability through verification.

3 Conclusion

In the context of innovation-driven social transformation and economic development, cultivating innovative talents has become a crucial task for Chinese universities. It is not only a national requirement but also an international trend in higher education to integrate specialization and innovation in the education system, as it is an effective way to cultivate innovative talents. The computer science program at our university has developed an effective implementation path for this type of training, which includes constructing a curriculum system that integrates specialization and innovation, exploring diverse teaching methods, building practical teaching models, and the construction of the evaluation system of innovation ability of integration of specialization.

The implementation of this reform has seamlessly integrated the concepts of innovation education into specialized education, promoting a new teaching mode that combines practice and theory. This approach has respected individual differences, stimulated students' interest and learning initiative, and cultivated application-oriented senior specialized talents who possess both specialized technological skills and innovative thinking and spirit, thereby meeting the requirements of social industry enterprises. Under this training mode, students have won 15 national awards and more than 200 provincial awards in innovation and entrepreneurship competitions, and the graduate entrance examination rate has increased steadily. Graduates have secured employment with well-known domestic companies, where they have played key roles. Additionally, the training of teachers has also yielded remarkable results, with over 30 provincial and ministerial level teaching and research projects and more than 20 provincial and municipal level teaching achievement awards.

Acknowledgment

This work was supported by The Research and Practice Projects of Higher Education Teaching Reform in Hebei Province in 2022(2022GJJG091) and Ministry of Education supply and demand docking employment education Project in 2023(20230109247)

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