

## Exploration and Practice of Cultivating Innovative Ability of New Engineering Talents Based on Interdisciplinary Fusion

Ze Zhang<sup>1</sup>, Xiaojun Ma<sup>1,\*</sup>, Di Zhang<sup>1</sup>, Desheng Liu<sup>1</sup>, Chunjiang Li<sup>1,2</sup>

<sup>1</sup>Jiamusi University, Jiamusi, Heilongjiang 154007, China

<sup>2</sup>Mudanjiang Normal University, Mudanjiang, Heilongjiang, 157011, China

\*Corresponding Author: mjzx2009phd@163.com

### Abstract

In order to implement the education and teaching concept of the construction of new engineering and meet the needs of the industry for the diversified, individual and dynamic talents, we formulate multidisciplinary talents training programs, shape the craftsman spirit, optimize the specialty structure, set up introductory courses, strengthen interdisciplinary fusion, and pay equal attention to knowledge and ability. We put effort into constructing a new system of cultivating innovative ability of new engineering talents, which is of interdisciplinary fusion and supposed to adapt to the demand of new economic development, with the hope of providing useful reference for the construction of new engineering.

### Keywords

New engineering; Interdisciplinary fusion; Talent innovation ability training; Exploration and Practice.

### 1. Introduction

Higher engineering education is an important part in the higher education system. A new round of scientific and technological and industrial revolution is approaching. The fourth industrial revolution is unprecedented in speed, scope and degree, which will trigger, reshape, subvert, reconstruct and change the world pattern of higher education. There is no doubt that it have a far-reaching impact. The implementation of a series of strategies, including Germany's "Industry 4.0", America's "Industrial Internet Strategy", France's "New Industry France", Japan's "Japan Rejuvenation Strategy", and China's "Made in China 2025", have made it clear for the further deepening, expansion and start of higher engineering education reform.

*Made in China 2025* is first ten-year program of action for implementing China's manufacturing power strategy. "By the centenary of the founding of New China, we will have built our country into a manufacturing powerhouse, leading the world manufacturing industry with the focus on a new generation of information technology, intelligent manufacture, new materials and biological medicine. We will strengthen the talent training covering professional and technical personnel, management personnel and technical talents, perfect the talent training system from the research and development, transformation, production to management. And we will implement the knowledge renewal project for professional and technical personnel and the training program for advanced and outstanding engineers, construct high-level engineering practice centers inside and outside the university, and build high-quality team with professional talents.

At present, a new round of technological and industrial revolution is accelerating around the world. With the core background of new economy, the new engineering construction has deeply changed the industries like the internet, giving birth to various new industries. There is an

urgent need of new engineering talents who can meet the demand of new economy, new technology and new forms of business. They are supposed to serve the future new engineering construction and upgrading the intelligent manufacturing. Industry has been ahead of education in the technological development of the new industrial revolution. So the training of professional talents should meet the needs of the new industrial revolution and they should keep up with the pace of development. Just like enterprises, the education also needs to finish transformation. "Excellence Plan" being the basis and starting point, the education reform will be expanded to multi-disciplinary areas and promoted to the level of national strategy and future development. The new engineering construction will be carried out on the basis of interdisciplinary fusion in order to solve the conflicts between "labor shortage" and "difficult employment", namely, the talent vacancy of new engineering and current engineering graduates failing to meet the demand of economic development.

## **2. Strengthen Interdisciplinary Integration and Revise Training Programs**

Based on the innovative ideas of "excellence initiative", namely innovative concepts, creative standards and complete system, the talent training program characterized by interdisciplinary fusion and flexibility will be formed, covering personnel training goals, training standards, detailed standards, course systems, teaching contents, teaching methods, training standard matrix, enterprise training program, teaching team, teaching plan, and quality assurance system. In terms of course system and teaching content, the general education system should be integrated, restructured and optimized so as to support multidisciplinary specialty education. The construction of new specialty courses is of interdisciplinary fusion, which helps cultivate students' ability of interdisciplinary thinking and cross-border integration. The new engineering discipline frontier knowledge, related interdisciplinary knowledge, principles and methods will be integrated into the specialty course system to broaden students' horizons and cultivate their future development ability. In terms of teaching methods, the research-oriented learning method is promoted, which is based on the problems and characterized by inquiry, discussion and participation. And universities will make full use of "Internet +", information technology and high-quality online education resources to help create conditions for innovative engineering education and teaching methods, and make them applied in the training of new engineering talents.

With the "Excellence Plan" as the carrier, the coordinated education system will be formulated to realize the coordinated educational mode featuring the cooperation between government and universities, industries and education, universities and enterprises, science and education and the cultivation of excellent engineering talents. Firstly, support the implementation of the government's industrial policies by training the engineering talents needed by the industry and guide the government's future industrial development layout through the construction of new engineering. Secondly, accurately seize the social demand for engineering talents, and give full play to the enterprise technology, personnel, conditions and support as well as the advanced cultural atmosphere in the enterprises.

As for the practice and innovation platform, we should establish the innovation and entrepreneurship education platform and engineering practice education system. For the construction of teaching body, the mode of "university teachers + prospective engineers = engineering teachers" is regarded as the general requirement of new engineering teaching bodies. The method of integrating "introduction, training and part-time job" will be adopted within the team construction. And related evaluation and incentive mechanism will be introduced. In terms of quality of talent cultivation, talent training quality has always been the starting point and the foothold of the new engineering construction. Based on the forefront of international engineering education development, we will make it our goal to train those talents

who can meet the demand of the future, the world and the industry. The outlook on the talent training quality will be reshaped, and the new standards of talent training will be set up. The effective training evaluation system will be made to guarantee that new engineering talents can meet the needs of new economic development.

### **3. Strengthen the Concept of Engineering Education and Shape the Spirit of Craftsman**

Based on the thorough implementation of the spirit of General Secretary Xi Jinping's speech at the *National Conference on Ideological and Political Work in Colleges and Universities*, Colleges and universities should strengthen the guidance of ideological and political education, and foster the new engineering education and teaching concepts including serving the national strategy, connecting with industries, leading the future development, and viewing students as the center. The ideological and political education is deeply integrated with the training of new engineering talents in order to cultivate the innovative and entrepreneurial thinking, ability and quality of engineering talents, shape the "craftsman spirit" of engineering talents, realize the crucial task of fostering virtue through education, and cultivate qualified workers and reliable successors for national construction. Under the guidance of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, colleges are supposed to shoulder the mission of "cultivating talents for the Party and the country" and the task of fostering virtue through education, and implement the ideological and political work through the whole process of education teaching. The course reform should be actively pushed and the action plan should be implemented to make all kinds of courses with the same direction of ideological and political theory and realize the cooperative educational effect. Innovation and entrepreneurship education will be integrated in the talent training, which means building a new talent training model. It can contribute to comprehensively improving the quality of education and employment, providing human resources and support for the country's innovation-driven development and industrial upgrading, and training students' innovative and entrepreneurial thoughts and methods. Under the background of new engineering, colleges and universities lead the innovation and entrepreneurship education of engineering talents under the help of ideological and political education. They will cultivate high-level talents who can meet the demands of the industry, the world and the future, help students establish lofty ideals of patriotism and the sense of innovation and entrepreneurship, and improve the quality of talent training.

### **4. Implement Classified Talent Training, Optimize the Specialty Structure**

As for the construction of new engineering, the greatest expansion of the engineering education reform lies in the specialty structure. The new engineering specialty should be characterized by leading, interdisciplinary, innovative, cross-boundary and developing. Taking Jiamusi University as an example. In recent years, the university has been treating the major national and regional strategies and industrial development needs as its main orientation. Under the guidance of the ideological and political curriculum, the university has tried its best to foster morality and cultivate talents, and pushed the coordination between college education and industries as well as medical field. What's more, it has promoted the comprehensive education reform like the construction of "four innovations", excellence plan, and innovation and entrepreneurship education. Deeply rooted in the the fertile soil of Sanjiang, it will inherit the local civilization and fulfill the mission of protecting border areas from the perspective of culture.

The university regards the construction of new engineering as an important platform for reforming talent training mode, giving full play to "local advantages" and "comprehensive

advantages" of the university. The new mode of "output-oriented, foundation strengthening and cross-promotion" with the characteristic of university oriented, enterprise leading, government guiding and market operation. The five-pronged education plan is supposed to be formulated and put into effect. We will comprehensively promote the reform of "ideological and political courses", deepen the reform of innovation and entrepreneurship education, implement the plan 2.0 of "Six Excellent and One Top", and promote the in-depth integration between universities and enterprises. Optimize the specialty structure, further promote the supply-side reform of specialty and do well in the specialty construction. What's more, the professional certification should be given more support, helping establish the new engineering specialties such as robotics engineering and biomedical engineering and build a provincial application-oriented demonstration specialty cluster combining stomatology with material science. The collaborative education mechanism will be improved, including "ideological and political education", "the integration of innovation, entrepreneurship, and mass entrepreneurship and innovation", "the second class", "art and sports practice", and "social practice", which is helpful for innovating talent training modes. We will upgrade the traditional engineering specialties, accelerate the new specialty construction, carry out classified talent training and achieve the interdisciplinary development. Therefore, it can be an impetus for the cluster effect where various specialties have access to integrating with each other and give birth to new engineering specialties and continuously optimize the specialty structure.

## **5. Strengthen Engineering Cognitive Education and Set Up Introductory Courses**

The traditional undergraduate talent cultivation plan and course system are set up based on the discipline and specialty. Those talents cultivated under this framework have rather high professional skills and they can basically meet the needs of professional posts. As the products have upgraded one generation after another and staff have been continuously driven by the personal growth, introductory courses of new engineering have acquired the entrance and guidance for new engineering education, and they have a powerful effect on popularization and demonstration. Specifically, the courses can be divided into several kinds of cognitive introductory courses, including introduction-oriented, discussion-oriented, experiment-oriented, design-oriented, practice-oriented. The attempt of new engineering reform, based on the introductory courses of new engineering, is regarded as one that has upgraded the education content in an overall way, which is of great importance and urgency. The course reform means a fairly big challenge for students and teachers, so they require the study and exploration for some time. Once the reform has achieved upgrade and success, the follow-up courses will be naturally influenced. Therefore, promoting the construction of new engineering can start with the new engineering cognition and cultivation of innovation quality. At present, China's "breaking five only" has gradually moved from cry to actions. At this historical point, the decision-making level of each university can view the reform of the introductory course of new engineering engineering as a strategic breakthrough to push the reform of new engineering education, and then put more effort into it, design a reasonable incentive mechanism, as well as attract more teachers to carry out innovative exploration on teaching reform.

## **6. Strengthen Interdisciplinary Fusion and Pay Equal Attention to Knowledge and Ability**

Promote interdisciplinary fusion and build a high-quality course system. The related courses should include seminar courses, interdisciplinary comprehensive courses, science frontier courses, innovation ability courses and capstone courses. The aim is to broaden the subject base,

promote interdisciplinary fusion, pay attention to the forefront of scientific and technological innovation, strengthen scientific research training, and cultivate students' independent learning ability and academic potential of doing innovative research. We will enhance quality-oriented education, optimize general education courses, develop students' humanistic qualities and scientific spirit, and foster their capabilities in practice and innovation and entrepreneurship education. In addition, our students will possess wholesome personality and ability of sustainable development, critical thinking, effective communication and expression, solving complicated problems and good team cooperation spirit.

Students should be encouraged to carry out advanced learning and make their learning more efficient. At the same time of focusing on individualized training, we should do our utmost to inspire students' potential by offering them more space to make their own choices. The modes of their study are supposed to be related with research and inquiry. We should encourage students to take an active part in the training of scientific research projects, and help them form the habit of deep learning, construct knowledge system featuring interdisciplinary fusion and develop the multi-dimensional abilities. Given the significant social demand, the talent training plan should be reconstructed and the talent training goal should be clearly positioned. There is an urgent need for the industry, enterprise, industry experts and educators, namely, they should be deeply involved in the whole process of talent training from the perspective of facing the whole world, the future world industry and the future industries. Our principle should be problem-oriented, which can help train the ability of solving complicated problems, break the barrier of subjects and majors, achieve interdisciplinary fusion and the integration of industry and education, and train talents under the cooperation among the government, universities and enterprises. The ultimate goal of the construction of new engineering is to cultivate outstanding engineering talents who can meet the needs of social development. Based on the "students-centered" education concept, the university has taken a series of measures centering on the construction of course system, teaching content, education and teaching methods to improve students' comprehensive ability. Besides the development plan of focusing on interdisciplinary fusion, much more attention should be paid to launching and implementing the plan for training innovation and practice ability. Meanwhile, we should promote the deep integration of information technology and education and teaching, carry out mixed learning and flipped classroom, create the learning environment featuring the combination of online and offline learning, in-class and out-of-class learning, virtual and real learning. And we should pay attention to the quality engineering evaluation and the incentive mechanism construction, forming a closed loop of talent training.

## 7. Conclusion

The new engineering construction path based on the interdisciplinary fusion is the specific measure for integrating engineering education with new engineering concept. It embodies the professional certification concept of being students-oriented, outcome-driven and continuous improvement. It aims to strengthen the engineering education, shape the craftsmanship spirit, optimize the structure of majors on the basis of classified talent training, make the talent training plan characterized by interdisciplinary fusion, and form the new engineering talent training system paying equal attention to knowledge and ability. Only by doing this can we help promote the quality of new engineering talent training and meet the demands of economic and social development for new engineering talents.

## Acknowledgments

Funded by the Higher Education reform Project of Heilongjiang Province "Exploration and Practice of College Students' Innovation and Entrepreneurship Education and Its Integrated and Progressive Support System under the Background of New Engineering (SJGY20210872)".

## References

- [1] Ma Xiaojun, Li Chunjiang and Xing Chuanbo. Analysis of the current situation of new engineering research and practice in local universities[J]. Research and Practice of Innovation and Entrepreneurship Theories, 2021, 4(05):1-3+6.
- [2] Wang Shibin, Gu Yuzhu and Xi Haixia. Research on the structure of key competence of new engineering talents for 2035[J]. Research in higher engineering education, 2020, (04):54-60+82.
- [3] Ma Xiaojun, Zhang Ze and Li Chunjiang. New engineering talent thought leading and the construction and implementation path of innovation and entrepreneurship course system[J].
- [4] Teaching and Educating (Higher Education Forum), 2020, (03):74-75.
- [5] Hu Guobao, Day Rui. The necessary orientation, practical dilemma and inevitable choice of "new engineering" talents training in local universities[J]. Heilongjiang Higher Education research, 2019, 37(03):156-160.
- [6] Long Fenjie, Shao Fang. The new ability of new engineering talents and its training practice[J]. Research in higher engineering education, 2018, (05):35-40.
- [7] Ma Xiaojun, Li Chunjiang, Song Hanjun. Strategies for cultivating innovative ability of new engineering talents in local universities[J]. Journal of Hubei Adult Education College, 2018, 24(04):19-21.
- [8] Jiang Xiaokun, Zhu Hong, Li Zhiyi. New mode of cultivating new engineering talents[J]. Higher education development and assessment, 2018, 34(02):17-24+103.
- [9] Jiang Xiaokun, Zhu Hong, Li Zhiyi. The quality structure and training of new engineering talents facing the new Industrial Revolution[J]. China University Teaching, 2017, (12):13-17+23.
- [10] Ma Xiaojun, Li Chunjiang, Zhang Ze. Development status and enlightenment of innovation and entrepreneurship education for engineering college students[J]. Technology Innovation Monthly, 2017, 30(13):57-58.
- [11] Ma Xiaojun, Yan Bingbing, Zhang Ze. Research and exploration of modern engineer training based on professional certification [J]. Technology Innovation Monthly, 2017, 30(11):89-90.