Research on the Model of Graduates' Innovative Ability Cultivation

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***Abstract*—Innovative, composite and applied talents are the main guarantee for the development of economic construction and scientific and technological progress in the new era of our country. The cultivation of postgraduate innovation ability plays an irreplaceable role in satisfying the needs of China's modern development and cultivation of high-quality innovative talents with disciplinary characteristics. This paper analyzed the current situation and reasons for the innovation ability of graduate students in China, studied the mechanism of graduate students' innovation ability training, proposed the construction of graduate students' innovation ability training system, and put forward the idea of attaching equal importance to basic courses and interdisciplinary courses by setting up a scientific teaching system. We suggested combination of teaching activities with scientific research activities as to cultivate graduate students' interest and exploration spirit, and attach importance to measures such as the combination of school education and enterprise scientific research projects, and establish a long-term mechanism for the cultivation of graduate students' innovative abilities, with the result of improving the teaching level and education level of graduate students, and nurture more innovative talents with innovative spirit, practical ability and interdisciplinary cultural quality.**

***Index Terms*—graduate students, innovative capabilities, cultivation mode, system construction**

I. Introduction

Postgraduate education is the highest level of higher education in China, and innovation ability has become a recognized indicator for evaluating the quality of graduate education. Cultivating high-level talents with innovative ability is the mission and responsibility given to graduate training units and graduate educators by the times [1]. Compared with the developed countries, the quality of postgraduate education in our country is still evidently insufficient, which is mainly manifested in the following three aspects: First, the lack of innovation spirit and innovation consciousness; Second, the low degree of participation in innovation activities; Third, a lack of high-level innovative results as there is little innovation awareness and little experience in innovation practice [2].

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II. Current Situation of Graduate Students' Innovation Ability in China

At present, there are problems of consciousness, motivation, resources, knowledge structure and lack of practical experience in the process of postgraduate innovation ability training. Problems with training units and educators are recognized as the following.

A. Lack of Innovation-Oriented Training Programs

The training program is the basic plan for postgraduate study and training in school. The content and value orientation of the training program directly affect the training results. A survey of the postgraduate training programs of various institutions in China can summarize the following characteristics. First of all, on the goal of training, we pay attention to the training of academic talents and ignore the training of applied talents; In the cultivation concept, there is a one-sided concept of "focusing on knowledge and theory learning, but ignore methods and ability gaining", "show favor to results rather than process" to varying degrees. Secondly, in the course setting, the teaching concept of "huge department, wide foundation" is not reflected, and the cross-disciplinary nature of the course setting is ignored. In addition, in terms of training methods, in the study of subject courses, the main focus is on the teaching of existing knowledge, mainly in the form of classroom teaching, and the dilution of teacher-student exchanges and discussion and exploration. In the limited and intensive postgraduate courses, practicality as the main body of the curriculum and training content turns out to be even scarcer.

B. Lack of Activity Platform to Encourage Innovations

According to the statistics of the Ministry of Education, in recent years, the enrollment scale of graduate students in China has been continuously expanding, and it has shown a sudden surge trend [3]. In the survey, nearly 70 % of teachers and graduate students believe that there is a lag in the number of necessary hardware facilities such as teaching and experimentation during the continuous expansion of colleges and universities; The per capita scientific research funds of graduate students are obviously insufficient; The number of graduate students who guide the tutor annually increases year by year, thus forming a situation where there are fewer

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mentors and more students. The lack of innovation resources will directly or indirectly affect the initiative and enthusiasm of postgraduate innovation, which will lead to the phenomenon of insufficient innovation ability.

In the course learning stage, the postgraduates mainly learn the knowledge delivered by teachers, and in the experimental research, they work mainly under the guidance of the subject research project of their tutors. Therefore, the vast majority of the activities of graduate students during the school year are centered on the arrangement of courses or mentors, with students themselves in a passive position to accept and study. In the course development stage, due to the lack of public laboratories and open public experimental platforms, many experiments and practical projects cannot be completed normally. In the thesis writing stage, although graduate students have participated in the tutor's course group and professional laboratory, due to the fixed research content and the expensive experimental equipment, graduate students have to follow the intention of the task group and the tutor to conduct relevant research and cannot study what they are interested in and have no easy access to various research equipment. Therefore, the ideas and thinking of graduate students' innovation cannot be developed because of all these limitations.

C. Lack of an Innovative Environment and Atmosphere

With numerous tasks of postgraduate training and heavy tasks of students' curriculum and tutor's scientific research, there is a tendency of strong utilitarianism among teachers and students. Innovation takes a lot of time and energy. Sometimes even after many years of research, it is difficult to make certain progress. It is no surprising that many people can only choose to abandon innovation and return to ordinary research.

In terms of graduate students, the following problems are manifested.

D. Shortage of Innovation Awareness and Incentives

Innovation consciousness is the starting point to cultivate innovation ability. It is found from the survey that students' innovation consciousness is not very strong. Traditional cultivation, curriculum learning and evaluation system have become important obstacles to the cultivation of postgraduate innovation consciousness. Ninety percent of graduate students believe that the cultivation method, curriculum content, and examination system affect the generation of their innovative consciousness and ability, while 72 % of graduate students believe that inappropriate learning methods and examination methods cause their scientific research interests to decline.

E. Incomplete Innovation Knowledge Structure

The structure of knowledge required for innovation capacity should consist of a mix of deterministic and indeterministic knowledge in a proportional manner [4]. The deterministic knowledge refers to the knowledge obtained by humans in the process of recognizing existing things and solving problems that they have faced. It can be summed up as a rule that can generalize its phenomena and results into abstract or specific forms of law. The uncertainty knowledge can be divided into two categories: practical knowledge and critical knowledge. Neither of these two types of knowledge can be directly mastered by recitation and memory. It needs to be acquired and mastered on the basis of understanding, and through repeated reflections and inferences and practices. However, in the survey, it was found that many graduate students are more willing to study existing theories in the study and research process than to actively explore them because of the high cost required to learn and master practical or critical knowledge.

F. Little Experience in Innovation Practice

Practice is the fundamental way to cultivate the innovation ability of graduate students. However, our survey found that only 36 per cent of students had practical experience in their field of specialization, due to lack of teaching practice bases, laboratories, mentors 'existing project and limited opportunities, resulting in unequal opportunities for practice among students.

Therefore, it is imperative for our graduate education to accelerate the institutional reform of graduate student training system and explore ways to improve graduate student innovation ability effectively. In the world, the graduate education of American universities is still the best, and the graduate students produced by them are indeed better than other countries in terms of innovation and practice ability, which lists as an important factor in the training of talents in American colleges and universities. We can refer to and draw on some thought essence and measures of American graduate education in improving graduate student innovation practice ability in order to enhance our graduate student innovation practice education.

III. Construction of a System for Cultivating Graduate Students 'Innovation Ability

The formation of the innovation ability training system for graduate students is influenced by many factors, not only some certain links in education, but also the comprehensive influence of the whole training process. We should focus on the main problems of innovation ability cultivation of graduate students, the unique orientation of the discipline, study the curriculum system, teaching methods, assessment and evaluation in the graduate students training system, and establish a graduate student innovation ability training system.

A. Setting up a Scientific Teaching System

The innovative curriculum system is conducive to the cultivation of innovative talents and the formation of innovative capabilities. The development plan ensures innovation requirements, and the flexible school system ensures that innovation is achieved. The graduate enrollment system in the United States is relatively loose, but it does not lower the standard. The graduate education in the United States has a complete and rigorous training program, namely, training goals and plans, strict

regulations on graduate student curriculum learning, scientific research participation, thesis writing, and high elimination rates for graduate students [5]. The goal of postgraduate training is clearly defined. The graduate students of academic degrees focus on academic training and scientific spirit, and master systematic research methods and academic norms for future academic careers. Taking professionalism as the primary goal of professional postgraduate education requires that they "acquire the ability to engage in academic activities and professional work, and can engage in creative professional work in this field." For graduate students studying for a professional master's degree, innovation ability and innovation spirit are also important training goals. Graduate education in the United States does not stipulate a pre-set number of years of study. Instead, it implements a flexible school system based on the academic score system which allows students to have sufficient time to study freely selected research objects and provides guaranteed time for academic innovation..

The scientific spirit of cooperation, questioning and inquiry is the basic condition of scientific innovation. The cultivation of postgraduate innovation ability begins with the scientific spirit and attitude of the students. The main purpose of postgraduate education is not simply knowledge learning, but intellectual development and knowledge exploration; the focus is on cultivating students' research atmosphere, research habits, and research methods to enhance professional skills and scientific exploration capabilities. Postgraduate teaching and management work must be closely around the promotion of the formation and development of the postgraduate spirit of inquiry.

The innovative curriculum system is conducive to the cultivation of the innovation consciousness of graduate students and the various comprehensive capabilities needed for innovation. With reference to foreign experience, we should avoid repetitive courses as far as possible in curriculum design, and strengthen the establishment of interdisciplinary and marginal courses according to the cross-cutting and integrated nature of disciplines, so as to reflect the frontier and international character. According to the development, innovation and interest of students, a variety of elective courses are set up, the proportion of computer courses is appropriately strengthened, and specific basic courses are set up according to the professional needs of different majors, and the basic courses are improved. In the process of teaching, students are trained to raise problems, analyze problems, and solve problems, and teachers are encouraged to adopt teaching methods such as heuristic, deliberative, and situational pedagogy leading students from traditional passive acceptance to active participation in the classroom, including motivating classroom atmosphere, guiding students to study, stimulating students' creative spirit, prompting students to understand problems from different aspects, and discuss problems and solve problems, as to cultivate students' innovative thinking. Diversified teaching methods play an important role in the cultivation of students' innovative thinking. In addition, the teaching content should be constantly improved and enriched. Teachers can introduce scientific research results into teaching content and enhance the forefront and professionalism of teaching content.

B. Equal Attention to Fundamental Courses and Interdisciplinary Courses

The learning and reserve of basic knowledge is the premise and foundation of postgraduate innovation practice. American colleges and universities pay great attention to the education of fundamental courses. This practice is inherited from the education of undergraduates, and then profoundly affects the education of graduate students. Undergraduate education and postgraduate education are closely linked from the organizational structure. Sound undergraduate education is the guarantee that graduate education can be further improved. The postgraduate innovation practice is based on undergraduate education [6]. This transformation is accomplished by graduate school. This kind of cohesive training model makes the postgraduate education in American universities pay attention to the teaching of fundamental courses, especially those requiring students to accumulate extensive basic knowledge and solid professional knowledge.

In terms of postgraduate courses, there are sufficient basic theoretical courses, accounting for about 50 % of all courses. The overall course volume and course difficulty of graduate students are greater than those of undergraduate students. In terms of assessment, the minimum requirement generally stipulated by American universities is that students must gain 80 % of the total class credits, and the requirements for unqualified courses must be rebuilt [7]. Those who fail to qualify within the specified period have to be dropped out of school. Postgraduate courses are not static and rigid indoctrination courses. In general, the implementation of the postgraduate classroom is more flexible and diverse after inheriting the diverse curriculum education model of undergraduates [8]. For example, postgraduate courses pay great attention to students' participation and initiative, and graduate students are taught by professors with rich scientific research experience. These professors use heuristic teaching to bring students step by step into the halls of scientific research. In addition, seminars are a common form of classroom, which can well stimulate students' creative thinking, especially in discussions and debates, and can further stimulate students' self-learning, expression and innovation [9]. In terms of teaching methods, the postgraduate class pays attention to creating a multi-media, information-based, experiential teaching environment in order to communicate the connection between the classroom and the external environment and stimulate and enhance students' interest in learning. Improving the flexibility and learning skills they need in a changing and expanding environment also enhances students' self-learning, application and creativity.

C. Combination of Teaching Activities and Scientific Research Activities

The educational purpose of colleges and universities is to cultivate creative talents rather than intellectual talents.

Teaching and scientific research have always been regarded as two basic points in postgraduate training [10]. Scientific research activities have been proved to be an necessary way to enhance the creative ability of graduate students. In American colleges and universities, there are many courses that combine teaching with scientific research, taking essential roles of guiding students from traditional knowledge learners to innovative minds. There are mainly experimental research-oriented courses and independent activity courses to guide and educate students' scientific research activities in the curriculum.

In the experimental research course, a topic often consists of a full-time professor and a couple of assistant professors, plus a group of graduate students to form a task force. Professors and teaching assistants play a guiding and auxiliary role. The group's research activities are mainly undertaken by students. The course forms are flexible and diverse, including seminars, debates, lectures, speeches, etc. All the activities are arranged around solving the actual problems of the task force, regardless of the form. The concept of experimental research-based curriculum can be summed up as follows: When everyone participates in the curriculum, the quality of education is optimized. Learning can be done both in and out of the classroom; Students are encouraged to think and act creativity in a vibrant research institution.

In the independent activity course, the college encourages students to arrange their own course time, find their own independent research topics, and meet with teachers and employees. At the same time, the teachers provide a variety of open and creative teaching experiments to meet the needs of students. Everyone will participate in this creative course to share their special talents, knowledge, interests and experiences. Some individuals or colleges may hold various forms of communication programs such as seminars, lectures, and open courses during this period to achieve the purpose of showing their attraction to others to give students opportunities to fully explore their interests and show their own expertise.

Based on the above experience, it is proposed to set up a combination of courses, pay attention to the combination of basic education and scientific research activities, and help graduate students to change from the original knowledge-oriented classroom indoctrination education to a research-based activity that focuses on scientific research and supplemented by the acquisition of required knowledge, thus realized from learning knowledge to applying knowledge, from accumulation to innovation transition [11]. After experiencing the enlightenment of these basic courses of education and transition courses, graduate students are directed to carry out formal scientific research activities under the guidance of mentors. Some mentors absorb graduate students to participate in the research of major national scientific research projects. Graduate students have become the backbone of many scientific research projects. Through scientific research with academic leaders, postdoctoral researchers, and other stuff, in the collision of different views and different ideas, in the specific practice of scientific research and innovation, graduate students can experience a strong scientific research atmosphere and gradually master the correct scientific research methods.

It is the ultimate goal of postgraduate education to cultivate professional interest and exploration spirit. Students are not only required to master advanced human knowledge, but also to stimulate interest in the pursuit of human academic truth so that they can continuously promote human development in future scientific research. It is strongly recommended that all of these primary innovations be encouraged, every single innovation idea of graduate students be valued, and every step of the effort to realize the innovation dream be helped, to ensure that the enthusiasm and exploration power inspired by interest allow graduate students to invest in innovative activities in a positive, active and conscious state. This cultural atmosphere that encourages innovation is more focused on the process of innovation, interest in the unknown areas of the profession than on the results of such innovation.

D. Integration of School Education with Enterprise Scientific Research Projects

The rapid development of science and technology in modern society and the continuous updating of science and technology have made the combination of technology and enterprises more integrated, and also made the cooperation between universities and enterprises closer [12]. On the one hand, the postgraduates required by universities can adapt to the requirements of modern innovative environment; On the other hand, enterprises need to continuously improve the scientific and technological quality of employees, through the introduction of talents and intelligence, to improve the enterprise's technological innovation capability. The demand of both sides quickens the pace of university graduate student training and enterprise alliance, so that today's graduate student education not only assumes the task of pursuing pure truth and engaging in teaching and scientific research talents, but also needs to cultivate applied innovative talents suitable for the needs of economic development and scientific and technological progress.

The cultivation of graduate students in the United States pays great attention to the combination with the business community. Practice has proved that this combination can not only enhance the innovation and practice ability of graduate students, but also meet the needs of the business community for current talents. Both sides have achieved great benefits in this cooperation model. In the process of cultivating graduate students at the university, the schools set up a platform for graduate students to cooperate with companies and give graduate students the opportunity to cooperate with professional technicians in the industry. At the same time, each graduate student has an academic tutor in the school and an employee of the company as a collaborator. Most of the research content contains actual problems that companies need to solve. Graduate students are involved in the project of the entire project as internship employees

of the company, and the relevant basic knowledge required can be obtained from the school professional mentors. On the one hand, it publishes the personnel planning book needed by the enterprise, a macroscopic overall guidance for university graduate students, such as guiding universities to set up master's degree in engineering and master's degree in engineering management for enterprises, thus shortening the distance between university graduate students and the business community; On the other hand, the joint training model of cooperation between universities and enterprises are gradually established and improved, directly linking university graduate students with the needs of enterprises. This kind of cooperation often appears in the form of enterprise cooperation research institutes, which carry out graduate education, based on the actual production and technical needs of the enterprise, and can award corresponding university degrees. This system of cultivating graduate students in enterprises makes graduate students more closely connected with the actual creative work, so that graduate students can better adapt to the needs of innovative talents.

IV. Conclusion

To sum up, the cultivation of innovation ability is the core of national higher education, and the cultivation of innovation ability of graduate students is the core of education. In recent years, the construction of innovation ability training system for graduate students in universities has received extensive attention. Bu investigating and analyzing the main problems existing in the cultivation of innovation ability of engineering graduate students, the system of innovation ability cultivation of graduate students are studied and speculated from many aspects. The strategy of improving the innovation ability of graduate students can be attributed to the "four establishment", that is: the establishment of innovation-oriented training programs; the establishment of a practice platform to encourage innovation; the establishment of independent innovation activity carrier; the establishment of an innovative environment and atmosphere. It is not only benefits the students' study and employment, but also meets the urgent need of the country for the complex and comprehensive innovative talents.

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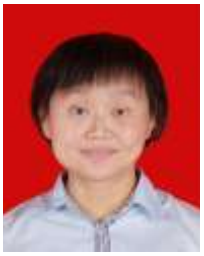

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