

# Exploration and Practice of Collaborative Training Mode of Four Supports System for College Students' Innovative Ability

Yongcai Pan<sup>1</sup>, Chuan Lin<sup>1,\*</sup>, Qingzheng Liu<sup>1</sup>, Yuwei Zhang<sup>1</sup>, Shenghui Pan<sup>1</sup>,  
Yanxia Wei<sup>1</sup>

<sup>1</sup> *School of Electrical, Electronic and Computer Science, Guangxi University of Science and Technology, Liuzhou, China*

*\*Corresponding author. Email: chuanlin@gxust.edu.cn*

## ABSTRACT

Focusing on the cultivation of the innovative ability of college students majoring in information, such as computer technology, information science, and information engineering and technology, and taking the 4×4 collaborative training mode as the blueprint, the curriculum system, orientation system, training system and platform system are constructed. Using different levels of training, the reform and practice of talent training mode with innovative ability are carried out in three-dimension and multi-level coordination with four aspects: theoretical curriculum optimization, professional orientation integration, practice teaching upgrading and innovation ability promotion.

**Keywords:** *information science, computer technology, innovation ability training, curriculum system, training mode.*

## 1. INTRODUCTION

The 21st century is an era full of creation, innovation and entrepreneurship. Innovation-driven development plays a dominant role. The development of the country and the social progress increasingly depend on the level of scientific and technological innovation and the cultivation of innovative talents. With the development of the international situation and the progress of education, countries around the world pay more and more attention to the cultivation of college students' innovative quality.

Innovative education is urgently needed to build an innovative country in the new era. Higher education in the new era calls for innovative education. Young college students in the new era rely on innovative education for their own development. Therefore, it is urgent to strengthen the cultivation of innovative education for college students in the new era [1-3]. On the theoretical and practical level, studying the training mode of innovative education for college students not only meets the needs of the development of the times, but also helps to renew the educational concept and deepen and develop the educational theory. Therefore, in order to adapt to the

development of the times, and meet the needs of training new engineering talents, and realize the characteristics of talents with strong innovation ability and practical ability, it is particularly necessary and imperative to integrate the talent training mode of innovative ability education into higher education and deepen the exploration, practice and reform of education mode.

Entrepreneurship education is an effective way to promote the country's innovative development and effectively improve the overall quality of college students. The research of innovation in education is a reform and exploration of national talent training mode in the new era, which has practical significance. Innovative exploration of education is very important to cultivate college students' initiative, ability and creativity and promote their high-quality development. Innovative education meets the requirements of the new era, can accumulate strength for the progress and development of society, lead people to actively and firmly join the current trend of reform and innovation in China, and make continuous efforts to increase people's sense of gain and happiness. Strengthening the research on innovation and entrepreneurship education can provide dynamic support for social development, which is of great significance to

the times. It is of practical significance to improve innovative education to cultivate qualified talents for the country and society, and to strengthen innovative education to provide materials and help for the growth of college students and innovative education in colleges and universities.

The Global Innovation Index (GII) report jointly released by the World Intellectual Property Organization, Cornell University and other institutions in 2017 shows that Britain ranks fifth in innovation performance among nearly 130 countries and economies, and the top four are Switzerland, Sweden, the Netherlands and the United States. A careful study of the development process of science and technology in developed countries shows that most of the innovative activities that make great changes in economic progress and people lives take place in institutions of higher learning. Whether it is the United States with mature science and technology development or Japan with rapid scientific development, colleges and universities play a vital role in the national science and technology innovation system.

## 2. COLLABORATIVE TRAINING MODE OF "FOUR SUPPORTS" SYSTEM FOR COLLEGE STUDENTS' INNOVATIVE ABILITY

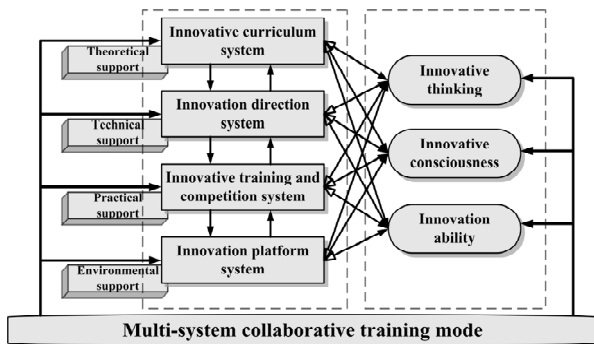


Figure 1 The collaborative Training Mode of "Four Supports" System.

We explore, study and practice the collaborative innovation ability training mode supported by four systems, which aims at "innovative thinking training, technology application practice, clear training process and full use of platform" for electrical information specialty, as shown in Figure 1. This model is intended to improve the teaching system, strengthen the construction and system of innovative ability training system, and implement multi-system integration and collaborative training. Through mode practice, we can guide the college students to master professional discipline knowledge as the foundation, to explore scientific research and innovation knowledge as the interest, to improve the ability of invention and creation as the goal, and to focus on multi-system collaborative education, so as to stimulate the cultivation of innovative thinking and

innovative consciousness of college students, cultivate their innovative spirit, train their innovative/entrepreneurial ability, and comprehensively transform professional knowledge from theoretical knowledge to practical operation, and promote the comprehensive and coordinated development of their knowledge, ability and quality.

### 2.1. Construct the Curriculum System to Provide Theoretical Support for the Cultivation of Innovative Ability

In view of the deficiency of the existing education and teaching system, which mainly completes the teaching of subject knowledge and lacks the courses of innovative quality education, we should construct an innovative curriculum system aiming at cultivating innovative consciousness.

Innovative courses are implemented in four stages according to the four-year undergraduate education process, as shown in Figure 2. First of all, we will carry out general education of innovation for all students, mainly introducing the concept and process of innovation. Through the study of general courses of innovative methods, students are encouraged to be interested in innovation, and build self-confidence, so as to promote the understanding and recognition of innovative ability education for electrical and information students. Then, it focuses on the students who have performed well after the previous stage of study and are willing to continue their studies. Secondly, we continue to carry out innovative practice course education among outstanding students. Finally, among top students, we carry out innovative ability training with higher requirements such as paper writing and publishing, patent application and project application. At this stage, through practical operation, scientific research projects can be declared, the implementation process can be monitored, and the writing ability of scientific papers can be cultivated.

Curriculum construction is the theoretical support of collaborative training system of innovative ability. The setting of conventional courses tends to teach the concepts of disciplines or specialties and the relationship between concepts, and lacks the combination with practical application. Students' interest in professional knowledge points is the driving force of learning and the source of creativity. Therefore, the construction of innovative curriculum system should be carried out in parallel on the basis of core subject curriculum system.

Through the construction of innovative curriculum system, we improve the existing talent training system, and complete the double combination of subject knowledge-based and innovative quality-based education. Therefore, the curriculum design scheme and curriculum categories of innovative curriculum system include innovative general courses, innovative basic courses,

innovative professional courses and innovative practice courses, etc.

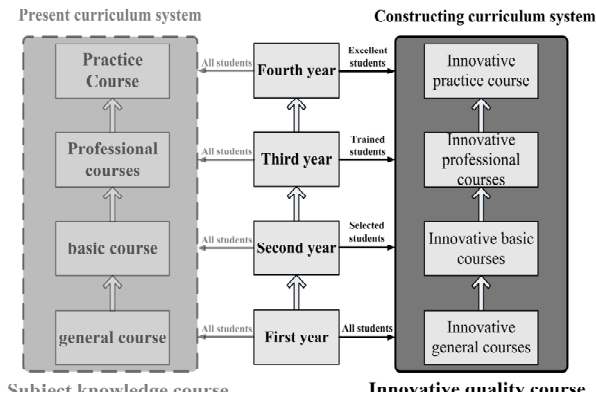


Figure 2 The construction of the curriculum system.

### 2.2. Construct the Orientation System to Provide Technical Support for the Cultivation of Innovative Ability

The effective combination of professional orientation and personal interest is conducive to the cultivation of innovative ability and the clear goal of talent education. Therefore, it is very necessary to study the system construction in the direction of cultivating technical literacy.

The direction of the system is divided into two main directions: soft and hard, according to the technical characteristics of the undergraduate education process of electrical and information universities, as shown in Figure 3. We complete the training of applied and academic innovative talents in software (hardware) engineering in their respective directions. In the system, systematic education of software (hardware) is carried out strictly according to the needs of the industry.

The system construction will transform the isolated skill oneness of students into systematic technology. In the process of building the students' orientation system, we will continue our education for four years. The direction construction is the technical support of the collaborative training system of innovation ability.

First of all, according to the two basic categories of soft and hard, the research and selection are carried out. After the previous study and research, according to their own interests, group exchanges and discussions, students-centered, teachers-assisted, according to the curriculum of the subject curriculum education system, through the second classroom, elective courses and other forms, students can complete the autonomous learning of computing information courses.

Secondly, according to the students' learning situation, through selection, they can enter the specific direction of specialized subcategories for special education. The direction of specialized software is refined into "artificial

intelligence" and "deep learning". The hardware direction is divided into "IC design", "smart device design" and so on. Base on the students' interests, personal potential is actively developed, and theoretical research and practical attempts are carried out in the same direction with the mode of team formation [4]. The transformation of students from passive education to active learning is completed in this stage.

Thirdly, excellence is cultivated in the selection of students. Furthermore, we carry out actual combat of software and hardware engineering projects for students with strong abilities. The directional characteristic is the landing of applied research. Team guidance teachers carry out education in the form of simulated topics, and train students' development ability and team cooperation consciousness through concrete steps such as explanation of ideas, task decomposition and function realization.

Finally, we complete the summary and embodiment of the top students' achievements. In this stage, students' innovative ability will be expanded and promoted, which will pave the way for further study and to meet the needs of the post. In this stage, we will strengthen participation in domestic/international competitions, writing and publishing papers, patent applications and summary of achievements, stimulate and enhance students' creativity, and drive the next generation of students with practical cases to achieve the effect of "mentoring".

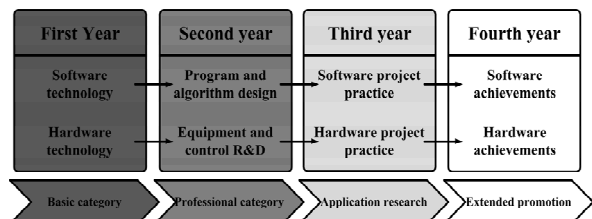


Figure 3 The construction of the orientation system.

### 2.3. Build a Training System to Provide Practical Support for the Cultivation of Innovative Ability

At present, subject competition is a measure of the status quo of quality engineering projects implemented by the Ministry of Education in colleges and universities, and it is imperative to promote the reform of talent training mode, improve students' practical ability and cultivate students' innovative spirit. This topic will focus on the construction of training and competition system aiming at cultivating practical ability. The training system adopts phased education in advance, completes the ideological construction of "initial cultivation, mid-term practice and later breakthrough", and implements the training process of "training, competition, cultivation and competition".

In the process of system construction, the characteristics of subject competition are fully

considered, and the training process of "training, competition, cultivation and competition" is implemented [5-7]. The construction of competition system is the practical support for the collaborative system of innovative ability training. The construction and implementation of this system has strengthened the combination of knowledge training and subject competition, emphasizing training to promote competition and substituting competition for training. The implementation of the system relies on the multi-level and multi-level discipline competitions of schools, cities, provinces, countries and international countries, builds a training mechanism with practical guiding significance and various ways, and practices a three-dimensional innovation ability training system.

We should complete the basic skills training in the first stage of the competition. In this process, because college students have just entered the university to receive education, the knowledge system is still lacking. Therefore, basic training activities such as "exhibition and study of works", "exchange of innovative team members" and "welding skills training" are completed, aiming at introducing students' interests and finding problems through contact and observation.

In the second stage of training, the basic discipline competition should be completed. In the early learning process, students have some basic knowledge, as well as the ability to practice and analyze problems. Moreover, colleges and schools have also launched discipline competitions for junior students, such as "Four Innovations" and "Science and Technology Festival Innovation Competition". With the help of students' basic competition, we can test the learning effect and lack of self, so as to study in depth and further enhance interest.

The project system training should be completed in the third stage of the competition. On the basis of the previous period, students begin to move towards the direction of system design. Participation in the whole process of specific projects helps students to look at problems from the perspective of top-level design. In the implementation of systematic training, the participating students put forward targeted improvement schemes and innovative ideas, and realized them through their own efforts, thus reflecting their self-worth, stimulating their interest and showing their innovative ability.

The professional comprehensive competition should be completed in the fourth stage of training. The last stage is the stage of potential stimulation. In many competitions, such as National College Students Electronic Design Competition, Intelligent Robot Challenge Competition, International Mathematical Modeling Competition and so on, there are many ability requirements to solve problems, such as preliminary preparation, time-limited design, paper writing, on-site response, innovation and creation, etc. Students who take part in the comprehensive professional competition have

comprehensive development ability, can independently undertake systematic product/task design as the person in charge, and reflect the effectiveness of cultivating innovative ability.

#### ***2.4. Build a Platform System to Provide Environmental Support for the Cultivation of Innovation Ability***

The construction of practice platform system is one of the important research contents of collaborative innovation ability training mode. Curriculum system, orientation system and training system are closely related to the construction of platform system. The platform can support the development of innovation activities, establish communication channels and provide corresponding safeguard measures. The systematic platform construction has built a three-dimensional environment for cultivating students' innovative ability, which enables students to enter the real scientific research environment and self-construct and develop knowledge system, technology system and training system.

Platform construction is the environmental support for the collaborative system of innovation ability training. The construction and implementation of this system strengthened the integration of multi-platforms, and advanced the transformation from the previously isolated platforms at all levels, which benefited more from teachers' scientific research functions, to the hierarchical integration of cultivating comprehensive three-dimensional innovation ability [7]. The implementation of the system is a gradient progressive platform integration scheme of teaching practice, comprehensive practice, academic practice and scientific research practice.

The basic level is the teaching practice platform with "public laboratory", "basic laboratory" and "open laboratory" as the core. Under the support of this platform, the bottom-level collaborative implementation of the other three systems, such as innovative general education, basic skills training and basic technical direction education, will be completed. The platform mainly undertakes the tasks of initial training, cognitive practice and so on, and completes the enlightenment education for students.

Improving the level is a comprehensive practice platform with "college students' innovation base", "innovation association" and "school-enterprise joint laboratory" as its core. Under the support of this platform, the other three systems, namely, innovative basic education, basic discipline competition implementation, specialized minor technical direction education, etc., will be implemented in a coordinated manner at different levels. The platform mainly undertakes the tasks of early-

stage technical upgrading, skills training and so on, and completes the training and education of students.

The higher level is the academic practice platform with "Professor's Studio" and "National Laboratory" as the core. Under the support of this platform, the collaborative implementation of other three systems, such as professional innovation curriculum education, project system training and applied research education, will be completed. The platform mainly undertakes the tasks of medium-term scientific and technological innovation and academic training, systematic development and design, and completes the promotion education for students.

In the practice process of the platform, the construction of teachers' team and the formation of innovative teams is actively carried out. Teachers are mainly full-time teachers, supplemented by part-time employees of enterprises. The students focus on the direction system, join the corresponding team of instructors under the platform system, and carry out vertical and horizontal project research and process training. The innovation team is jointly managed by the selected instructors and responsible student leaders, forming a stable team structure, practicing the collaborative training system, and developing hierarchical innovation ability training.

The platform also needs to set up an academic team of teachers' scientific research with reasonable structure according to their professional titles and research directions. We should group students according to their grades, majors, interests, etc., and integrate them into the teachers' scientific research academic team. The way to carry out scientific research, and the establishment method of achievement database should be studied to ensure the continuity of platform and team building, and provide reference materials for subsequent teachers and students.

### 3. CONCLUSION

This model is intended to improve the teaching system, strengthen the construction and system of innovative ability training system, and implement multi-system integration and collaborative training. Through the mode practice, we can guide college students to master professional discipline knowledge as the foundation, to explore scientific research and innovation knowledge as the interest, to improve the ability of invention and creation as the goal. Focusing on multi-system collaborative education can stimulate the cultivation of innovative thinking and innovative consciousness of college students, cultivate their innovative spirit, train their innovative/entrepreneurial ability. And professional knowledge is comprehensively transformed from theoretical knowledge to practical operation, and promotes the comprehensive and

coordinated development of their knowledge, ability and quality. This study aims at the students majoring in electrical information in Guangxi University of Science and Technology to explore and practice the innovative ability training mode. In the process of implementation, the beneficiaries are all students of electric majors, and can also be used as a demonstration for other engineering majors to cultivate innovative talents. At the same time, the study provides reference for the cultivation of innovative ability of electrical information majors in other colleges and universities inside and outside the region, and provides forward-looking and exploratory experience in mode reform.

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### REFERENCES

- [1] Zhao Kai, Yuan Xiaoling, Yue Zhen. Experience analysis of innovative talents training in foreign universities and development of creative class with Chinese characteristics [J]. *Education and Teaching Forum*, 2019 (34): 6-9.
- [2] Chen Lu. "Internet" under the background of innovative ability training curriculum teaching mode research [J]. *Science and technology and innovation*, 2021(20):164-165.
- [3] Gan Wanyang, Tian Quanxi. Exploring the path of cultivating college students' scientific and technological innovation ability under the background of innovation and entrepreneurship education [J]. *Journal of Hubei University of Economics (Humanities and Social Sciences Edition)*, 2020,17(12):135-137.
- [4] Cui Xiyan, Li Haiyan. Research and practice on the cultivation mode of innovation and entrepreneurship ability of agricultural college students [J] *Journal of Changchun Normal University*, 2020,39 (8): 137-139.
- [5] Hu Hailong. Research on the innovative ability training mode of postgraduates under the background of new engineering [J]. *Education and Teaching Forum* .2021.12 (52): 149-152.
- [6] Han Zaichao, Zhang Yingjun. Research on Innovation and Entrepreneurship Competition and Cultivation of College Students' Innovation and

Entrepreneurship Ability [J]. *Theoretical Research and Practice of Innovation and Entrepreneurship*, 2019,2(6):17-19.

- [7] Kang Yiting, Ma Fei. Competition-driven interdisciplinary innovation ability training mode exploration and practice [J], *Beijing Education* 2020 (8): 93-96.