



Research Article

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**Research on the cultivation of students' creative ability in computer science**

Li Tu and Chi Zhang

School of Information Science and Engineering, Hunan City University, Yiyang, Hunan, China

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**ABSTRACT**

*This studies is based on the previous research of the teaching work, we treated undergraduate colleges orientation as a starting point, and studied the development direction of computer science, developed students' innovation ability, engineering qualities, practical abilities, and we established the corresponding evaluation mechanism to deepen the reform of teaching, we improved the content of practice teaching, methods and means of reform, the construction of practical teaching system, then we optimized the allocation of resources for practice teaching, and increased the fund input of practice teaching, studied the construction of teacher's team in higher professional education of China and strengthen the standardization of innovation ability of teaching. This research and implementation of this project will form a new system of innovation ability training for computer majors in undergraduate colleges and universities; it has a good prospect of application and popularization.*

**Keywords:** Creative ability, Engineering quality, Innovation, ACM

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**INTRODUCTION**

Innovation is the soul of a country; it is the driving force and source of a country too. Higher education undertakes the important task of training high level talents for the society, creative education is an important part of college students' training, and it is an effective way to improve their comprehensive quality [1]. Cultivation of innovation ability of college students is one of standards to test the ability of a university. Especially in research-based universities, innovative education should be strengthened to enhance the capability of independent innovation and build innovation type national goals[2]. In today's increasingly fierce international competition, universities strengthen the cultivation of innovative practical ability of college students, which are extremely important to university students, college and our country. Therefore, the cultivation of college students' innovative ability should be attached great importance by the society.

**The cultivation of innovative ability is the need of the development of universities**

Entering the new century, Chinese higher education strides into a fast developing period [3]. Chinese government attaches great importance to the level of training innovative talents in colleges and universities, the innovation ability becomes the symbol of high quality talents, the quality and quantity of the innovative talents are important standards for college. Although colleges do not bear a large number of the strategic research on the national level which key universities take on, it can significantly improve the overall scientific and technological capabilities and accelerate the economic development. To improve college teaching quality and the comprehensive strength, and build up a brand for university, we must strengthen students' ability of innovation and practice, cultivate innovative talents, This is an inevitable choice for colleges and universities to improve the quality of talent, and seek greater space for the survival and development.

**The cultivation of innovative ability is an important way to improve their competitiveness**

Survey results show that: 90% of large international companies are committed to innovation, in their recent annual reports or the speech of their executives; they treat the innovation as a core competence of them [4]. According to statistics, in the world's top 500 enterprises, in the area of high-tech industry research and development, the number

of required scientific and technical personnel is 5 times that in the traditional industries. Thus, the enterprise has a huge demand for innovative talents. As an important part of the overall quality of the individual, innovative practical ability will become an important factor in the competition of graduates employment. So higher education should cultivate students' innovation ability.

### The cultivation of innovative ability is the need of social

The historical experience indicates that the transformation and development of higher education must meet the needs of the politics, economy and culture of a society. Educational system must adapt to the economic structure, the development of education must meet the demands of the public [5]. After proposing strategy of innovative national, more than 200 cities had proposed to construct high level innovative city successively, it depends on innovative education, according to the needs and development of innovation, to cultivate innovative talents is an inevitable requirement for the development of society and economy.

## EXPERIMENTAL SECTION

The precondition of generate the innovation ability is the training of innovation quality. With the graduate student education innovation plan vigorously implemented, the most important part that should consider of training program is to focus on the innovation quality of professional bachelor degree in computer science [6]. Nowadays, there is some deficiency of the design of training program in many colleges. From the point of cultivation conception, there are some phenomenon in different degree, such as to value common knowledge teaching but underestimate the training of methods and tactics; to value common science and technology knowledge teaching but underestimate humanity teaching; to value common cognition but underestimate affection; to value common theory but underestimate ability, etc. From the opinion of curriculum provision, it doesn't incarnate the educational philosophy that includes great discipline, wide basis. Meanwhile, it ignores the cross-disciplines in curriculum provision. As far as in the phases of course training, the main objective of teaching is imparting the previous knowledge and the main means of teaching is classroom teaching. While traditional classroom teaching limits of innovative thinking and creativity of students. It will reduce the interaction between teacher and student and it is bad for thinking inspiration. In the phases of graduation thesis work and graduation design, students mainly study the related research under tutor's guidance. Most of the time students learn in a relatively passive way. So it will lead local, sealing thinking of graduate student .It leads to many misunderstanding. Moreover the insufficient of training program restricts shaping creative personality and it impedes cultivating effectively the lofty ideal, courage, perseverance, cooperation and spirit of devotion that is needed all by innovation. It leads to some students lack of innovation.

Compared with foreign countries, there still exists a big gap in innovation teaching contents and methods, specialty in higher education, the institutions is divided too detailed, the teaching material content is old, and the theory lags [7]. The traditional teaching method is still dominant. The classroom teaching method is conservative, openness is not enough. Although some colleges have developed optional course that is related to training of innovation in order to offset the weakness, but students are satisfied with the credits and they do not improve their innovation ability [8]. It will make students can't adapt themselves to the need of rapid development in the modern society and they can't study the innovative and stood in front of the research area after graduation.

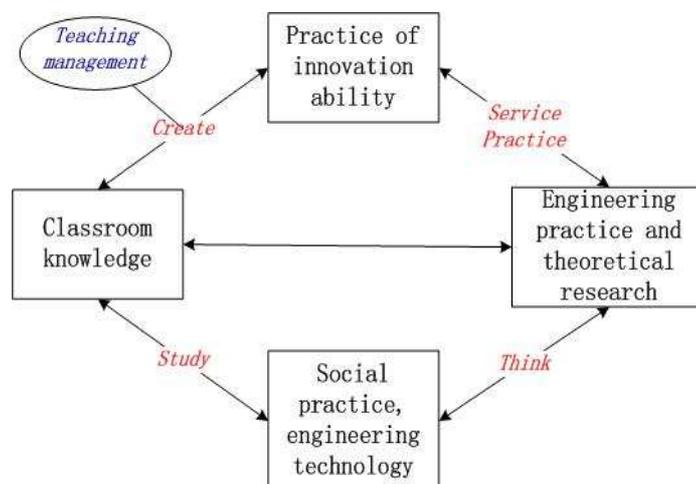


Figure 1. Educational philosophy

The construction of innovative talent team is the core of building an innovative country. Innovative ability is the ability to provide new ideas, theories, methods and by using knowledge and theory. Now we proposed a recycling education method: "S (Study) → T (Think) → S (Service) → C (Create)". It is shown in figure 1.

When students enter the new field of expertise, they study (S) and think (T) through the classroom, basic experiments, they accept and understand knowledge, then they enter service (S) or practice phase, in the research and application environment, students actively find their lack of knowledge, they go back to study (S), and continue to deepen the thinking (T), find the answer from the existing knowledge system, at last they create (C) and innovate.

Creativity is the psychological potential of every student. It is necessary and possible to cultivate students' ability to innovate, but this kind of potential needs to be stimulated. Innovative ability is multifaceted system engineering, it includes the spirit of innovation, thinking, knowledge, professional skills, teamwork and other content, it requires complex processes, such as problem of choice, formation of ideas, solution of problems, results and applications, it's not easy to achieve, and it needs to cultivate the path through innovative talents. We put forward an innovative talent training method; it is shown in figure 2. We guide students into service (practice) or scientific research, we guide our students to learn actively, consciously and creatively, and we cultivate students' ability to discover problems, analyze problems and solve problems.

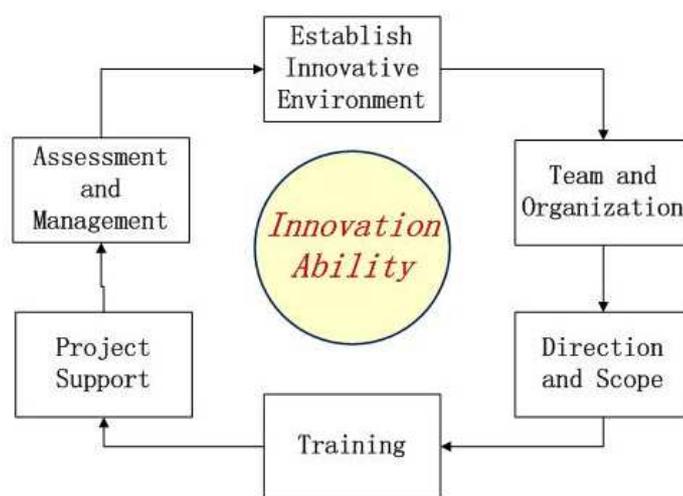


Figure 2. Innovative talents training method

## RESULTS AND DISCUSSION

### Build an innovative ability training system

According to the characteristic of computer specialty in university, this research built four layers of training system for practice ability from the perspective of the cultured need for engineering-type talents and research talents. The four layers are fundamental practice ability, professional practice ability, comprehensive practice ability and innovative practice ability. The research also studied the main context of each of four layers in detail.

Fundamental practice ability is that all undergraduate should have and it is also the most basic ability of practice ability. It mainly includes presentation skill, high adaptive capacity to environment, self-study ability, interpersonal skill, foreign language ability, computer application ability and ability to organize and manage.

Professional practice ability is the ability for solving the social and professional practice problem by using professional theoretical knowledge. Such as practical handle ability, data analyzing ability, ability for software designing and analyzing, experimental ability, using of simulation software etc.

Comprehensive practice ability is mainly based on comprehensive and designing experiments, and it aims at training the student's ability for analyzing and solving the problem by using their learned knowledge.

Innovative practice ability is mainly based on engineering project, research project, embedded system competition, ACM programming contest. It attracts excellent students who have special skills in subject or major to participate in innovative activities. So it should include the capacity for scientific research, systematic design ability and inventiveness. Through this study, we will obtain a relative complete training system for practice ability that is

adapted to student who majored in computer in local university.

### **Research on the cultivation of innovative ability**

In local universities, enhancing the innovative abilities of students is to strengthen their abilities of autonomous learning, information acquisition, observation and analysis, experimental research, expression and communication as well as cooperation and so on. The research contents can be listed as follows:

#### *Cultivate innovative ability by using computer network*

The computer network has a unique role in the process of cultivating the innovative abilities of university students. The online resources are so rich that learners can acquire knowledge according to their own needs.

At any time, and at any place, university students can exchange their opinions with others including free discussion and debate which bring the subjective initiative into full play. Specifically, we should pay attention to the following points in the process of cultivating students' innovative ability with the network: Firstly, we should redefine the function of campus network, now the campus network can only be used to send emails and search for information. Therefore, we must change our concepts, for instance, we can uphold the network teaching mode appropriately for specialized core courses to build up a new class of cultivating students' innovative ability. The second point is to change the role of teachers which means to improve the quality of teachers and strengthen the construction of online innovative education. In the course of the construction, it is paramount to change our mind. In other words, we ought to get rid of the current curriculum system frame and carry out theoretical researching, and practical exploration. And in this way, the creative curriculum system can be formed.

#### *Strengthen the practice of teaching and the construction of practice base*

First of all, we should strengthen the laboratory construction. We need to construct a series of innovative laboratories involving electronic technology, computer, robot and so on, enrich the contents of experiments, and improve experimental forms. To lay the foundation for research, such aspects should be enhanced as regulations for laboratory, operation management of equipments, maintenance awareness and laboratory practice skills, these laboratories are open to students all times. The undergraduates should be provided with necessary conditions and strong support through the way of combining college students' discipline competitions, innovative experiment plans, special districts in which training top-notch innovation talents and graduation projects. And students who have strong suits can be appointed as a lab assistant.

Secondly, we need to strengthen the construction of practice base. We should make over all plans on the construction based on the combination of research and practice, and we should insist on both intramural and extramural teaching basement constructions. It is important to create a new pattern of innovative teaching resources and develop students' innovative space.

#### *Optimize the training programs*

The establishment and perfection of training programs should highlight the goal of cultivating innovative talents; it should strengthen the foundation, reflect the differences, intensify the practice, focus on the latest technology, pay attention to cross-disciplinary research and construct the training system of innovative talents. It has the following cultivating characteristics:

- a). It combines the innovative national construction, economic construction and social development needs, it enriches the education contents and enhances the timeliness of graduate education.
- b). It implements classified training which means to carry out classified training programs between "Academic Research" and "Application Research" for academic graduate students.
- c). It implements curriculum cross curriculum and it strengthens the cross feature of graduate courses to integrate and optimize the knowledge structure of students. We can finally reach a new and creative conclusion due to the mutual collision of different thinking, views, theories and technologies. Figure 3 shows the relationship of innovation ability training system.

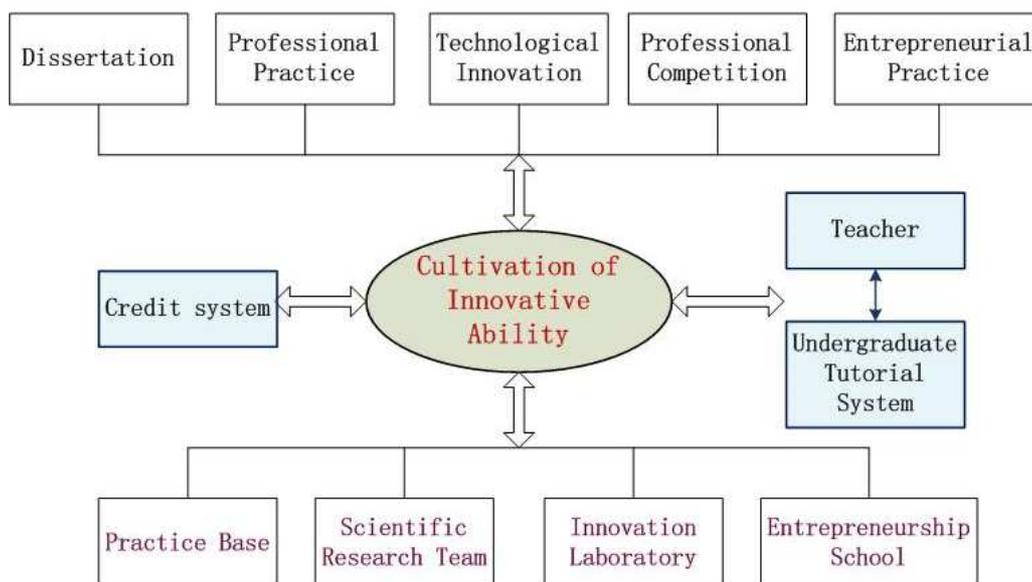


Figure 3. The relationship of innovation ability training system

### Research on the cooperation modes in universities

The cooperation between universities and enterprise is mainly to promote the course construction and strengthen manipulative ability of students which further improve their innovation ability. With the extremely rapid growth of computer technology, computer courses such as programming courses, embedded system, network engineering, software engineering and so on, they all have their own characteristics. Therefore, we can not completely imitate cooperation models of other professional school enterprises. Actually, there are four ways that work for computer specialty cooperation:

#### *The mode of "enrolling the enterprises into university"*

Colleges are responsible for providing training base and other services. Students can be supplied with productive training posts by introducing the enterprise into school and constructing intramural training base. Through the corporation, the quality of teaching can be improved and the manipulative and innovative abilities of students can be intensified by recommending advanced technology of enterprises and veteran teachers.

#### *The mode of "enrolling university into the enterprise"*

Enterprises are responsible for providing training base and other services. The students can be supplied with productive training by introducing school into enterprise and constructing extra mural training base. Extra mural training need to make sure that students can master the job skills, enhance their practical skills and understand the social attribute of posts by the way of taking the project as the core and the feasibility as the evaluation criteria. In management, we take the strictly enterprise mode in extra mural training base, we let the students feel the corporate culture, enhance the sense of responsibility, improve the ability of teamwork.

#### *"Equipment sharing" mode*

The enterprise and the school provide equipment together, and they establish the productive training base, at the time of production, enterprises provide productive training positions for students. This mode of cooperation achieves the school enterprise resources and sharing, it greatly improves the utilization of equipment. Teachers, students and enterprises are in a real professional environment, they develop commercial software, built website, this not only let the student get accumulate rich experience in the project, but also improves the teacher's professional and technical level.

#### *The mode of "school enterprise cooperation"*

Corporate training institutions will be introduced to the college, the college offers free space and equipment, schools and enterprises form "binding model" training team together, and they carry out professional skills training for enterprise employees and college students. The direct model enables the school's curriculum to follow the requirements of the enterprise and the development of technology, at the same time it expands the part-time teacher team, and it promotes the construction of professional course of computer, it improves the overall level of running a school of computer specialty.

### Establish the evaluation system of the training system for innovation ability

Educational evaluation is to judge the value of educational phenomenon according to some educational value view or educational goals, by using scientific method, through systematically collecting information, and by analyzing and interpretation, it continuously optimizes the quality of talents training and provides the basis for educational policy making. According to the characteristics of computer undergraduate courses, we study the evaluation mechanism, it includes: teaching content, teaching methods, teaching attitude, teaching effect and other teaching observation points. Course experiment teaching and graduation practice and graduation thesis or design, social practice, practice have clear requirements on teaching, and the management regulations and measures are incorporated into the syllabus, we let each student understand the evaluation standards before the internship, there are two ways to evaluate students' innovation ability training system:

#### Assessment of teachers

We establish the quality standard and evaluation system of innovative teaching, which includes experimental and practice teaching quality standards, graduation design (Thesis) quality standard, experiment teaching effect evaluation index system, standardize the monitoring and evaluation of innovation in teaching. Then according to these criteria we strict with them, it covered by the experimental class, practice and probation, the implementation of the "three check" system of school, department, teachers "three class" system, then we establish school inspector organization information system .

#### Assessment of the innovative achievements of college students

We can check the students' innovation ability through the written test or experiment, and we establish a special inspection of practice teaching evaluation mechanism, practice teaching material checking mechanism, online teaching evaluation mechanism for students and practice teaching information feedback mechanism, then we carry out vertical and horizontal evaluation of teaching quality, and we carry out a full range of monitoring of innovative teaching.

After more than 3 years of exploration and practice, great progress has been made in the practice of the training system of computer innovation ability, we has achieved preliminary results. This proved that this kind of talent training mode is scientific and advanced. After the students participated in the innovation project, we have investigated 911 students. The survey results are shown in table 1:

**Table 1. Survey results after the students participated in the innovation project**

Contents of the survey	Increase ratio (%)
Understanding and application of knowledge	99.34
Teamwork and communication	99.16
Understanding of the project	94.23
Project design and Implementation	100
Active learning	96.51
Interaction between teaching and learning	90.28
Interest in learning	90.76

After carrying out the teaching mode of the talent training system of innovation ability, in the process of course, practice and project, students have got good achievements in learning initiative, teamwork and communication, comprehensive understanding ability, practical ability and expression ability, the survey results before and after the implementation of innovative teaching mode is shown in table 2:

**Table 2. Survey results before and after the implementation of innovative teaching mode**

Contents of the survey	Obvious improvement	No effect
Learning initiative	900	11
Teamwork and communication	889	22
Comprehensive understanding ability	880	31
Practical ability	900	11
Expression ability	850	61

## CONCLUSION

This study aimed at to meet the needs of society and students employment, we aimed at cultivating students' innovation ability, practical ability and high-quality practical talents in computer specialty, and we deepened the practice of teaching content and methods, we improved innovation teaching system, optimized the allocation of resources for innovative teaching, we increased funding for practice and built the contingent of teachers, strengthened the innovative teaching standardization and modernization management, by using school enterprise cooperation, and comprehensively improved the computer specialty students' innovative teaching quality. Based on

computer competitive confrontation, this way can motivate students to improve their level of knowledge and skills, and improve team cohesion in contest.

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