

## On innovative quality and its cultivation in Enginery specialty talent

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**Abstract:** This paper first discusses the nature of innovative quality and innovation education under the background of economic globalization and educational internationalization, and then expounds the primary characteristics of innovative talent in engineering specialty in view of the reality of talent training in our country's higher education. Last, it advises, aiming at the principal problems in innovation education in our country's engineering institutes, that we should foster a view of all-round engineering education, enhance teachers' innovative abilities, optimize course systems, advance the students' engineering capability, create an innovation environment so as to vigorously widen the ways of cultivating innovative talent.

**Keywords:** mechanical engineering, specialty, innovative quality, innovative talent, ways of training

### 1. Foreword

Engineering industry is one of the pillar industries in the economic and social development, and the advanced manufacturing technology, which has come from the building technique combined with material science, informatics, control science and management science, is now given priority of development all over the world. With the swift development of the society, economy and science, many new and higher requirements, especially those of cultivating engineering capability and innovative ability in enginery specialty personnel, are put forward. Since innovation consciousness and innovation thinking are the important basis of engineering capability and innovative ability, we should lucubrate the primary characteristics of innovative quality, innovation education and innovative talent, explore the ways of cultivating such talent in enginery specialty. All these will be of great importance for improving the talent-training quality and the talent's ability in taking part in the international competitions.

In recent years, we have undertaken such key educational reform programs in Jiangsu province as "research and practice on the quality of the talent in mechanical engineering specialty, mode of cultivation and on the reform in teaching content and course system" (No.98016) and "research and practice on the cultivation of innovative and pioneering talent in mechanical engineering specialty (No.05038). Through the work we have formed some rough ideas about how to foster and enhance the modern-mechanical-engineer quality. We welcome any advice for the purpose of raising the quality of training mechanical engineering professionals.

### 2. Innovative quality and innovation education

Innovation sustains the progress of a nation. It is an inexhaustible motive force for the prosperity of a country. Normally, innovation refers to all the new theories, new ideas, new knowledge, new technology, new products, new mechanisms and methods obtained through human's creative work in the process of changing the subjective and objective world for the purpose of adapting actively to the development of the economy, society, science and technology, accumulating social spiritual and material wealth, promoting

work efficiency, and ultimately uplifting the living standards and welfare of human beings.

More fundamental, more profound, more permanent than knowledge and ability, quality is the basic nature of human, which has a direct effect on their consciousness, thought, opinion, discovery and creation. According to epistemology, innovative quality comprises innovative consciousness, thinking and characters. It, in a sense, determines a person's innovative ability in creative behaviors. That is to say, one with fine innovative qualities can give full play to his innovative potential, exhibit his innovative ability and make innovative achievements. Otherwise, he will accomplish nothing. In the theory of pedagogy, personal quality develops for the most part through study and education and improves with in-depth education or training received. All this clearly shows that we must implement innovation education to enhance the makings and capabilities of innovation.

Following the natural law of education and human development, laying stress on the method of elicitation and teaching different students differently, and adopting modern research, probe and construct teaching models, innovation education must be able to enhance the innovative consciousness, thinking and spirit and internalize them in students. In a broad sense, all pedagogical activities that can help the students built up creative ambition, foster their creative spirit, inspire their creative thinking, enhance their abilities and provide effective training are innovation education. Taking a wide view, human's education phylogeny can be divided into three major phases. The first is the phase of traditional teaching and learning. Its primary characteristic is to pass on and carry forward departed social norm, knowledge and skill. It is mostly in adaptation to agricultural economic society. The second is the phase of latter-day alternative education. It pays more attention to realistic demands that knowledge be applied into practice. It is mostly in adaptation to industrial economic society. The third is the phase of modern education. The main feature is to look on future and lay stress on fostering hominine all-round qualities and give emphasis to lifelong education. It is mostly in adaptation to the time of knowledge economy. Therefore, to promote innovative education vigorously is the call of time and necessity of history.

### **3. Primary characters of the innovative personnel in enginery speciality**

So far, there are many research papers and achievements about the primary characters of innovative personnel. Relying on their own knowledge and comprehension, most investigators describe the characters from respective angle and familiar fields and the descriptions have much in common. In our opinion, modern mechanical engineers must be characterized by:

#### **(1) Strong curiosity**

The natural disposition of scientific spirit roots in curiosity. Science and technology in mechanical engineering are comprehensive with a long tradition and time brand. Those who have made outstanding achievements in engaging in the basic research, product development and technical application and devoting themselves to the reform, improvement, rebuilding, innovation and creation of mechanical equipment/devices, instruments and systems mostly possess strong enterprise, sense of mission and curiosity.

#### **(2) Vivid independence personality**

Personality independence is the precondition of thinking independence. One without personality independence will have no thinking independence. It is a universal law that creativeness derives from personality independence. Generally speaking, there is no uniqueness to the avenue of achievement in mechanical engineering technology, but the major parameters of appraisalment are the same, quality and benefit. So in the course of training, we should learn to comprehend and tolerate. We should encourage, help and support the students with brilliant independent characters.

### **(3) Unyielding questioning consciousness**

Questioning consciousness is the basic of questioning and criticizing spirit, the essence of which is the scientific thought of seeking truth from facts. To implement the thought we should be discontented with the existing conclusion, disbelieve the explanation that is regarded as exclusively correct, not to fetish authoritative arbitration, and should not bend to any extrinsic pressure and not to abandon our own opinion.<sup>[7]</sup> Theories in mechanical engineering and their application systems are centuries old and relatively perfect, which has been regarded as insurmountable. Therefore, only under the conditions of strengthening students' unyielding questioning consciousness, questioning and criticizing spirit, more talent setting the trend will come forth successively and mechanical engineering will be in its full bloom.

### **(4) Solid engineering makings**

Advanced engineering education possesses relatively definite specialty whose application background is engineering with practice as its foundation. Solid engineering makings are requisite to make achievements and innovations in mechanical engineering field. Generation of mechanical new theory, new technology, new process, progressive methods or pioneer product invariably rests with long-term accumulation of knowledge and experience of the creator, rests with their exploring of engineering theory and substantive application practice. The innovation or creation that is capable of withstanding the test of engineering practice and proof of time can be accepted and ratified by enterprises, industries and the society.

### **(5) Originality and team cooperation**

Mechanism is a complicated system, and advanced manufacturing technology touches on material science, engineering mechanics, electronics, informatics, control theory, management science and some other scientific fields. Any reform, improvement, rebuilding, innovation or creation in mechanical design and manufacturing is oriented by originality and achieved by cooperation of a few or tens of or even hundreds of people. So team spirit and a broad mind are required. Respecting the creative labor and other's hard work and achievements, cooperating in unison, we can forcefully push forward the development of mechanical engineering science and technology in our country.

### **(6) Tenacious willpower**

Creative activity is hard work which tests out one's will. In the creation process, the main body of innovation often encounters unimaginable difficulties. Each innovation requires arduous work on the basic of long-term accumulation. Furthermore, they have to face shackles of traditional notions and iterative frustration. Willpower is a quality with which one is able to go all out for achieving his own selected target. None but strong-minded individual can explore with great concentration, face any difficulty valorously, succeed finally and enjoy the pleasure of innovation. Apparently, creators in mechanism field should have tenacious willpower and fortitudinous spirit.

## **4. Primary ways of cultivating innovative talent in enginery specialty**

Today economic globalization and educational internationalization are inevitable trends. The swift development of national economy and society cries for innovative and pioneering talent. As the principal channel of training talented engineering personnel, advanced engineering education plays an essential role in the formation of the personnel's knowledge, ability and quality and has definitive influence upon their consciousness, quality, spirit and innovative ability. According to the above analysis and discussion, the main approaches to cultivating modern mechanical engineer with innovative quality and abilities should be:

### **(1) Fostering a view of all-round engineering education**

The view of all-round engineering education requires people to pay much attention to engineering practice and its systematicness and integrality. The true nature of the view is the determination of the

all-round, coordinated and sustainable development between human and society, between the advancement of engineering technique and the boom of nature and ecosystem. To achieve all this, we should first persist in combining science with humanism, lay stress on disciplinary crossing, sparkplug interaction and interpenetration between liberal arts and science, and widen the foundation of engineering education. Second, we should inherit and innovate, make effective efforts to foster the students' engineering and innovative ability. Third, we should combine school education with lifelong education, enrich ourselves constantly with new knowledge and new technology and make engineering education open and more internationalized.

### **(2) Developing teachers' innovative ability**

Teachers play a very important part in cultivating students with innovative quality and capability. In view of the fact that our university teachers are to enhance their teaching and engineering capabilities, we have been making efforts to raise the whole level in them. We have carried out two programs since 2002, 'program for young teachers to be qualified for teaching' and 'training program about engineering capacity among young teachers'. In these programs, there are 16 items of training and examination: pre-post training, related examinations, class attendance and tutoring, preparations for lessons, preliminary teaching, experimental teaching, laboratory construction, course design instruction, cognitive practice instruction, manufacturing practice instruction, self practice, graduation project instruction (thesis), multimedia teaching and courseware making, scientific studies and research, teaching research and class tutor. For the moment, about 85% young teachers have passed the programs favorably in our university. As a result, we have achieved the goal to raise considerably the whole level in teachers.

### **(3) Optimizing course system**

In fostering innovative and pioneering personnel, we should focus on optimizing course system. We made efforts to set up a new talent-training system in 2003. To make it more scientific, rational and forward-looking, we have combined quality-oriented education, universal knowledge education, basic knowledge, specialized knowledge, ability training with personality development, so as to realize four changes-- to change the mentality about utilitarian education and foster oriented educational view of training advanced specialized personnel; to change the mentality about scientism education which attaches importance to science and technology and looks down on humanism and set the education thought to interact scientific education with humanism education; to change the mentality which overvalues the same standard and lay stress on development of healthy individuality and teach students in accordance of their aptitude; to change the mentality of traditional teaching and learning which pays attention to inheritance and make the students have the courage to innovate with a pioneering spirit. At the same time, we have added some new front-edge courses to enrich the connotation of the specialty and raise its level.

### **(4) Advancing engineering capability**

Conforming to the all-round engineering educational view and aiming at fostering engineers with modern techniques, management knowledge and pioneering spirit, we, in 2002, following the construction notion of blocking, combined type and open type, set up a multilayer, all-round and comprehensive engineering training system related with mechanism, electron and management. Moreover, following epistemology, we constructed four platforms: cognition of industrial system, training of foundation work, practice of modern engineering system and integrating and innovative training. Based on the four platforms, we gave priority to 11 show-how teaching windows such as numerical control technique, quick-speed manufacture, non-traditional machining, electromechanical control, PLD & SOPC, and so on. This incarnates the unity of modern design, modern manufacture, modern control and modern

management, explores the new training model of enhancing engineering consciousness, engineering capability and innovative thinking and lays stress on the ability of engineering practice and recreation.

### **(5) Creating an innovation environment**

Good tools are prerequisite to the successful execution. To foster the students' innovative consciousness and innovative ability, we should, first of all, give different kinds of lectures, make series of academic reports about the development in mechanical engineering, inform students about the front edge research in machinery subjects to lay foundation for latter technological innovations. Second, we should set up some energetic scientific clubs, establish some associations keen on machinery innovation and draw up a plan to carry out innovative activities systematically. Third, we should organize innovative activities at different levels, involve the students in such kinds of competition given by a school, a province or a country as mathematical modeling competition, electronic design competition, challenge cup, advanced manufacturing technology competition, competition of mechanics innovation works and robot execution competition and sparkplug pioneering spirit and encourage the students to enter the laboratory at the earliest opportunity to participate in research subject initiatively. Fourth, we should formulate policies to encourage the students to participate in innovative activity. We can form systematic innovation-excitation mechanism by adding innovation credits, encouraging innovative achievements, giving innovative students priority in graduate-matriculation. And we should initiatively give students hardware and software support in technological innovation, create loose innovation environment and supply them extensive space for the development of their individuality and creativity.

Admittedly, the cultivation of innovative quality and innovative talent is a complex and systematic project. And what's more, teaching reform and increasing the quality of talent cultivation are two permanent topics of advanced education. We should summarize the work done previously, enrich the connotation of innovative quality, proceed further with the reform of cultivation mode, teaching contents and course system, keep on exploring and practicing for fostering a large numbers of innovative personnel with solid foundation, high quality and great capability.

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