

Talents Training of Higher Engineering Education in the View of Large-Scale Engineering

ZENG Lijuan^{[a],*}

^[a]College of Human Science, Northeast Petroleum University, Daqing, China.

*Corresponding author.

Supported by the Higher Education Scientific Research Planning of the Heilongjiang Association of Higher Education (No. HGJXHB21110168).

Received 20 January 2014; accepted 16 April 2014
Published online 26 May 2014

Abstract

The idea of large-scale engineering is a new educational idea according to comprehensiveness rationality, which is a novel training mode combining the engineering practice with kinds of value idea, such as science, technology, economics, society, environment zoology, civilization and aesthetic art, etc.. In perspective of large-scale engineering, the talents should have the abilities of higher engineering quality, comprehensive knowledge background, good liberal quality and join in social activities. The talents training of higher engineering education in the view of large-scale engineering should adopt some methods as follows: reforming the courses system, enhancing practical teaching, non-intelligent factors education, and scientific and technological innovative activities, and improving engineering practice abilities.

Key words: Large-scale engineering; Higher engineering education; College students; Talents quality; Training

Zeng, L. J. (2014). Talents Training of Higher Engineering Education in the View of Large-Scale Engineering. *Higher Education of Social Science*, 6(3), 83-88. Available from: URL: <http://www.cscanada.net/index.php/hess/article/view/4559> DOI: <http://dx.doi.org/10.3968/4559>

INTRODUCTION

Training quality-oriented innovative talents is the education strategy of building the innovation countries

and obligation and mission of higher education in the new stage. Higher education is a subclass of education. In the view of globalization, facing the challenges of technology advancement, economic development, restriction of environment and resource, influence of traditional ideas, the qualities of education teaching and talents training are interesting to attention all the time.

1. THE REALISM CHOICE OF THE IDEA OF LARGE-SCALE ENGINEERING ACCORDING TO COMPREHENSIVENESS RATIONALITY

The engineering education has been a basal strength of technology and industry innovative since industrial revolution in Europe. The higher engineering education provides the help of technology innovative and talents, at the same time, which actualizes the development of itself. The higher engineering education system in China has been accomplished after exploring in some decade years, and has trained many talents for building social economical development, which supports the Chinese industrialization revolution. After developing the engineering education in China, China becomes the biggest country of the world in the engineering education. In background of economical globalization, the engineering education how to combine with modern demand is a key question of education.

For the demand of global economics development, the talents training of engineering education should not only be suited for the domestic industry and market, but also faced for the global industry and market, which should train the high quality talents have the competition abilities in the world market. However, the engineering education in China have not been keeping up with the world development in ideas and actions, and not found a foothold in international development. Considering the practical

circumstances in China, the engineering education objective are training modernistic engineering talents having the abilities of international view, communicating with different cultures and global profession competition. At the same time, the global society faces many serious questions, such as resource exhausting, environment pollution and finance crisis, et al. And realizing sustainable development is imminent demand of human subsistence. Thus, the present society has a requirement of talents have the abilities of long-range profit target, professional engineering ideas, and resolve the social question relating with engineering. The engineering ideas are the ability and action of human brain to nature (Bao, 2008, p.452), economical and natural environment, which can create new physical fortune by carried out a engineering, based on predominating natural rule, respecting and protecting the nature, rationally and legally exploring the nature. Recently, the contents of environment and sustainable development put in the higher education, but there are encountering a key question, which is how to systemically combine with the characteristics of human, resource, energy, environment and economics in China, how to design the content of sustainable development education and estimate the its effect, and how to combine sustainable development education with engineering education. From the view of modernization level, there are prodigious distance between China and others medium developed countries nowadays. And China constituted the development aim that will basically realize the innovation country in 2020, and established the development direction. In 2020, China will achieve many technological harvest have a momentousness in the world, and enter into the innovation countries range, which provide the powerful basement of building the well-to-do society. The technological innovation is the key to build the innovation country. So the technological innovation talents training play an important role in engineering education. The technological innovation should translate the knowledge into realistic productivity, but the corporations are the main body in the process. Thus, the higher education keeping on cooperating with corporations in training the talents is the basement of engineering education in China. Considering above analyses, the systematical investigation and innovation of modern engineering education should be accomplished. And the idea of large-scale engineering becomes a necessity choice for guiding the high quality engineering talents training in higher engineering education. The kernel contents of large-scale engineering are defined as follows: unification of ideas holist and practice, synthesis of engineering, science, art, management, economic environment, and culture. In which, engineering technology are main body, and science theory are basement, and art technique and management methods are assistant, and economical benefit, environment ethic, culture value are planning as

a whole (Zhang, 2009, p.8). Compared with traditional engineering views, there are three characteristics in large-scale engineering education view. First, large-scale engineering education combines science, technology, and other non- technology factors into integrative view, and forms whole engineering systems. Meanwhile paying attention to engineering technology, other non-technology factors are integrated into engineering system as endogenesis (Xie, 2008, p.36). Second, large-scale engineering education breaks through limit of singularity value view who only chases after economical profit, and combines with kinds of value views such as science, economics, society, environment zoology, culture, taste arts and ethical morality. Then large-scale engineering education can guide the engineering practice, and choice the engineering value for harmonious state in human, society and nature, at last realize the multi-value views. Third, the large-scale engineering education emphasizes the knowledge systems for training the engineering talents, such as professional engineering practice abilities, energetic creativity spirit, and favorable personality and literate human qualities. The large-scale engineering education improves the limitation for traditional engineering education excessively paying attention to the technology level, which brings some questions, such as engineering course students can not understand the cost and management, and run short of humanities culture, all-around thinking, and innovation and designing abilities. The large-scale engineering education is a education idea of colligating all logos, which break out the professional limitation, increase the professional range, pay attention to professional intersection, find a foothold in qualities education, strengthen the training of innovation abilities, emphasize integration and whole and system of the thinking training. The large-scale engineering education provides the help for training the novel engineering talents have the abilities of innovation and development, which is realism choice in higher engineering education reformation.

2. THE REQUIREMENT OF TALENTS QUALITIES IN THE LARGE-SCALE ENGINEERING VIEW

According to education guidelines in China, the talents training aim of high schools is producing the socialism building talents and successor have the integration abilities of morality, intellectuality and physical strength, which is the collectivity of talent qualities. However, the large-scale engineering education view is a requirement of development between society and engineering education, which emphasizes to train the talents have the abilities of thickness profession, commodious knowledge, better ability, high quality, rich innovation spirits and

ability, who are the engineering talents for adapting the requirement of social economics, and science technology, and culture development in 21 century. The large-scale engineering education view is a synthesis of knowledge, experience, abilities and personality. In the large-scale engineering education view, there is illumination of engineering education in United States. The engineering education talents training mode is producing generalist in United States, which trains the system engineers have the abilities management, humanities, economics, zoology, ethic, engineering and technology, who are the successful rank and fashion. For example, the education training mode of the Stanford university is that all students in or from the Stanford university have the high qualities of exhibiting the culture, morality and self-respect, respecting the others, who believe that they will benefit from kinds of resources of Stanford university, and have the abilities of serve the society and people in future, and are rank and fashion in intelligence and social contribution (Zhao, 2009, p.183). Many students in United States become rank and fashion in intelligence and social contribution for they attain education and have the high qualities. However, the engineering education in China has been a professional education for a long time, emphasizes the professional qualities education and omits the humanities qualities education, which leads to some questions, such as the college students exhibit to be poor of culture qualities, have the weak abilities of adapting social requirement, have out of focus humanities qualities. Therefore, the education standard in China carried out in 2008, which is *the engineering education authentication standard*, which adopts eight basical requirements the students should accomplish. The basical requirements are as following. The students should have the abilities of humanities quality, social responsibility and profession moral. The students should have the abilities of resolving the questions using application mathematics, natural science and economics management. The students should have the abilities of professional theory, knowledge, experimental technology and engineering practice. The students should have the abilities of acquiring the literature and information. The students should know the professional laws. The students should have the abilities of knowing the engineering effect on natural world and human society. The students should have the abilities of organizing management, intercourse and cooperation. The students should have the abilities of life study, international view, intercourse, competition and cooperation. Synthesizing the eight requirements, the engineering talents should have four abilities of professional engineering, width knowledge background, better humanities quality, and society responsibility.

The engineering abilities include many factors, such as the integration application abilities of basical knowledge,

professional theory and professional technology, the searching and studying abilities of new knowledge and technology, the intercourse abilities of professional work, the writing abilities of engineering technology papers. The engineering abilities also include the practice and innovation abilities of college students, which are innovation abilities based on practice basement, and which require the conditions, such as accurately analyzing questions in engineering practice, providing resolve scheme in design, and rationally settling the question.

Integration knowledge background require the conditions of knowing the engineering science knowledge, natural science knowledge, management basement knowledge, economics basement knowledge, law basement knowledge, environment basement knowledge and arts basement knowledge, also knowing the engineering technology of planning, designing, experiment and execution. Integration knowledge background avoids the questions of talents training in western developed countries, such as some western developed countries criticized their engineering education that produced bad talents, such as the talents studying the machine can not know the electricity, and the talents studying the electricity can not know the machine, and the talents studying the heat process can not know the cold process, and the talents studying the cold process can not know the heat process, and the talents studying the fluid can not know the solid, and the talents studying the solid can not know the fluid, and the talents studying engineering course can not know cost and management, even lose of humanities knowledge and culture.

The better humanities qualities should have the abilities such as controlling the sense, sensibility and purpose itself, rationally resolving the relation of man and nature, man and society, man and man, serving the society, contributing to human, and happy itself.

The society action abilities should have the abilities such as harmony, organizing, leading, obeying and intercommunicating. In 21 century, the benefit relations of engineering broaden, which include many teams, global diversification member, officer and global buyers, which improves the requirement of society abilities of engineers. Therefore, the engineers should have the abilities of hearkening, speaking, writing and communicating (Ma & He, 2007, p.56).

In 21 century, the knowledge structure of modern engineering talents are more complex, and the abilities of modern engineering talents are more comprehensive, and the engineering qualities of modern engineering talents are more pressure. The higher engineering education in China should be have a foot in now and future, and improve talents training modes that are not rational and not suited for social needs, and construct a new higher engineering education talents training modes in China.

3. TALENTS TRAINING STRATEGIES OF HIGHER ENGINEERING EDUCATION

3.1 Reforming Course System, Structure and Content & Constructing of Scientific Knowledge System

The main problems of engineering teaching course system at present are as follows: too much emphasizing on engineering scientific knowledge while little attention to the engineering practice training, paying attention to professional knowledge while not comprehensive quality and ability training, ignoring the knowledge role in social humanity, economic, and environmental protection.

Therefore, colleges and universities should speed up the engineering education curriculum reformation. We should strengthen the interdisciplinary course setting; through breaking out discipline barriers and eliminating simple mathematical accumulate type between subjects. In order to cultivate comprehensive ability to analyze and solve complex engineering problems of talents in the future, we should realize the penetration and contact between subjects broaden the subject areas. The course (Zhao, 2009, p.185) established mutual penetration of curricular knowledge system of literary, science, engineering, around the training objectives. That is *engineering quality, comprehensive knowledge background and the thinking mode, the humanity quality, social activities*. For example, electrical engineering and computer science (EECS) in MIT (Massachusetts Institute of Technology) requires students must learn 21 courses, including natural science, humanities and social science, engineering technology, communication course and experiment courses, and so on. Computer science students not only learn the computer specialty knowledge, but must study interdisciplinary electives the curriculum of electrical aspects. Through increasing the proportion of humane quality education course, makes the students meet the harmonious development. Form the correct engineering values and life values by cultivating humanistic spirit of students, setting reasonable science curriculum system help students to increase the cognitive and understanding of multidisciplinary even more industry, and lay a solid knowledge foundation of treatment engineering complex problems in future.

3.2 Strengthening Practice Teaching Link & Training Students' Innovative Spirit and Practice Ability

Practice teaching is the most important content in engineering education. Perfect the system of practical teaching is the foundation to cultivate students' engineering quality. Engineering schools should combine theory teaching with practice teaching and form a relatively independent and complete the practice teaching system for supporting theoretical teaching. The system

consists of three practical teaching links, including experiment, practice and design. Clearing the links between the each link, ensuring realize target to each link and auxiliary plan, strengthening practice guidance and monitoring of the whole process, promoting the development and improve of students' innovation ability and practice ability.

Strengthening the experimental link and setting the scientific experiment project. We should reform and update the experimental teaching contents, reduce the demonstration and verification experiment. In the meanwhile, increasing the integration, designing and innovative experiment. As a starting point of training ability of students, we should give full play to students' subjective initiative. In order to make the students have the abilities of the knowledge, observation, some typical engineering technical problems analysis, we should inspire students' thinking and creative. Moreover, the students' scientific research test method should be preliminary trained, and which will lay a solid foundation of future work.

The high level of engineering training center and experimental center should be established, the practice content could be selected carefully. To strengthen the contact type of work, we should increase the practice proportion of new technology, new process, and new equipment as far as possible. The modern education technologies are introduced, and then the outdated method could be gradually replaced, for example master trains apprentice. To improve the training and guidance of engineering practical ability of students, we should provide the opportunity for students doing by themselves, so as to really face the engineering practice, and the engineering education should focus on training the necessary professional skills and creative thinking of students.

Strengthening cooperation between schools with enterprises, we should build and expand the education practice based on the target of training talent inside or outside school. We should take use of real industry environment in enterprises to develop practice teaching. The students will deepen understanding the enterprise production process through engineering fusion. They master the latest information industry, the production technology and the operation skills, thus improve their practical capability.

Strengthening cooperation between schools with scientific research institutions, and building scientific research innovation base of higher engineering education are required. Though selecting outstanding students, they participate in the development, designing and scientific research project research of new product. So that exerting potential of students, cultivating their use of scientific thinking analytical and problem-solving skills, and improving their scientific quality are required.

3.3 Strengthening Non-Intelligence Factor Education & Improving the Students' Comprehensive Qualities

The idea of large-scale engineering is the overall quality requirements of students. It is not only knowledge, technology, engineering quality of the subject, and also good personality quality of emotion, will, perseverance, self-confidence and so on. In the past, people thought that man's wisdom was good memory, observation, thinking ability, operating ability, language expression ability. While modern psychologies believe that human wisdom is a multiple complex with emotional factors, including the moral, aesthetic feeling, rational feeling and so on. The famous American psychologist Sternberg proposed *triple intelligence* theory. In addition to the structure intelligence, he also put forward the scene intelligence and experience intelligence. He emphasized adapting to the environment and transformation experience is performance of human wisdom (Zhang, 2000, p.82). The facts show that scene intelligence (also called emotional intelligence) can help people form stable deep sense of morality, sublime aesthetic feeling and firm will feeling by inspiring creativity, adjusting the behavior way of people and promoting interpersonal communication association. What is the key to success or promote agent for the contemporary university students in engineering practice activities? That is high sense of responsibility and ambition, positive and optimistic attitude and the courage to the spirit of inquiry. Therefore, strengthening the cultivation of non-intellectual factors in engineering education and raising good character of students are required.

3.4 Developing Science and Technology Innovation Activities & Promoting the University Students' Engineering Quality Training

College students' science and technology innovation activities are the education practice. It is also the important means of promoting teaching reform under the education background of large-scale engineering. Through learning, transformation, using and independent creation for the science and technology culture knowledge to guide and train college students' science and technology innovation consciousness, innovation spirit and innovation ability. The innovation, business projects of science and technology generally launched in university, and attracted many college students to participate. Various universities provide strong support for students' science and technology innovation activities in the policy. Such as improving the college students' guide agencies of science and technology activities, setting up the security system of the students' innovation activities, optimizing the implementation environment of innovation education. Facts show that students can automatically find problems and actively seek the solutions. Students have developed thinking ability, improved observation,

and imagination, operation ability through science and technology innovation activities. And then they have exercised independent thinking and cultivated the spirit of innovation, arousing their determination to pursue science and knowledge. At the same time, students constituted close cooperation team in the science and technology innovation activities. They not only experienced the comprehensive characteristic of course cross and fusion of modern engineering, they also comprehended the humanities connotation and moral significance in the engineering activities. They experienced the humanity quality and the moral quality should have in engineering activities. It plays a supplement extensions role to form the engineering quality for college students.

3.5 Building Teachers' Team of Double Teachers & Enhancing Teachers' Project Practice Ability

The professional teachers are the important factor to restrict the training of students' project practice ability. As a professional teacher of engineering university, you should have double quality and ability of teachers and engineer. You can not only teach theory knowledge, guide student practice, experiment, design and project study, also have the necessary engineering practice experience. Colleges and universities should take various measures to improve the *double division* transformation of professional teachers, increase the ratio of *double teachers* in higher engineering education. Young professional teachers can cultivate engineering consciousness and ability for the corresponding engineering technical post by means of regular exercise in the enterprise. Part-time teachers who have practical experience of engineering and technical also can be hired, improving the ability structure of teachers' team. Professional teachers should participate in the long-term relevant cooperation of research and development activities with enterprise, closely connect with the practical science and technology, and maintain their own academic level and continually improve the engineering practice ability, so as to improve the students' project practice ability.

CONCLUSION

In the new pattern of economic globalization, modern engineering talents should be trained in the view of large-scale engineering. It is the trend of society development, and also an inevitable trend of engineering education. Engineering education should face the engineering practice and all-round development of human being, emphasizing equal attention to the engineering and scientific research, strengthening the humanity quality and innovation ability, improving the training of students' engineering project comprehensive ability and practice ability, and make the students become the core force of the industrial revolution and the science and technology innovation.

REFERENCES

- Bao, Q. J. (2008). Enhancing students' modern engineering sense based on conceiving, designing, implementing and operating (CDIO) conception. *Journal of Fujian University of Technology*, (5). (in Chinese).
- Ma, T., & He, R. L. (2007). Higher engineering education: To meet the challenge of course cross fusion—The strategy and orientation of the reform of higher engineering education from industrial circles in our country. *China Higher Education Research*, (3). (in Chinese).
- Xie, X. Z. (2008). An exploration of the connotation and essential features of “large-scale engineering”. *Research in Higher Education of Engineering*, (3). (in Chinese).
- Zhao, R. (2009). The higher engineering education curriculum setting characteristics of the United States and some useful references. *Journal of Xi'an University of Post and Telecommunications*, (1). (in Chinese).
- Zhang, J. J. (2000). *Innovative quality*. Press of China Science and Technology University. (in Chinese).
- Zhang, L. B. (2009). Exploration and thinking to the reformation of higher engineering education in the view of large-scale engineering. *China Higher Education Research*, (8). (in Chinese).