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Future-Oriented New Engineering Construction

-- A Case Study of Jiamusi University

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Abstract

New engineering construction is an important strategic decision and deployment for higher education of engineering to adapt to the development of new economy and industry. In view of the historical background brought about by new engineering, this paper systematically analyzes its connotation and characteristics, construction objectives, principles, ideas and key directions. Taking Jiamusi University as an example, this paper points out the practical difficulties of innovation and entrepreneurship education for new engineering talents in local universities, puts forward the main measures, constructs the training mode, and expounds the implementation results.

Keywords

New engineering; Talents training mode; Innovation and entrepreneurship education; Educational effectiveness.

1. Introduction

Under the challenge of new economy, the new engineering construction is a major action plan to continuously deepen the reform of engineering education on the basis of "Excellent Engineer Education and Training Plan" in order to serve the national strategy, meet the needs of industry and orient to the future. Due to the new and rich connotations and multidisciplinary integration, its construction is a complex and systematic project with Chinese characteristics, which reflects the changes of the times. And it involves many participants and a wide range of areas and has far-reaching influence, thus playing a role of pilot in the reform and development of China's higher education. The key to its smooth development relies on accurate grasp of the core concept, connotation and requirements of the new engineering, deep understanding of the essential problems and scientific top-level design and reasonable planning.[2]

In 2017, when the Ministry of Education held a seminar on the development strategy of higher education of engineering in Fudan University, the colleges and universities present had a heated discussion on the training of engineering talents in the new era, jointly explored its connotation and the choice of its construction and development path, and reached the "burden consensus" of the new engineering. Subsequently, the "Tianda Action", "Beijing Guide" and Notice from Department of Higher Education of the Ministry of Education on Research and Practice of New Engineering were issued successively, initiating new engineering research and practice projects. Therefore, a discussion on new engineering has been launched in colleges and universities all over the country, and new engineering has become a hot topic in the field of engineering education. In fact, the research and practice of new engineering centered on its education reform in the new ideas, new structures and new mode, new quality, new system, is to solve the talent gap in new engineering and the contradicition between "labor shortage" and "difficult employment", which means that the engineering graduates can't meet the needs of

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economic development. Therefore, colleges and universities should cultivate diversified, innovative and open-minded talents by means of inheritance and innovation, integration, coordination and sharing[3,4,5].

2. Outline of New Engineering Construction

The background of the new engineering. The development of new economy is the core background for the construction of new engineering. We should carry out major national strategies geared to the needs of national construction, transform and upgrade industries based on industrial development, build new international competition advantages oriented to the future competition. Looking forward, we should lay out, establish and develop new disciplines needed by the future industry for higher education, and timely train outstanding engineering talents who can lead the future and industrial development.

The connotation and characteristic of new engineering. In new engineering, engineering refers to engineering disciplines and its related majors, which includes threefold meanings, namely "new type" "new discipline" and "emerging subject". The new engineering is characterized by its guidence, integration, innovation, interdiscipline and development. Guidance refers to its frontier characteristic. Integration is the subject characteristic. Innovation is the attribute characteristic. Interdiscipline is the industrial characteristic and development is the dynamic characteristic of new engineering. The "newness" in the new engineering is a broad concept, which can be considered from two aspects: "stock renewal" and "incremental supplement". The new engineering aims to solve complex engineering related to economic and social problems and future development, and the responsibilities it takes is to make it not a "pure" engineering discipline.

The goal of new engineering construction. We should lay out and build strategies for the contruction of our country, set up future-oriented engineering disciplines and majors to meet industrial needs and cultivate a group of interdisciplinary and outstanding engineering and scientific talents with innovative and entrepreneurial ability, dynamic adaptability, cross-border integration ability and high quality. In addition, we should take root in China and cultivate talents with "both political integrity and ability" in the construction of new engineering.

Principles for new engineering construction. Based on service orientation and future needs, it needs to give full play to overall advantages and highlight training characteristics.

The Construction ideas of new engineering. National future industrial need and principles will be analyzed and predicted. And we should identify new engineering to be built on the basis of an all-round analysis of resources in the whole school. Moreover, we need to plan, set up and organize new engineering. It is also necessary to research new engineering and its disciplines, build platforms for talents enrollment and cultivation, construct a quality assurance system for training new engineering professionals and establish professional dynamic adjustment mechanism.

The emphasis of new engineering construction. It should integreat research and practice in the construction of new engineering. We should focus on its “model innovation”, build a platform and training mode, conduct innovation and entrepreneurship education, integrate vocational education and research with industry and establish quality assessment system for it.

To sum up, the construction of new engineering is a complex and comprehensive systematic project involving multiple industries, departments, disciplines and schools, which cannot be accomplished overnight and needs the concerted efforts of the government, industry and universities as well as the full cooperation of the whole university.

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3. Practical Dilemma of Innovation and Entrepreneurship Education for New Engineering Talents

First, we do not cultivate talents from a very high ideological position and lack craftsman spirit. In addition, we are too narrow-minded in our knowledge, ability and vision and have weak awareness to serve and subordinate the overall national strategy, regional economic and industrial layout. Second, our educational resources of engineering are dispersed. So, it is urgent to expand its breadth and depth in collaborative innovation and entrepreneurship education. The curriculum system of innovation and entrepreneurship education is not deeply integrated with professional education, which makes it difficult to cultivate new engineering talents to meet the current social needs. Third, due to the lack of deep integration between curriculum system and professional education, it is difficult to adapt to the new changes of employers' demand for new engineering talents. Fourth, the training base for innovation practice is scattered and relatively independent, and the cultivation of students' practical ability is superficial and fragmented, which makes it difficult to form a complete chain of production-education collaborative innovation mechanism.[1]

4. The Main Measures of Innovation and Entrepreneurship Education for New Engineering Talents

In recent years, our university focuses on the needs of industries in such as health, manufacturing, education and culture and centers on national and local key strategies and industries to reinvigorate Heilongjiang in an all-round manner and upgrade Jiamusi. Therefore, we have issued Opinions of Jiamusi University on Promoting the Implementation of Industry-University-Research Cooperation to fulfill the fundamental task of cultivating people through virtue led by ideological and political curriculum. Furthermore, we promote the collaboration between industry and education and between medical services and education, build new engineering, new medicine, new agriculture, new liberal arts, implement Excellent initiative and reform in innovation and entrepreneurship education. In addition, we take root in Heilongjiang, adhere to its culture and fulfill the mission of guarding the border areas with culture. Our university highlights the "industry-university-research-use" collaborative education as an important basis for the reform of talent training mode, gives full play to "local" and "comprehensive" advantages of our school and builds output-oriented and integration-based new model with "schools as the core, enterprises as the leading body and government as the guidance in market operation". At the meantime, we set up a total of 117 regional and industrial off-campus innovation practice bases and a new platform for the integration of industries, universities, research institutes and users.

As the only local comprehensive university with medical and engineering disciplines in Heilongjiang Province, the university has established a medical department to promote the integration of "industry-university-research-application" and "collaboration between medical education and teaching". Heilongjiang provincial key laboratory of oral biomedical materials and clinical application, engineering center of stomatology, application-oriented undergraduate demonstration professional cluster with stomatology and materials science characteristic are established. And a regional medical center is under construction. In order to actively serve the new industrialization, the university has signed "industry-university-research-application" strategic cooperation agreements with Peking University Health Science Center, China national medical device Co., LTD., Jiamusi municipal government and Jiamusi medical and health enterprises. It has formed a "complete system" integrating the production, research and application of new dental implants, thus improving the technology of oral products, driving the high-end development of oral materials and products in Heilongjiang

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province and filling the gap in the domestic oral product market. So, it has shown the obvious advantages and characteristics of "industry-university-research-use" collaborative education. At present, aiming at the connotation and requirements of the new engineering, our university has strengthened the construction of the new engineering from four aspects, namely, optimization of the professional structure, reform of the talent training mode, comprehensive collaborative education and the evaluation of teaching quality.

4.1. "New" Concept of Education

We will strengthen education in innovative projects and foster the spirit of craftsmanship. We should inherit the spirit of northeast version of Yan 'an and carry forward the characteristics of "three roots education" (frontier rooted, deep rooted and practice rooted) by taking the opportunity of political and ideological course. We should explore to integrate students' ability in innovation and entrepreneurship into the education of engineering talents in an all-round and deep manner.

What's more, the innovation and entrepreneurship thinking will be integrated into the whole process of engineering talent training system and studnets' innovation and entrepreneurship dreams will be inspired. Meanwhile, we should simulate a variety of scenarios and combine with a large number of cases to cultivate students' cognitive ability in environment. In addition, we will carry out innovation and entrepreneurship practice, establish a number of research and development laboratories with internet thinking, small dream factories, innovation studios, etc. And we should break traditional teaching methods, use campus we-media, official accounts and other forms to increase publicity, so that students can access entrepreneurial information in various forms and help them shape scientific and rational innovative and entrepreneurial thinking[6].

4.2. "Pragmatic" Path and Method

The reform of engineering education and teaching should be reformed and teaching resources of engineering innovation practice should be integrated. With inheritance and innovation, interdiscipline and integration, coordination and sharing as the main approaches, an integrated and professional new paradigm of innovation and entrepreneurship education for new engineering talents is constructed, which include classroom teaching and extracurricular activities, scientific and technological innovation, experimental and practical training, extra-curricular activities, project cultivation, competition guidance and practice incubation.

Guided by the improvement of students' innovative spirit and consciousness and innovative and entrepreneurial ability, it forms an innovative and entrepreneurial education system for new engineering talents in an all-round manner which involves all staff in the whole process. And it actively meets the needs of industries, gathers elements and resources both inside and outside the university, and innovates talent training paths and methods[7].

4.3. "Excellent" Training Mode

We should break down barriers and boundaries that restrict the training of innovative and entrepreneurial talents, explore to integrate medicine and engineering and upgrade traditional engineering majors. More importantly, we should highlight new engineering specialty cluster as the vehicle and establish new structure which combines medical and engineering talents training. At the same time, biomedical engineering, rehabilitation and therapeutics, robotics and other majors will be deeply integrated, and the traditional engineering major will be upgraded into a new engineering major.

The future-oriented new engineering construction requires us to absorb new achievements in big data, cloud computing, artificial intelligence, virtual reality and other scientific and technological developments and set up frontier, comprehensive, entrepreneurship-led, problem-oriented and interdisciplinary seminars and other courses. A problem - and subject-

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oriented education model should be established, and research-based learning and challenging learning should be implemented so as to meet the requirements of new and emerging industries on innovative and entrepreneurial ability and quality of new engineering talents [8].

5. Innovation and Entrepreneurship Education Model for New Engineering Talents

In order to deeply integrate innovation and entrepreneurship education with new engineering construction, we need to expand and connect them in a horizontal and vertical manner and integrate them into the whole process of talent training in local colleges and universities. The school has established a trinity of personnel training community which includes government, school and enterprise. It has formed a new mode of cultivating engineering talents' innovation and entrepreneurship ability, which is characterized by "a trinity of government, university and enterprise and integration of creative stimulation, innovative training, creative practice and enterprise incubation".

5.1. An all-round Deep Integration with Top-level Design, Perfect Mechanism and Outstanding Characteristics

We should strengthen top-level design and include innovation and entrepreneurship education in the 13th and 14th Five-Year Plan and comprehensive reform plan of the school. The innovation and entrepreneurship training plan and innovation and entrepreneurship education for college students will be included in professional training programs, and policy support will be given in terms of curriculum setting, student course selection, examination, achievement recognition, credit recognition and student status management. First, we should build a mechanism to ensure its work; Second, we should improve teachers' quality and promote innovation and entrepreneurship education; Third, we should pay attention to the connotation and optimize its system; Fourth, results should be emphasized and platforms for innovation and entrepreneurship education should be built.

We should improve the mode of training new engineering talents for innovation and entrepreneurship. First, we need to improve the system and mechanism, stimulate students' creativity, explore all kinds of its education resources with scientific top-level design, and improve its effect with a complete system. Second, we need to promote diversified collaboration, guarantee students' innovation, advance excellent talent supply through in-depth integration of industry and learning, and enhance students' innovation and practice ability through in-depth cooperation between schools and localities, schools and enterprises and among schools. Third, we need to create an incubation environment for students to start businesses, and build platforms for innovation and entrepreneurship such as business incubation bases and maker Spaces. In addition, we should promote the deep integration of information technology and engineering education, innovate engineering education methods, and improve the quality of talent training.

The curriculum system of cultivating new engineering talents with innovative and entrepreneurial ability should be reconstruct. It should construct a comprehensive curriculum system of innovation and entrepreneurship education for new engineering talents, including ideological and political education, classroom teaching, extra-curricular practice, second class, social practice, art and sports practice, innovation and invention, entrepreneurship simulation, entrepreneurship guidance and consulting services. We should promote the integration of government, schools and enterprises, closely meet the needs of industrial chains and innovation chains to serve regional development, actively expand platforms and models for cooperation between government, schools and enterprises, and promote their integrated development. We can work with local governments and industrial enterprises to jointly set

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talent training goals, curriculum system and practical teaching mode, jointly build the teaching staff, integrate industrial concepts, technologies and resources into teaching, and focus on improving students' ability to connect with the industry, thus playing a role of pilot in serving and influencing regional economic development[9,10].

5.2. Forming A Idea-Based Joint Force for Engineering Education By Breaking Barriers and Integration

Guided by the construction of ideological and political curriculum, we should inherit engineering culture, shape craftsman spirit, and integrate students' innovative spirit, innovative consciousness and innovative and entrepreneurial ability into the education of engineering talents in an all-round way. And we should take the initiative to serve series of national major strategies as the starting point, connect with the industry as the objective, and lead the future development of the industry as a new starting point. At the same time, it is of great importance to break down barriers and boundaries that restrict the training of innovative and entrepreneurial talents, and explore the integration of medicine and industry and the transformation and upgrading of traditional engineering majors. We should set up disciplines on the basis of needs of industries, break the barriers of disciplines (specialties), promote the reform of engineering education and teaching, and establish engineering training centers so as to improve the functions of college students' science and technology innovation centers and innovation and entrepreneurship colleges. With inheritance and innovation, interdiscipline and integration, coordination and sharing as the main approaches, an integrated and professional practice base of innovation and entrepreneurship is constructed, which include classroom teaching and extracurricular activities, scientific and technological innovation, experimental and practical training, extra-curricular activities, project cultivation, competition guidance and practice incubation. In the meantime, we should expand teachers team and promot new way to train "double qualified" teachers. Teaching teams and practice platforms involving different departments, disciplines and universities and enterprises should be built, and "craftsman studio" and "innovation and entrepreneurship teachers' studio" should be established. Teachers should be encouraged to participate in production practice in enterprises and engineers from enterprises should participate in talent training. Schools and enterprises should jointly build teaching resources and carry out technological innovation, so as to form a joint force of innovation and entrepreneurship education for new engineering talents.

6. Effect of Innovation and Entrepreneurship Education for New Engineering Talents

6.1. Remarkable Results Have Been Made in Innovation and Entrepreneurship Education f New Engineering Talents

In recent years, the enthusiasm of college students to participate in innovation and entrepreneurship runs high. They have won many awards in various kinds of competitions at all levels. In "Internet +" College Students Innovation and Entrepreneurship Competition in Heilongjiang province, they won 6 gold prizes, 31 silver prizes, 34 bronze prizes and "Excellent Organization Award" for many times. They won 1 gold, 2 silver and 4 bronze medals in the final of the 12th "Challenge Cup" Heilongjiang college students' business plan competition. Excellent results have been achieved in the national "TRIZ" Cup College Student Innovation Method Competition, National College Student Life Science Competition, National Undergraduate Electronic Design Competition, "Sharing Cup" Innovation Competition of Science and Technology Resources Sharing Service and other innovation and entrepreneurship competitions. In addition, we successfully held the 6th China International College Students'

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"Internet+" Innovation and Entrepreneurship Competition and launched Heilongjiang Province "Red Tour built by Youth Dream".

A total of 497 educational bases, such as college students' practical training and product innovation and creativity practical base have been set up through the cooperation among government, enterprises and school. The national science and technology park for college students has been built, with an area of 20,000 square meters, 12 professional service personnel, 87 enterprises settled in, and 1 high-tech enterprise. 10 enterprises have been founded by our teachers and 17 enterprises have been founded by college students. The university has established an open and sharing mechanism of science and education resources, effectively stimulating the vitality of innovation subjects and constantly optimizing the innovation and entrepreneurship ecosystem. At the same time, 664 square meters of business and office space were provided to support the landing incubation of the innovation and entrepreneurship fund projects. Our graduates such as Gesang Wangdui and Huang Zhonghua have played a leading role in innovation and entrepreneurship, and our graduates have been highly recognized and widely praised by the society.

6.2. Prominent Brand Effect of Innovation and Entrepreneurship Education for New Engineering Talents

We fully implement outcome based education (OBE) concept which centers on student, orients to output and improve continuously. It has formed education mode of innovation and entrepreneurship for new engineering talents, which is characterized by "a trinity of government, university and enterprise and integration of creative stimulation, innovative training, creative practice and enterprise incubation". We promote the reform of "curriculum ideology and politics", implement the "Six Excellence and One Top-notch" plan 2.0, and promote the deep integration of schools and enterprises. Robotics engineering, intelligent manufacturing engineering, biomedical engineering and other new engineering disciplines have been established, and one provincial-level application-oriented demonstration specialty cluster has been established for stomatology and material science. We will improve the collaborative education mechanisms, including ideological and political education, mass entrepreneurship and innovation, second class, art and sports practice, and social practice, and create new models for training talents.

In 2017, our university was approved as one of the first demonstration universities for deepening innovation and entrepreneurship reform in Heilongjiang province. In 2019, the science park was identified as the Heilongjiang science and technology enterprise incubator, Heilongjiang technology transfer demonstration base, and the entrepreneurship and innovation base of small and medium-sized enterprises of Heilongjiang Province. The first batch of research and practice projects of new engineering has been approved by the state and Heilongjiang province. In 2019, it integrated engineering resources to built an engineering training center, and established innovation and entrepreneurship college. In 2020, the university was approved as one of the first batch of "Shared Innovation and Entrepreneurship Incubation Platforms". In 2021, the university was approved as a National University Science park. The innovation and entrepreneurship education for new engineering talents has played a prominent role in demonstration, radiatation and guidance.

7. Conclusion

The new engineering construction embodies the professional certification concept of student-centered, results-oriented and continuous improvement. Through major enrollment and training, it should optimize the professional structure and implement the reform of "student-centered" talent training mode, so as to establish a multi-dimensional education mechanism for innovation and entrepreneurship and a teaching quality evaluation system with students'

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lifelong learning ability as the core, thus forming a closed loop of new engineering talent training and effectively improving new engineering talents' ability in innovation.

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