

# *Innovative Practice and Research on the Cultivation Mode of Innovative and Entrepreneurial Talents in Emerging Engineering in Colleges and Universities*

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**Abstract:** The construction of emerging engineering requires the cultivation of talents, especially those high-level ones with strong practical ability, innovative spirit and international competitiveness to support future emerging industries and new economy. However, the current cultivation mode of universities has gradually failed to meet the needs of society. This paper analyzes the current situation of the talent cultivation mode in universities, points out and analyzes the reasons of the problems and proposes the measures, in order to enhance students' innovative spirit, entrepreneurial consciousness and innovative and entrepreneurial ability, thus meeting the needs of the changing industrial structure of society and adapting to the new normal of economic development.

## 1. Introduction

The outline of the 14th Five-Year Plan and the 2035 Vision for National Economic and Social Development of Henan Province states that: adhering to the central position of innovation in the overall situation of modernization, taking science and technology innovation as a strategic support for the development of the province, deeply implementing the strategy of developing Henan through science and education, the strategy of strengthening the province through talents and the strategy of innovation-driven development, improving the innovation system and comprehensively shaping new advantages in development.<sup>[1]</sup>

On April 8, 2017, the Ministry of Education held a seminar on the construction of new engineering disciplines at Tianjin University. On the same day, Zhang Daliang, former director of the Department of Higher Education of the Ministry of Education, published an article entitled "Six Issues Oriented to the Construction of New Engineering" in Guangming Daily, which summarized the six concepts of the construction of emerging engineering majors, namely "building majors in the light of the needs of industry, modifying the content in line with the development of technology, implementing the reform on the basis of the school-running subject, applying the teaching method according to the interests of students , creating conditions based on the internal and external

resources, establishing standards depended on the international frontier , thus indicating the direction for the construction of emerging engineering.<sup>[2]</sup>

## **2. The Current Situation of Talent Training Mode in Universities**

The Law of the People's Republic of China on Higher Education stipulates that the mission of higher education is to cultivate high-level specialists with a sense of social responsibility, a spirit of innovation and practical ability. Moreover, the education is bound to develop science, technology and culture, and to promote socialist modernization. At present, many universities are exploring the reform and innovation of talent training mode, but there are still some problems to be improved.

Firstly, the demand for industrial upgrading has been barely met. With the rapid development of the society, it has witnessed the rapid change of the digital economy, big data, artificial intelligence, virtual simulation, cloud computing and other emerging industry technologies, in which the need of a large number of professionals majored in the similar fields. However, at present, the college graduates are incapable to work immediately in the emerging industries without a 3-months or 1 year long pre-job training. However, there are less than a half of them who are able to handle the work quickly and easily.<sup>[3]</sup> Secondly, the assignment ratio of theoretical and practical courses unreasonable. At present, the ratio of theoretical courses in most universities exceeds 70% of the total class hours with the problem of emphasizing theory but not practice. It has resulted in a phenomenon that the graduates are equipped with sufficient theoretical knowledge but poor practical skills. Meanwhile, most of the teachers in colleges and universities have undertook the teaching task directly after the graduation of PhD, and the proportion of "Double qualified teachers" with practical experience is relatively low. Although these teachers have done projects with their supervisors during their masters and PhD phases, they still emphasis on theoretical knowledge in the process of practical teaching. Thirdly, the talent training model is stereotyped. The Opinions on Deepening the Reform of the Education System and Mechanism emphasizes the need to innovate the mechanism for cultivating talents. Higher education institutions should take the talent cultivation as primary task, improve the ability of cultivating talents in all aspects. Innovative and entrepreneurial education should be integrated into the whole process of talent training, flexible learning systems should be implemented, and teachers should be encouraged to innovate teaching methods. At present, many universities focus on merging and expanding with an aim to be more comprehensive, neglecting the innovation of talent training mode, let alone the innovation and entrepreneurship education.<sup>[4]</sup>

## **3. Analysis of the Demand for Innovative and Entrepreneurial Talents in Emerging Engineering Disciplines Based on "Demand Orientation"**

"Demand orientation" means the demand of the development of society, enterprises and students, which steers the educational philosophy, objectives and methods of training talents in universities. Therefore, the cultivation of emerging engineering talents in universities should be demand-oriented, and conduct research on what kind of talents are needed in today's society, then determine what kind of professional knowledge and ability the students need to possess, so as to ensure a complementary development of theoretical and practical ability. The main analyses are as follows:

### **3.1. Equipped with Solid Specialized Professional Knowledge and Skills**

From the survey of enterprises related with the major of heavy machinery and measurement, it is indicated that the work of current graduate students in the enterprises can be roughly divided into three categories: application-oriented, composite and innovative ones. Among which the students

engaged in application-oriented work is the main force of the development of enterprises, which is the basic requirements of cultivating talents for the universities in turn. Not only the professional theory and elementary skills are needed by the enterprises as for the application-oriented talents, but also those with the ability of integrating and optimizing the practical skills and theoretical knowledge.<sup>[5]</sup> Therefore, emerging engineering students should strive to master the theoretical knowledge and basic skills during their studies and apply flexibly into practice. Only in this way can teachers combine theory and practice together and lay a solid foundation for the future work.

### **3.2. Equipped With the Ability to Identify and Solve Problems**

As for the graduates who choose to engage in the original specialized fields, the majority of them shall work in the related positions such as equipment maintenance, equipment management, mechanical design or technology development and so on. Therefore, the ability to identify and solve problems is essential in the enterprises. Especially the core task of the work related with the mechanical design and technical development lies in the problem seeking, finding and solving repeatedly, then refining the design and development results step by step to produce an excellent piece of work. For this reason, the students majored in mechanical engineering and measurement should be cultivated with competences of finding and solving problems within the design and development cycle through a great amount of practices in the realistic projects during the school years.

### **3.3. Equipped With the Ability to Learn and Innovate Restlessly**

Compared with the large mechanical and measurement majors in the emerging engineering discipline, most of the traditional majors are oriented to the demand of talents within a certain kind of industry or field under a relative stable condition. The ability of continuous innovation is barely needed. While emerging engineering major is a multidisciplinary major combined with core technology such as the Internet+ and industrial intelligence, it shall interact with more industries. The enterprises in the field will witness an accelerated development with a high demand of innovation and talents.<sup>[6]</sup> As a result, in the context of the emerging engineering discipline, students should recognize the importance of life-long learning, develop good learning habits, thus equipped with the innovative ability to learn new knowledge, solve new problems continuously.

## **4. Building a "Demand-Oriented, Two-Wheel Drive" Model for Cultivating Innovative and Entrepreneurial Talents in Emerging Engineering Disciplines**

### **4.1. Optimizing Training Objectives and Curriculum System through School-Enterprise Cooperation in the Industrial Needs**

Universities should take the initiative to cooperate with industrial enterprises, grasp the frontiers of technology of industries through survey and research, understand the employment needs of companies, and solve the problem of disconnection between training objectives and social needs. Combined with The outline of the 14th Five-Year Plan and the 2035 Vision for National Economic and Social Development of Henan Province, the training system is determined to cultivate talents in the needs of working in intelligent equipment manufacturing and instrumentation industry. On the basis of the emerging engineering discipline, the aim is to build up technical personnel with creativity and lifelong learning ability. In response to the problem of large span among disciplines and multiple kinds of courses, it is better to integrate the teachers and entrepreneurial experts together in the fields of mechanical design and manufacturing and its automation, vehicle

engineering, intelligent manufacturing, measurement and control technology and instrumentation. The teaching content should be firstly inter-connected and then penetrate and reorganize within the circle for the final optimization. The participation of experts in enterprises will level up the practicality and modernity of the course. As for the curriculum, it is useful to strengthen the practical aspects of teaching, increase the proportion of practical teaching courses, extend the time of practical teaching, practical training, innovation and entrepreneurship courses, break through the restrictions of professional disciplines in universities, create the course system of extensive majors, set up interdisciplinary practical teaching courses, and implement comprehensive education of practical course, so that students from different disciplinary backgrounds can participate in practice together to enrich their knowledge system. <sup>[7]</sup>

#### **4.2. Building a Quality Assurance System for Talent Training with "Demand-Oriented" as the Goal**

The quality assurance system of talent cultivation for emerging engineering majors is constructed from three aspects: the management on teaching process, the surveillance on teaching quality and the guarantee on teaching resources, ensuring that the implementation of OBE concept is effectively implemented. Firstly, it is necessary to improve the curriculum system. The emerging engineering major is comprehensive with various orientations. When formulating the curriculum system, the course orientation should be set according to the development characteristics and demands of the industry as well as the interests of students. The goal, process and plan of talent training should be clearly defined. At the same time, while the great importance attached to the core knowledge absorption, teachers should also focus on strengthening the cultivation of practical ability, innovation ability and professional quality, so as to enhance the comprehensiveness of curriculum system and personnel training program.<sup>[8]</sup> Secondly, the colleges and universities should build a team of professional teachers. Teachers, as the main body of education and teaching, are essential to teaching quality. College teachers should have not only rich theoretical but also practical teaching experience. The higher requirements are needed for the teachers including the ethics, professional ability, comprehensive quality and so on in regards to the school-enterprise cooperation and talents training. Thirdly, it is beneficial for the universities to create an innovative way on practical teaching. Universities should take the ability cultivation of students as the goal, enhance the interest and effectiveness of professional courses teaching, therefore the students can learn knowledge in practice and improve practical ability from knowledge, thus cultivating inter-disciplinary talents for the society. Meanwhile, the colleges also organize some competitions on skills and knowledge to understand the situation of students' study and teachers' teaching quality. Fourthly, build a multi-dimensional practical platform. Universities should actively establish contact with enterprises, build the plan on school-enterprise cooperative education, take the internship as a good opportunity of interacting with enterprises. When they are engaged in the realistic engineering projects, they will learn to solve practical problems so that the practical courses will be closer to the engineering projects in real life.<sup>[9]</sup> Besides, innovation and entrepreneurship ideas should also be incorporated into teaching, exploring teaching reform from the perspective of innovation and entrepreneurship, and stimulating innovative thinking and enthusiasm under the background of both major they are taking and the entrepreneurial teaching. Teachers can also refine and study the problems found in the process of the application on scientific research projects. Teachers and students can participate in the research together on the basis of the specialized subject.

### **4.3. Building a "Two-Wheel Drive" Practical Teaching System Based on Skill Competition and Integration of Production and Education**

Entrepreneurship should be driven by the innovation, and a sound training system for innovative and entrepreneurial talents including in-door teaching, independent learning, practical training, guidance and assistance should be established, so as to enhance students' innovative spirit, entrepreneurial consciousness and innovative and entrepreneurial ability, as well as meeting the needs of social industrial structure and actively adapting to the new normal of economic development. Firstly, the colleges should establish a practice center for innovation and entrepreneurship. Practice platforms such as Freescale smart car shall be established to integrate innovation and entrepreneurship education with professional education on the foundation of talent training programs. As the leading role, the practice is an useful way for students to grasp and apply theoretical knowledge, so that a comprehensive competence of innovation and entrepreneurship shall be established. The training program of innovation and entrepreneurship should be carried out in which the students can be grouped by the interests with teachers in charge. In the training process, teachers should guide students to start from the realistic life, find and put forward the problems they are interested in. At the same time, the innovative points, difficulties and depth of the project should be discussed together by the teachers and students, combined with the characteristics of students, ensuring the feasibility of the project backed up by a complete plan. Secondly, it is also essential to establish an innovation practice base with enterprises and research institutes to combine the concepts of education on entrepreneurship and engineering. Students can be arranged to experience the work and engineering of enterprises, meanwhile the universities can have a better understanding of the current employment needs of enterprises so that they can adjust the curriculum system according to the information. Teachers from other universities can also be invited for the guidance in the innovation and entrepreneurship education with an aim to form a closer relationship between the education and reality. Through the cooperation between universities and enterprises, the latest technologies of related industries can be introduced into colleges and universities as the directions of development. Moreover, the education on innovation and entrepreneurship can be carried out driven by the program to cultivate applied and innovative talents who are capable of serving the regional economy and social development.<sup>[10]</sup> Thirdly, teachers should enhance the competitiveness of students through the way of skills competition. Skill competition is an important way to improve ability of innovation and entrepreneurship of students. The emerging engineering competition lays more emphasis on professional practical ability and encourages students to participate in various skills competitions, which enables students to better explore the forefront of the industry, discover and finally solve the existing problems in the industry through innovation and entrepreneurship. Meanwhile, it can also cultivate students' skills in communication, written and oral expression, teamwork, organizational planning, creative thinking and so on. Colleges and universities should also take skills competition as the starting point, improve innovation and entrepreneurship courses, set up a complete system of individual and group guidance, special lectures and competition training with a well-linked process, thus improving innovative skills and quality of students.

## **5. Conclusion**

The training mode of emerging engineering innovation and entrepreneurship featured with "demand-oriented and two-wheel drive" is beneficial for improving the innovative ability of the students in the first place. Through the way of participating in the competitions such as graduation design, innovation and entrepreneurship competition, national 3D digital innovation competition and so on, students can improve the innovative abilities with teamwork spirits to meet the demands of varying social industrial structure and adapt to the new normal of economic development.



Secondly, it is conducive to the construction of emerging engineering disciplines in large mechanical and measurement and control majors. Through the way of carrying out innovative and entrepreneurial talent training program, implementing the concept on the development of emerging engineering, formulating the objectives and orientations on professional training, building a well-round on-campus practical platform and off-campus practical base, it is beneficial to achieve the integration of industry and education, as well as the science and education, thus blazing a trail on collaborative education and innovation. Finally, it contributes to provide the mode that the relevant institutions can draw on in the construction on the emerging engineering majors with a greater influence. The construction of the cultivation on emerging engineering innovation and entrepreneurship talents is based on the following five principles, namely, full coverage, complete process, integral chain, industry-education integration with collaboration and multi-disciplinarity. The paper discusses the innovative practice of emerging engineering innovation and entrepreneurship talent cultivation in colleges and universities, explores new paths for the implementation of emerging engineering innovation and entrepreneurship education in large mechanical and measurement and control majors, and provides valuable experience for relevant institutions at the provincial level.

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