World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:14, No:12, 2020

Encouraging Collaboration and Innovation: The New Engineering Oriented Educational Reform in Urban Planning, Tianjin University, China

Tianjie Zhang, Bingqian Cheng, Peng Zeng

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf

***Abstract*—**Engineering science and technology progress and innovation have become an important engine to promote social development. The reform exploration of "new engineering" in China has drawn extensive attention around the world, with its connotation as "to cultivate future diversified, innovative and outstanding engineering talents by taking 'fostering character and civic virtue' as the guide, responding to changes and shaping the future as the construction concept, and inheritance and innovation, crossover and fusion, coordination and sharing as the principal approach". In this context, Tianjin University, as a traditional Chinese university with advantages in engineering, further launched the CCII (Coherent-Collaborative-Interdisciplinary-Innovation) program, raising the cultivation idea of integrating new liberal arts education, multidisciplinary engineering education and personalized professional education. As urban planning practice in China has undergone the evolution of "physical planning -- comprehensive strategic planning -- resource management-oriented planning", planning education has also experienced the transmutation process of "building foundation -- urban scientific foundation -- multi-disciplinary integration". As a characteristic and advantageous discipline of Tianjin University, the major of Urban and Rural Planning, in accordance with the "CCII Program of Tianjin University", aims to build China's top and world-class major, and implements the following educational reform measures: 1. Adding corresponding English courses, such as advanced course on GIS Analysis, courses on comparative studies in international planning involving ecological resources and the sociology of the humanities, etc. 2. Holding "Academician Forum", inviting international academicians to give lectures or seminars to track international frontier scientific research issues. 3. Organizing "International Joint Workshop" to provide students with international exchange and design practice platform. 4. Setting up a business practice base, so that students can find problems from practice and solve them in an innovative way. Through these measures, the Urban and Rural Planning major of Tianjin University has formed a talent training system with multi-disciplinary cross integration and orienting to the future science and technology.

***Keywords*—**China, higher education reform, innovation, new engineering education, rural and urban planning, Tianjin University.

Tianjie Zhang, professor, School of Architecture, Tianjin University, China; Deputy Director, Institute of Urban Heritage Preservation and Regeneration, Tianjin University, China; PhD, School of Design and Environment, National University of Singapore, Singapore (e-mail: arch_tj@126.com).

Bingqian Cheng, PhD, School of Architecture, Tianjin University, China (corresponding author, e-mail: 18302285156@163.com).

Peng Zeng, vice-president of School of Architecture, Tianjin University, China; associate professor, School of Architecture, Tianjin University, China (e-mail: urbanplan@tju.edu.cn).

Fund Items: The National Nature Science Foundation of China (No. 51778403, 51778406); Major Research Project of Philosophy and Social Science of the China Ministry of Education "Research on China's Marine Heritage" (No. 19JZD056)

I. Introduction

BIG data, Internet and artificial intelligence have brought a profound impact on people's work and life, and there is a huge reform for the world. In the future, the world building will need engineering talents with knowledge in different fields and responsibility of the times. The higher engineering education is facing a new round of reform. Under the situation, The Chinese Ministry of Education has positively carried out a new engineering construction in the past few years, and one important work is to present a series of solutions to speed up the construction of high-level professional education system to cultivate compound talents with good ability engineering technology innovation to adapt to the future need, so as to lead the development of all industries in the future [1].

As a high-level university with the engineering background in China, Tianjin University's multiple advantageous disciplines involved with the "new engineering" reform wave, especially the discipline of urban planning. Depending on the background of the urban and rural development in China, Architecture School of Tianjin University undertakes a series of revolution measures with the target of building a discipline that is top in China and first-class in the world and cultivating leading talents in urban and rural planning industry with the ability of internationalization and innovation according to "new engineering construction plan of Tianjin University - CCII".

II. "New Engineering" Education: Collaboration and Innovation

In the past few years, main developed countries and emerging economies in the world have started to develop cutting-edged manufacturing industry. After the international economic crisis in 2008, many politicians and experts in developed countries have come to realize that the foundation of economy should be still the real economy, and the manufacturing industry as the pillar of real economy should be the root of the country. Manufacturing industry is a crucial role for national economic strength and national security. To deal with the challenge of financial crisis, the real economy should be revitalized. The main developed countries have released the strategic report on engineering education reform to push the innovation of engineering education reform, such as National Strategic Plan for Advanced Manufacturing in the United States released by America in 2012 and the National Network of Manufacturing Innovation in 2013, "Industry 4.0 Strategy" presented by Germany in 2013, "The New Industrial France"

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf

Strategy presented by France in 2013, "British Manufacturing 2015" Strategy presented by Britain in 2014, etc. In the emerging economics, Korea and India have announced strategies to develop new engineering.

Chinese government also keeps pace with the world's advanced manufacturing trend to release development strategies. In 2015, the State Council of China has released Made in China 2025. It is pointed out that we must stick to innovation-driven, intelligent transformation, strengthening foundation, green development to accelerate the transform from a big manufacturing country to a powerful manufacturing one. In the next few decades, a new round of technology reform and industrial reform would form a historic intersection with China transforming economy, and there would be a profound change of engineering in the society. The progress and innovation of engineering technology would be a key chance to push the social development of our country. For the denser technology and increasingly faster technology development, cutting-edged manufacturing enterprises could win from global competition with the highly skill workers performing in high-level implementation system. Such global industrial reform would force the universities to have reflection on engineering education, so there comes the construction of "new engineering" education.

"New engineering" education is another perspective to explore the higher engineering education reform, and it is also the "Chinese scheme" of Chinese higher education to face the advancing manufacturing industry in the world. In 2016, the principal of Tianjin University, Zhong Denghua, has suggested the concept of "new engineering" firstly, and then the Chinese Ministry of Education organizes some universities with high level in the country to explore the specific implementation approaches.

A. Connotation of "New Engineering"

The connotation of new engineering is: with the guidance of cultivating students with morality, the construction idea of coping change and shaping future, the main approaches of inheritance and innovation, intersection and integration, coordination and sharing, the diversified and innovative excellent engineering talents should be cultivated [2]. The specific contents are:

1. Cultivate Comprehensive and Innovative Talents with high Level

Currently, China is in the period that the Industry 2.0 and Industry 3.0 are parallel with the emergence of Industry 4.0, so there is diversified demand to engineering talents. It needs to build up a multiple talent training structure connected with the whole industry chain, from R&D, design, production, sales to management and service. In addition, according to the talent need of all industrial chains, the scale from vocational degree, bachelor, master and doctor should be optimized. For the qualification of engineers, they should master compound skills including social skills, systemic skills, skills to fix complicated problems, resource management skills and technique skills.

2. Build up Future Actively

Innovation is the first motivation to lead development. The basic challenge of innovation is to explore the changing unknown. Engineering education is to link with science, skills and industry development directly. Engineering talents and engineering technology are the key roles to change the world, so the engineering education in the future should not be only limited by the old opinion of "adjusting to society" but shoulder the mission to shape the future and bring welfare for human beings. Therefore, universities should positively explore new idea, new structure and new mode to cultivate the excellent engineering talents adjusting to time and future change [3].

B. Actions of Tianjin University

With the initiatives of "new engineering" education, Tianjin University actively explores the innovation and entrepreneurship education. It is mentioned that there should be cultivation of global vision, innovation and entrepreneurship, critical thinking, independent lifelong learning, easy communication and negotiation, good leadership and other qualities in the process of engineer cultivation. Here are the specific measurements: 1. Facing the technology and industrial development in the future, the barrier between schools and disciplines should be knocked down to build up an interdisciplinary, multidisciplinary and open education platform for new engineering education, so as to explore the new mode of new engineering school in the future. The wall between universities and society is destroyed to implement a profound integration of industry and university, interdisciplinary integration, integration of domestic and international training and positive integration of teaching-researching-studying. The isolation between teaching and scientific research should be eliminated to have a close interdisciplinary cooperation among key laboratories, engineering centers, maker spaces and innovation and entrepreneurship incubators at all levels of the university. There should be comprehensive and continuous innovation on the new engineering talents training concept, mode, curriculum system, teaching and learning methods, teaching and learning content, quality standards. 2. Intersection and integration are the breakpoints of major engineering technology innovation. To boost the exchange of different disciplines and build up joint employment system of cross-schools, it is encouraged to build up interdisciplinary and multidisciplinary teaching team in the new engineering platform of university level to carry out the development of training programs, curriculum design, especially project-based curriculum design for interdisciplinary majors, so that there is an overall improvement in the curriculum level and cultivation level by co-building and sharing curriculum. The curriculum requirement is the basis for the teacher employment. The enterprise staff is employed to participate in the curriculum building with the standard of professional construction level. 3. Exploring a tutor group training mode, and the tutor group is formed by academic tutor, enterprise tutor, entrepreneurial mentor and instructor to achieve the reasonable faculty distribution, serving students with academic guidance, study supervision, entrepreneurial

instruction and psychological counseling to help them to solve problems timely. 4. Scientific research laboratories and engineering centers at all levels are open to support students with project implementation, innovation and entrepreneurship and discipline competition, which would cultivate their study interest and interest of scientific research, such as setting up "Xuanhuai School" and "Dahuo" makerspace these innovation and entrepreneurship practice platforms [4] (Fig. 1).



Fig. 1 New Engineering talent cultivation idea of Tianjin University [5]

III. New Form of Chinese Urban and Rural Planning Education

Advanced technology reform forms a historic intersection with Chinese economic transformation. "New engineering" education reform imposes huge impact on the talent cultivation of urban and rural planning in China. "New engineering" construction is to introduce the latest development of industry and technology and the latest requirement of industry to talent cultivation to update the teaching content and curriculum system. By present, China is going through the restructure of reform of national spatial governance system and spatial planning system, and the planning practice is going through a development process from material space planning – urban and rural comprehensive strategic planning - land and resources management planning. The education of urban and rural planning is expanded from design and engineering filed to the field of society, economy and ecology. The talent training mode is improved from the cultivation of engineering design to that of such multiple types of management and policies (see Table II).

IV. Main Education Reform Measures of URBAN and Rural Planning Discipline in Tianjin University

To adjust to the requirements of Chinese domestic spatial governance for urban and rural planning in the new era, Architecture School of Tianjin University carries a series of reform measures for the courses of urban and rural planning discipline according to the connotation of "new engineering" education, including:

A. Add Courses Lecturing in English and Build up Internationalized Teaching Team

Teaching in English is an important part of education internationalization in universities. By far, Architecture School is actively introducing scholars from famous universities in foreign countries to have lecture in our school [7]. For the research universities in our country, the main mission of internationalization is to cultivate the high-quality talents with international vision and international competitiveness [8]. As a high-level research university in China, Tianjin University's urban and rural planning discipline is one of the advantageous disciplines. With the initiatives of "cultivating talents with global vision" suggested by the "new engineering" education, Architecture School tries its best to have construction of curriculum in English to enhance the discipline advantage. It is adopted with "cooperative teaching by scholars at home and abroad" to have a key buildup of characteristic professional courses with high level; and the construction of professional curriculum in English is reformed and improved ceaselessly. There are 24 professional curriculums in English completed or opened, including two of them for research method. All of them are lectured by foreign professors introduced from other countries. The curriculums are studied from how to choose study theme, formulate study plan, write and review research papers and used research tools (Fig. 2). There are 6 of them for theme theory. Three of them are lectured by foreign professors. The theme contents are in the field of ecological resources and environment, low energy consumption and sustainability, geographic information and planning support, international planning comparison and other professional fields. In addition, three more theory curriculums in English are added in 2019, including Sustainable development of Asian-Pacific Cities, Urban Sociology, Theory and Practice of Sustainable Community Building (see Table I).

TABLE I
List of Partial Curriculums in English

Curriculum Name	University of the Teachers
Urban Planning and Design1	Tutor team
Research Methodology	University College London
Research Methodology and Academic Writing	The University of Texas at Arlington
Ecological Environment and Urban Development	Cardiff University
International Comparative Planning	Cardiff University
Introduction of GIS and PSS	Manchester Metropolitan University
Built Environment in a resource conservation perspective	Tianjin University
Bionic process applied for the urban planning and architecture design for sustainable settlements	Tianjin University
Energy Efficient Building Design in Practice	Tianjin University
Urban Planning and Design1	Tutor team

B. Set up Online Lecturers and Trace after Cutting-Edged Knowledge of Discipline

"New engineering" education advocates the training of innovative thinking and the importance to timely know the discipline frontier trends. Urban and rural planning discipline in Architecture School of Tianjin University invites the teachers from international universities to have on-site lectures, and there are also a series of online talks. Famous scholars in international professional fields are invited to share the international study frontier, which is efficient and economic exchange.

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf

TABLE II
REFORM IN URBAN AND RURAL PLANNING AND COUNTERMEASURE OF PLANNING DISCIPLINE EDUCATION [6]

Main Background	Target and Requirement	Core Content	Countermeasure of Discipline Development	Key Point of Teaching Reform
National Institutions Reform (Natural Resources Ministry)	Resort the land and space resources and have a systemic restoration and comprehensive treatment; have supervision on the development and use of land and space resources; build up space planning system with implementation supervision.	"Multiple compliance"; build up land space strategy planning system; enhance mechanism construction; medium management; change from volume adding planning to inventory planning; protection is more important than development; proportion of macro strategic planning is increased.	Planning education evolves from spatial planning of material level to comprehensive strategic planning, and then to comprehensive management planning; pay more attention to urban and rural development of urban and rural areas, the resources talents and ecological environment in regional development; focus on training thinking ability, rational analysis skills, communication and coordination ability.	Besides the traditional urban and rural planning engineering skills, the key points of professional knowledge expansion is land resource, ecological environment and policies management; appropriately increase the proportion of knowledge related to sociology, economics, ecology, geography and law; strengthen the cultivation of students' language expression ability, comprehensive coordination ability and the ability to read and understand policies and regulations in undergraduate education
Big Data Era	Positively build up big data analysis and decision-making system; integration and utilization of massive data information to realize the measurement of decision making.	The calculation analysis and evolution ability of massive data information; the support of effective data acquisition, exchange and processing; data decision-making platform buildup.	Planning tends to be more scientific and rational; analysis of information technology in space, data processing, map expression, virtual geospatial reconstruction, urban planning simulation, etc.	Cultivation of big data processing ability; p professional knowledge of GIS; computer simulation technology; the construction of mathematical model; the use of network resources. Planning skills are derived from remote sensing, GIS and big data analysis with the enhancement of methodology education.
Era of Mass Entrepreneurship and Innovation	The introduction to mass entrepreneurship and innovation concept; core target is to activate social energy and release the creativity.	Wide coverage, innovation of content design management, innovation of scientific research, innovation of technique, mode innovation and service innovation.	Transform traditional cognition to innovation education; pay more attention to the recreation during the knowledge delivery.	Training of innovative thinking mode; strengthen the application of theoretical knowledge in the re-practice; build up innovation platform for diversified cooperation; build up competition incentives system; positively build up cultivation of bachelor tutoring mechanism.
Engineering Authentication	1.Open cultivation objectives to meet the campus positioning and adjust to the social and economic development need. 2.Cultivation objectives could reflect the achievement that students could reach in the professional field after the graduation. 3.Regular assessment on the reasonability of cultivation target and have revision on the cultivation objectives according to the assessment result; the assessment and revision process should have the participation of industries or enterprise experts.	Education modes is transferred from "content-oriented" to "achievement-oriented"; have a dynamic adjustment of the talent cultivation objectives; introduce the social assessment mechanism; the student requirements should be clearer; curriculum system enhance engineering practice; faculty team emphasize engineering practice background.	Formulate practical training objectives; have timely adjustment according to the feedback in society; introduce the more extensive assessment mechanism of planning industry; the industrial experts is included with planning, architecture, tourism, environment and real estate planning, etc. The participation of multiple departments to prevent from driving surface with spot.	Adjust cultivation scheme and teaching outline content according to the actual demand in the society; enhance the comprehensive talent cultivation; loose entry and strict graduation. Set up examination mechanism according to the opinion of industrial experts; build up scientific and reasonable assessment system.



Fig. 2 Course Scenery of Research Methodology and Academic Writing

C. Organize International Joint Workshop and Design Exhibition to Improve the Comprehensive Ability of Students

The students and teachers of urban and rural planning discipline of Tianjin University have exchange and cooperation with internationally renowned institutions or firms in the teaching form of international joint planning workshop. Meanwhile, the students and teachers of the planning discipline positively respond to the current major national development

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf

needs. They choose the design theme and teaching content of ecological planning, rural planning, urban updating, planning management and community planning to have an effective combination between the teaching content with the national development strategy. For example, "International Joint Planning Workshop of China, Britain and America" set from 2018 is cooperated by Architecture School of Tianjin University, Architecture School of University of Texas at Austin, Urban and Regional Planning School of Cardiff University, Public Management School of China Renmin University, Urban Design School of Wuhan University has been held for two years. The "Tianjin Anshan West Road Historical District Renewal" in 2018 and the "Urban Renewal in Xizhimen District of Beijing" in 2019 could enable the students from different countries and various disciplines to complete the planning design, which boosts the exchange and integration of disciplines to improve the planning practice level and communication and coordination ability of students (Figs. 3-6). In addition, the teachers and students of planning discipline positively hold and attend international design exhibition to cultivate professional practice ability and innovation ability. When learning the excellent design thinking and trend in the world, their excellent design thinking would be shown in the international exhibition to enhance the social competitiveness and international influence of planning discipline.



Fig. 3 The students participating in the workshop visit the Tianjin Urban Planning Exhibition Hall, International Joint Planning Workshop of China, Britain and America in 2018

The postgraduates in urban planning discipline are encouraged to take part in the academic conference at home and abroad and they would have financial aid. Students could go to America, Italy, Singapore, Korea, Britain, Japan, Canada and so on to attend high-level international conferences, so as to show the academic level of Tianjin University through theme speech, special speech, paper presentation and other forms. Concurrently, the school actively undertakes international conference in the field of urban planning and attaches important to interdisciplinary communication. For example, in the seminar of "Urban Renewal and Protection and Utilization of Waterfront Space" in 2019, the experts and scholars from first class international universities, such as the Royal University of Queensland, Tsinghua University and so on are invited to Tianjin University to have a discussion on the latest theory and practice of urban planning discipline, which would broaden the horizon of teachers and students to know the new direction of internationalized research (Fig. 7).



Fig. 4 Students have a field research on the living situation of resident in historical block, International Joint Planning Workshop of China, Britain and America in 2018



Fig. 5 Students in the workshop reports the design achievement, International Joint Planning Workshop of China, Britain and America in 2019



Fig. 6 In the design curriculum teaching, Joint Workshop of 7 Universities in China, America, Japan and Korea in 2019



Fig. 7 Abundant international exchange activities of teachers and students in planning discipline

D.Set up Enterprise Practice Base to Push the Transformation of Industry, University and Research Institute

Out-of-campus practice basis is an important carrier and platform of practice teaching part and it is also important button and window of theory to connect with reality. Under the background of new engineering construction, urban and rural planning discipline builds up practice base through the cooperation between enterprises and university, which is not only good for application of theories taught by curriculum to practical project timely and cultivate application senior talents but also beneficial for students to find out problems and suggest innovative solutions from the practice. Architecture School of Tianjin University depends on a complete range of disciplines and national, provincial and ministerial scientific research institutions to carry project cooperation with planning design institutions and design companies, such as Collaborative Innovation Center (Cultivation) of Chinese Traditional Villages in the Protection of Architectural Heritage, The Key Scientific Research Base of the State Administration of Cultural Heritage for Surveying and Mapping of Cultural Buildings (Tianjin University), The Key Laboratory of Information Technology and Culture Ministry of Architectural Cultural Heritage Inheritance, and the Ecological Technology Engineering Center of Tianjin Old City Reconstruction. In addition, the school forms practice institutions with the members of design workplace through professional faculty power. For example, some teachers in the schools establish a "scientific research creation organization". The members are the teachers of universities, principal of planning and design institution, principal of national or local urban and rural planning academy, and so on. These institutions setting could greatly push the combination of theory and practice.

V.Conclusion

A new round of technology reform and industrial reform would form a historic intersection with China economic transform, and there is huge impact of "new engineering" education to cope with technical and industrial reform on the engineering education reform in all aspects in China, especially the urban and rural planning discipline. Urban and rural planning discipline is to cultivate the talents engaging for urban and rural planning design, management and consultancy for the social and economic development and urban and rural construction service for the new need of such national strategic development as new urbanization and rural revitalization. To meet the requirement of the reform, the university adds some curriculums lectured in English, builds up internationalized teaching, sets up online speeches, organizes international joint workshop and design exhibition, establishes enterprise practice bases and push the transform of enterprises and university. All of these reform solutions should be reference for universities at home and abroad.

References

[1] Guodong Lu. (2017) Reflections of the Paths of Construction and Developing Emerging Engineering Education. Research in Higher Education of Engineering, 05, 38-41.
[2] Denghua Zhong. (2017) The Connotation and Action of New Engineering Education. Research in Higher Education of Engineering, 03, 1-6.
[3] Aihua Wu, Yongfeng Hou, ect. (2017) Accelerating development and construction of emerging engineering, taking initiative to adapt to and lead the new economy. Research in Higher Education of Engineering, 01, 1-9.
[4] "Tianjin University Scheme 2.0" for New Engineering Education was Released. http://www.tju.edu.cn/info/1026/3151.htm. December-14-2020.
[5] Tianjin University held a symposium on new Engineering construction. http://news.tju.edu.cn/info/1003/47671.htm?from=timeline&isappinstalled=0. October-19-2019.
[6] Mingyan Bi, Lei Sun, etc. (2019) Research on CDIO Mode of Urban and Rural Planning Personnel Training Under the Background of New Engineering Education. Empirical Research on the Modernization of Higher Education II, 9.
[7] Hui Sun. (2020) A Study on the Methods of Implementing Lecturing in English in Universities. Education Teaching Forum, 11, 229-230.
[8] Zhiyong Liu. (2020) English Curriculum Construction in the Context of Internationalization of Higher Education. Education Teaching Forum, 09, 212-214.

Tianjie Zhang, Professor, School of Architecture, Tianjin University, China. Deputy Director, Institute of Urban Heritage Preservation and Regeneration, Tianjin University, China. Visiting Scholar (2014-2015), School of Architecture, University of Virginia, USA. PhD, School of Design and Environment, National University of Singapore, Singapore. Her research focuses on cultural landscape, heritage preservation, place regeneration.

Bingqian Cheng, a Ph.D. candidate in School of Architecture, Tianjin University, China. Her research focuses on heritage preservation and cultural identity.

Peng Zeng, Professor, School of Architecture, Tianjin University, China. Vice Dean, School of Architecture, Tianjin University, China. Director, Department of Urban and Rural Planning, Tianjin University, China. PhD, Architecture, Tianjin University, China. His research focuses on smart urban and rural planning in the context of big data

Open Science Index, Educational and Pedagogical Sciences Vol:14, No:12, 2020 publications.waset.org/10011712/pdf