

TSIEN EDUCATION/ELITE PROGRAM IN MECHANICS

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Summary In 2009, Tsinghua University launched a special education program “Tsinghua School Program”, with up to 160 “best of the best” students selected from 3,330 freshmen entered Tsinghua University per year. The mechanics program, Tsien Education/Elite Program (TEP) with up to 30 students per enrolled year, is the constituent program of “Tsinghua School Program” and is honored after the legendary Chinese scientist Hsue-shen Tsien (1911-2009), who is the father of China’s aerospace program and founder of Tsinghua mechanics department. The objective of TEP is to train elite scientists and lay down solid foundation for their future development not only in the mechanics field but also in engineering as a whole. The focus is to improve the innovation ability, knowledge capacity, and comprehensive quality of the students. The concept of TEP is introduced and the actions taken to fulfill the objective are discussed. Finally, some preliminary outputs of the actions are presented.

After having been the “world factory” for a decade, China became the world second largest economy country in 2010. In particular, its industrial product part contributed over 40% of its whole GDP and was very close to the largest – 85% of that of USA. For further development, China has to meet many challenges. One of the biggest challenges is how to change the economy from labour-intensive into a knowledge- and innovation-based one.

“Why have China’s universities failed in the last 60 years to cultivate academic and technical leaders that achieved in great creativity and innovation?” This so-called *Hsue-shen Tsien question* that was most concerned with by Tsien in his last few years of life had immediately become one of the hottest issues in this country after the death of Tsien on 31st October 2009. Hsue-shen Tsien not only is the father of China’s aerospace program, but also may be the most influential scientist in the past half century in China. The above challenge is, however, also a great opportunity for education. For example, over years China has continuously increased its investment to R&D (over 20% increasing ratio per year from 2004). The leadership of this country decided to start remarkably enhancing its education (over 18% investment increase in 2011). The special high education structure in China may provide some unique chance for education, in mechanics in particular.

The higher education system in China was strongly influenced by the former Soviet Union’s one. Tsinghua University is viewed as a typical example here. In 1952, the Chinese government regrouped the country’s higher education institutions in an attempt to build a Soviet style system, with individual institutions tending to specialize in a certain field of study. Tsinghua University was disassembled, losing its law school, school of agriculture, school of sciences and humanities, and became a polytechnic engineering university – long time being referred to as the “MIT of China”. This effort together with Chinese tradition and culture helped China to quickly establish an independent and comprehensive industrial system and had the drawbacks of depressing creativity and innovation. Although Tsinghua started to incorporate a multidisciplinary system since 1980’s, its majority is still in engineering and IT in the measures of both faculty and students. One example is that Tsinghua has a huge faculty (over 400) separated in 5 departments, of mechanical engineering, precision instruments and mechatronics, thermal engineering, automotive engineering, and engineering mechanics. In comparison, those fields are typically involved in just one mechanical engineering department in USA with a faculty of one order smaller size. The department of engineering mechanics at Tsinghua gives heavy lectures in mechanics (such as mechanics of strength) for thousands of students per year from all over the university. Similar reasons may explain why there exist more than seventy independent mechanics departments in China, despite there was a movement in the last two or three decades to cancel such departments in USA as well as some European countries. As a fact, these countries have smaller and smaller industrial product parts.

Tsinghua is almost always ranked as the first or second best university in mainland China in most national and international rankings. Admission to Tsinghua is extremely competitive, particularly for students who are interested in science and technology. In 2009, Tsinghua launched a special education program “Tsinghua School Education Program”, with up to 160 “best of the best” students selected from 3,330 freshmen entered Tsinghua per year. The Program includes six projects: mathematics, physics, chemistry, biology, IT, and mechanics. Each project is independently designed and operated by a team with its chief professor taking the full responsibility. The mechanics project, called Tsien’s Elite Project (TEP) with up to 30 students per enrolled year, is established in honor of Hsue-shen Tsien, who is also the major founder of Tsinghua’s mechanics department. Quanshui Zheng is the chief professor of the TEP.

The education in China lacks two extremely important factors, as commented by Richard C. Levin, the President of Yale University, and many other educationalists. One is the width in interdisciplinary; another is the in-depth critical thinking. Mechanics is about motion and deformation of matters. Through Newtonian mechanics, quantum mechanics, and Einstein’s general and special theories of relativity, mechanics is the foundation of the whole science and

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technology. On the other hand, applied mechanics played a major role as a bridge between basic sciences over a century, and helped many engineering branches to become quantitatively designable based on theories and methods mainly developed in mechanics, such as fracture mechanics and finite element method. The TEP has the focus on “engineering science”, with an emphasis in mechanics.

The TEP’s objective is to train elite scientists and lay down solid foundation for their future development not only in the mechanics field but also in engineering as a whole. The focus is on their innovation ability, knowledge capacity, and comprehensive quality. A number of measures have been taken to fulfill the objective: (1) The first three years will adopt liberal education, with main courses on humanity, social sciences, mathematics, physics, chemistry/biology, and mechanics. (2) The students choose their specialty at their fourth years. (3) The analytical, numerical and experimental skills of students will be strengthened by a variety of courses, which will include theory, experiments and projects. (4) The students can opt to stay four years for a bachelor degree, or longer for a master or doctorate degree. (5) A tutorial system is adopted for the Class and each student will have a tutor to help him/her on various issues during study. (6) Enhance internationalization and contact with top industries. (7) Employ the most appropriate teachers from not only Tsinghua University, but also the Zhongguancun area (including China Academy of Science and Peking University).

For the above goals, the TEP is supported primarily by the Department of Engineering Mechanics, with joint efforts from seven other departments from School of Aerospace, School of Mechanical Engineering and School of Civil Engineering, as well as the University’s multidisciplinary center, the Center for Nano and Micro Mechanics. Dozens of famous professors from international top universities, including Brown University, California Institute of Technology, Harvard University, MIT, Northwestern University, University of Cambridge, and UIUC, are involved as the TEP advisory board members, students’ supervisors, and short courses’ lecturers.

In this presentation, the concept of TEP is introduced and the actions taken to fulfill the objective are discussed. Finally, some preliminary outputs of the actions are presented.