

Research and Practice on Basic Composition and Cultivation Pattern of College Students' Innovative Ability

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Abstract

Facing the increasingly fierce international competition, it has been the core of higher education to explore how to cultivate college students with innovative ability. College students' innovative ability is mainly composed of basic ability, innovative thinking and innovative actions. In conformity to the above composition, the cultivation pattern should include learning basic knowledge, training innovative thoughts and learning innovative skills. The learning and practice in school, students' independent learning and social practice serve as the three main sections in the development of innovative ability. In addition, some effective methods are beneficial for college students' innovative thoughts and practice including schools providing optional courses on innovative education, teachers conducting researches on education and teaching and applying innovative education theories and practical innovative skills to professional courses.

Keywords: College students, Basic ability, Innovative thinking, Innovative actions, Cultivation pattern

1. Introduction

Facing the increasingly fierce international competition in the current era of knowledge economy, it is quite urgent to strengthen the cultivation of talents, especially innovative ones. With the core lying in students' innovative ability, it is of great significance for researchers and professionals in higher education to strengthen cultivating students' innovative ability. This issue is not a pure educational problem but closely related to social structure and system. The implementation of innovative education calls for a favorable social environment as well as the interaction between the educational system and the whole social system. Fundamentally, innovative education won't do without an overall innovation of social structure and system. Without the atmosphere and environment encouraging innovative talents, there are few teachers with innovative spirits, not to mention cultivating students' innovative abilities. However, the environment for innovation is coming into existence. In August 2002, a seminar on creation and creative education was authorized by Higher Education Department of the Ministry of Education to be held by Southeast University, which attracted over 50 representatives from more than 30 universities. In the first innovative staff training course held in Shanghai in September 2003, over 100 representatives all over the nation were present. In spite of the importance of environment, it is more important to make joint efforts to create favorable environment. Innovation roots from practice, including both practical explorations into theories and practical actions based on them. This paper shares with the readers the theoretical and practical explorations in cultivating college students' innovative abilities in the recent years and relevant effects.

2. Connotation and Basic Composition of Innovative Ability

2.1 The Connotation of Innovative Ability

Several thousand years' history of Chinese educational development is dotted with some simple ideas and methods for the cultivation of innovative ability. For instance, it is over 2000 years ago that Laotzu put forward the idea that everything in the world comes from not-being; Confucius proposed to teach students in accordance to their aptitude and to give students opportunities to think independently. In 1919, famous Chinese educationist Xingzhi Tao introduced the concept of "creation" into education for the first time. In his article *First-Class Educationists*, he proposed to cultivate talents with creative and explorative spirits due to its importance for China's survival and prosperity (Zhang, 2000). When Zemin Jiang met with talents specialized in science and technology in the scientific city of New Siberia on November 24, 1998, he said that innovation should be the soul for a people's development as well as an inexhaustible motivation for a nation's prosperity and the key to

innovation lies in talents while talents depend on education to grow up (Ministry of Education, 1999). Based on this speech, a heated discussion on the connotation of innovative ability, factors influencing the cultivation of innovative ability as well as cultivation methods has been conducted with the cultivation of college students' innovative abilities as a significant goal of China's educational reform.

If we have an overview at the achievements made in the recent ten years, we'll find three main opinions on the connotation of innovative ability in spite of the different opinions on innovative ability among Chinese scholars: the first one, represented by Baochen Zhang, Yan Li, Peng Zhang, claims that innovative ability refers to the ability for individuals to utilize all the known information including the known knowledge and experiences (Zhang, 2005) to produce special and original products with social or individual value (Yue, 2004). It is composed of innovative sense, thoughts and skills, with innovative thoughts as the core (Xin, 2003). The second opinion, represented by Jiangying An and Huiyun Tian, claims that innovative ability is manifested in two interrelated parts: the acquisition, reformation and application of the known knowledge and the research and invention of new ideas, techniques and products (Wang, 2006). The third opinion, represented by Bin Song, Shouqiang Zhuang, Zongxiang Peng, Shilong Yin, starts with the knowledge structure of innovative ability and holds that knowledge is composed of basic knowledge, professional knowledge (Dong, 2006), instrumental knowledge or knowledge on methodology (Li, 2006). Regardless of the differences among them in description, all the above three opinions give clear explanations on the connotation of innovative ability.

2.2 The Basic Composition of Innovative Ability

According to the above explanations on its connotation, innovative ability should be composed of basic ability, innovative thinking and innovative actions.

2.2.1 Basic Ability

Basic ability here should include the following two aspects:

Basic professional ability

In the present times with incessant changes in knowledge, learning at college still lies in the basic learning stage in any specialty. Generally, a qualified college student is expected to have skills in computer and information, knowledge on management, environment, market and law as well as knowledge, theories, methods and skills relevant to his specialty. It is not quite hard for a person with systematic professional training to achieve such a goal, but all college students are supposed to have a wide and solid basis in their specialties.

Basic innovative ability

This mainly refers to the ability closely related to innovative ability in a person's mental quality, such as attention, imagination, will-power, memory, reaction, endurance and so on. Lying at the layer of innovative personality, these abilities play an indispensable role in creation although they cannot produce achievements directly. It is worth mentioning that basic innovative ability hasn't drawn enough attention from universities and students, not to mention its systematic cultivation.

2.2.2 Innovative Thinking

This mainly refers to the ability to produce creative thoughts. As the core of innovative ability, innovative thinking is the thinking ability during the innovation process (Li, 1987). That is, the thinking process can be called creative thinking as long as its result is innovative.

2.2.3 Innovative Actions

Innovative actions, the ability to conduct creative actions, are external behaviors dominated by thoughts, hence falling to the category of innovative practice. The ability in innovative actions can be regarded as the ability to produce original achievements with individual actions dominated by their innovative thoughts, hence an indispensable part in innovative ability.

3. The Cultivation Pattern of Innovative Ability

3.1 The Cultivation Pattern of Innovative Ability and Its Connotation

Innovative ability should be cultivated with certain methods and means. According to the basic composition of innovative ability, the cultivation pattern of college students' innovative ability should be as follows:

(1) Learning basic knowledge. Knowledge is an important basis for ability and learning basic knowledge serves as a reserve for the formation of basic ability. The basic knowledge relevant to basic professional ability mainly includes basic humanities courses, basic professional courses and advanced courses; the basic knowledge relevant to basic innovative ability mainly include the basic principles of creatology, the basic composition and

characteristics of innovative ability, internal and external factors for the development of innovative ability and so on.

(2) Training creative thinking. All the three basic forms of thinking, including abstract thinking (logical thinking), imaginal thinking and inspirational thinking, can produce innovative achievements while failing to represent the connotation of innovative thinking. In spite of so many different opinions on innovative thinking in creatology, we agree that the forms of thinking should be viewed from the perspective of its result. Therefore, all the thinking activities producing new achievements and achieving new levels should be regarded as innovative thinking. Generally, innovative thinking is the effective development of certain basic thinking form or the effective integration of many basic thinking forms, especially the latter. Currently, the widely-accepted forms of innovative thinking include: divergent and convergent thinking, positive and reversed thinking, associative and imaginative thinking, logical and critical thinking and so on. The nature of innovative thinking lies in its originality, transcendence and unrepeatability.

(3) Learning innovative techniques. Innovative techniques originated from America. In 1938, Alex Faickney Osborn, manager of BBDO Advertising Corporation in New York, created brainstorming. Innovative techniques had been more perfect by 1960s. In Japan, creatology researchers summarized and published over 300 creative techniques. Researches in this aspect began in 1980s when scholars conducted a research on the creative activities in Hetian Road Primary School in Shanghai and created "Hetian Twelve Law". We agree that creative techniques refer to those procedural and standardized methods and skills summarized during practice which can be applied to innovative activities. Innovative techniques can be divided into different types according to different principles. For instance, we have individual techniques and collective techniques. The former refers to the methods which can be employed by individuals, such as disadvantage enumeration, free association, pairs of cards and so on. Collective techniques refer to those conducted by many people, such as brainstorming, synectics method and so on. It is a ladder leading to success to learn innovative techniques, through which innovative thinking can be converted into innovation actions and therefore innovative accomplishments can be achieved and innovative ability can be reflected finally.

(4) Innovative Practice. Obviously, innovative practice is an important and core section in the cultivation of innovative ability as well as the central manifestation of innovative actions. Only in innovative practice can innovative thoughts, ideas and techniques be integrated and the acquired knowledge and skills be comprehensively employed to solve practical problems, hence forming and reflecting innovative ability.

3.2 Strategies for the Implementation of Innovative Ability Cultivation Pattern

In our opinion, the cultivation pattern of college students' innovative ability should be implemented through school learning, social practice and independent learning.

3.2.1 School Learning

School learning is the main channel to cultivate innovative ability.

Professional basic ability is mainly gained through the learning and practice of professional basic knowledge, to be more specific, through theory teaching and class practice. In the former aspect, the basic principles of creatology and specific professional courses can be combined to have educational reforms and researches on teaching contents, teaching methods, the construction of specialties and courses and so on, which will achieve obvious effects; in the latter aspect, reforms can be conducted in the construction of professional and innovative labs, specialty practice, course design, theses and other practical sections in order to offer a better platform for the cultivation of students' innovative abilities. Innovative basic ability can be mainly achieved through the learning and practice of innovative basic knowledge. To be more specific, courses related to creatology should be organized to give students systematic explanations on the basic theories, principles, innovative thinking methods, innovative techniques of creatology in order to equip them with powerful weapons for innovation and therefore to speed up the development of innovative potentials.

3.2.2 Social Practice

The nature of innovation lies in practice. American universities are obviously different from Chinese ones in that social practice starts at school where each student has the opportunity to participate in the design and practice of some relevant projects in enterprises for at least one year, hence basically guaranteeing that they will become qualified engineers sooner after graduation. However, in China, even for a very excellent student, there is a great disparity between his innovative ability and that demanded in practice. In order to solve this problem, students have to participate in some significant projects through which their independent working ability can be gradually improved. Only by applying innovative thinking methods and techniques to actual practice will students'

independent innovative abilities be really improved. One possible solution is to strengthen students' practical abilities by strengthening their practice and communication with the society. For instance, stable practice bases should be established or the practice function of the factories run by schools should be perfected or strengthened to base students' graduation designs and theses on a practical basis. Participating in teachers' practical research projects is another way. With some big projects divided into some small ones, students will have more chance to have practice. In addition, some technological innovation activities with rich contents and various forms should be frequently organized and a variety of competitions and social practice activities should be held during vacations.

3.2.3 Independent Learning

Demanded by the current era and fierce competition, independent learning is a main channel for students to enhance their innovative ability after graduation. Independent learning mainly includes: new knowledge, theories and methods related to their own specialties, knowledge and skills demanded in their practical work. For those people who have never learnt creatology before, independent learning of innovative methods and techniques is of particular importance. Called for by practice, independent learning can be conducted through self-learning, taking refresher courses and a variety of trainings.

4. Practice and Effect

In recent years, certain effects have been achieved through our efforts to cultivate college students' innovative abilities.

1). Establishing an optional course named Creatology and Creativity Development Exercise. Its major objectives include: First, organizing classes and practical activities to stimulate students' innovative spirits, eliminate the air of mystery in the eyes of students and establish students' confidence in converting their innovative potentials into actual abilities through practice, exercise and experience; second, enlarging students' thinking space through innovative thinking exercise; third, grasping innovative techniques. Classes are conducted in many forms including discussions, contests, case analysis, games and so on in order to create a vivid and active atmosphere. This course has gained great popularity among students since it began over two years ago.

2). Injecting new vigor into traditional educational reform by introducing the basic principles of creatology to professional classes. For example, the methods of reversed thinking and imaginal thinking are applied to the course of Basis of Electromechanical Design and two new methods including "visual method of instruction" and "reversed method" are proposed and have achieved remarkable effect in practice.

3). Choosing excellent students to participate in teachers' research projects to enhance their interest and enthusiasm for learning. During the process, students have to look up documentary materials, confirm and conduct experiment plans, finish experiment reports all by themselves, hence developing their independent thinking, cooperative spirits as well as innovative sense.

4). Having innovative practice. Innovative engineering labs and off-campus practice bases have been taken advantage of to conduct some activities such as robot design contests, electronic design contests and electronic sport contests for college students, in which students have greater enthusiasm and have won remarkable result and they have gained factual evidence for their graduation designs and theses. It is shown in practice that innovative thinking methods and techniques not only have theoretical significance for the cultivation of college students' innovative abilities but can be employed to students' practice and exert actual effects. It is worth further study how to cultivate college students' innovative abilities and how to implement the cooperation between schools and enterprises.

References

- Dong, Sheying. (2006). The Construction of Multi-Level Cultivation Pattern of Students' Innovative Ability Based on Research Projects. *Journal of Xi'an University of Architecture and Technology*. (2): pp91-94.
- Li, Naijun. (1987). Reflections on Innovative Thinking. *Thinking Science*. 2.
- Li, Naijun. (2006). Practical Research on Improving College Students' Innovative Ability. *Heilongjiang Higher Education Research*. 6.
- Ministry of Education. (1999). *Reference Materials for Educational Development Action Plan Geared to 21st Century*. Beijing: Beijing Normal University Press. p4.
- Wang, Hui. (2006). On the cultivation of College Students' Innovative Ability. *Journal of Northeast Agricultural University (Social Science)*. (1): pp51-53.

Xin, yali. (2003). Investigation on Elements Influencing College Students' Innovative Ability. *Psychological Science*.

Yue, Xiaodong. (2004). On the Cultivation of College Students' Innovative Ability. *Higher Education Research*. (1): pp85-86.

Zhang, Minsheng. (2000). *Xingzhi Tao's Educational Ideas and Practice*. Shanghai: Shanghai Music Press. pp59-60.

Zhang, Peng. et al. (2005). *Current Situation and Countermeasures of the Cultivation of College Students' Innovative Ability*. University Education Science. (3): pp50-53.