

College Students Training Method in New Engineering Disciplines Based on 3E Integration Mode

Xiaoqing Jiang^{*}, Nianqiang Li, Changzhi Wei, Shiyao Cui, Lingyin Wang, Yue Zhao

School of Information Science and Engineering, University of Jinan, Jinan, China

Email address:

ise_jiangxq@ujn.edu.cn (Xiaoqing Jiang)

*Corresponding author

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Abstract: The education quality of new engineering disciplines is essential to the prosperity and technological development of the country. There are problems need to be solved such as the inconsistency between talent cultivation and national needs as well as social development, and the low proportion of professional teachers participating in innovation and entrepreneurship education as well as ideological and political education which are necessary and important in the current college students training in new engineering disciplines. This paper proposed an integrated mode based on three types of education including professional education, ideological and political education and innovation and entrepreneurship education, which is named Three Types of Education Integration Mode (3E Integration Mode), to improve the social adaptability and competitiveness of college students in the background of new engineering disciplines. In this paper, we proposed improvement methods for the 3E model from three aspects including curriculum building, major construction, and supporting of college policies in order to effectively solve the practical problems in college students training. In terms of curriculum building, we aim to make the content of professional courses more suitable in the background of new engineering disciplines and technological advancements through reconstruction of course content and reforms in teaching methods and modes. For major construction, we discuss the construction of a comprehensive curriculum system, promoting learning through competitions, and the synergy between teaching and learning, as well as optimizing the student evaluation system. These measures enable college students to develop independent learning and practical abilities while possessing a solid theoretical foundation. Finally, we believe that supporting of college policies, including faculty training and enhancement and reforms in talent evaluation systems, serve as guarantees for implementing the aforementioned improvements.

Keywords: Curriculum Ideological and Political Education, Innovation and Entrepreneurship Education, New Engineering Discipline

1. Introduction

In 2023, college graduates face huge employment pressure because of the influences of COVID-19 lasted for three years and the resulting international economics situation. According to statistics, the number of college graduates in 2023 reaches 11.58 million in China, with an increase of 820,000 on the basis of the number of tens of millions in the previous year. In addition, there are a large number of returning graduates from overseas colleges, former graduates and mature labor force in the labor market. At the same time,

the number of students taking the postgraduate entrance examination in 2023 was 4.74 million, with an increase of 170,000 compared to last year, while the admission rate was less than 30%, which makes the number of students who failed the postgraduate entrance examination further expanded compared to 2022 [1]. By 2024, the number of college graduates will continue to increase, reaching approximately 11.87 million.

Nowadays, the employment difficulties for college graduates and the recruitment difficulties for enterprises coexist. The knowledge taught in colleges lags behind the technological development of enterprises, and the technology

update of industrialization cannot keep up with the international forefront research, which results in "bottleneck" technology in the way of the national development. For some colleges students, they are experiencing "unemployment upon graduation" that causes relating social problems. In 2022, the idea of "innovation increases momentum, entrepreneurship promotes employment" was stressed. Innovation leading entrepreneurship and entrepreneurship driving employment have become an important way to solve the employment problem of the current younger generation.

The improvement of the quality of college students' cultivation in the fields of new engineering disciplines and the efforts making up for the gap between the traditional engineering training system and the current situation, are of great significance to help college students stand out in the severe employment and social competition, which can make college students cultivation closer to the needs of society and the country. From this aspect, there are many successful experiences for us to learn from. For example, since the early 1980s, the University of Nevada has regarded entrepreneurship as the capstone course for electronic engineering majors. The capstone course integrates knowledge points related to product design, and covers several aspects such as invention, innovation, patent, product quality, marketing, sales, and finance *et. al.* The fusion of entrepreneurship and professional skills is helpful to improve the ability of social adaptability and professional competitiveness of the college students.

The significance of ideological and political education through curriculum is pointing out the direction of students' cultivation. Since 2015, in order to promote higher education reform, China has introduced a series of relevant policies about the ideological and political education through curriculum and innovation and entrepreneurship education. These national policies provide training ideas for the achievement and integration of professional skills, innovative practices, and value guidance of college students in the background of new engineering disciplines. Chinese scholars and teachers have conducted a large amount of research on the ideological and political construction of professional courses [2-6], the ideological and political education through curriculum with innovation education [7-9], and the integration of engineering basic courses with innovation and entrepreneurship education [10-15]. They have also discussed the necessity of integrating the ideological and political education through curriculum, innovation and entrepreneurship education, and professional education [16, 17].

In the background of cultivating new engineering talents, professional education, ideological and political education through curriculum, and innovation and entrepreneurship education will achieve the unity of students' knowledge, ability, and value cultivation goals. Thus, this paper proposes a new engineering college students training mode named 3E integration mode that deeply integrates three types education including professional and technical education, innovation and entrepreneurship education, and ideological and political

education through curriculum. We deeply explore the problems faced in the cultivation of college students in new engineering fields and the implementation methods of 3E integration mode, which helps to cultivate innovative engineering students with ideals, political identity, and the ability to participate in the development of the Chinese nation and promotes the development of higher education.

The content of this paper is arranged as follows. The Section 2 conducts an in-depth analysis of the main problems encountered in the training of college students in the field of new engineering disciplines. Section 3 introduces the 3E integration mode for college student training and points out solutions to existing problems from three aspects including curriculum, major and polices. Finally, conclusions are provided.

2. Problems of College Students Training in New Engineering Disciplines

2.1. Existing Cultivation Mode Is Inconsistent with Country Needs and Social Development

At present, technology develops at high speed and with high quality in China, while the cultivation mode in most universities or colleges is still relatively fixed, and the training methods lag behind social development in the following aspects:

When the same major is set or built at different levels of universities in different regions, similar cultivation plans and curriculum systems are adopted. Consideration about teachers, teaching facilities, student quality and education resources are insufficient, and the particularity of regional economic and social development is ignored, resulting in uneven quality of cultivation and inadequacy support for local economic and technological development, which causes a significant bias in graduate mobility and exacerbates the imbalance in regional technology and development.

The pace of curriculum system reform in universities is slowed down because a large number of teaching reform achievements are difficult to implement really. Some universities have formed distinct researching and teaching teachers' teams, which means the lecturer is familiar with classical theories but out of touch the latest technological advancements to some extent because they don't conduct scientific research, while teachers who do scientific research do not teach undergraduate students much. Thus, undergraduate students' studies still focus on classic course content, lacking innovative thinking exercise and research practice and with narrow professional perspectives. Against the backdrop of the rapid development of the industrialization trend of scientific and technological achievements, a large number of new engineering research fields have been formed through interdisciplinary intersection, bringing a large number of innovation and entrepreneurship opportunities and talent gap. However, college graduates with insufficient ability hardly seize these opportunities.

The contradiction between talent supply and demand

reflects that the traditional training system for college students is clearly inconsistent with the needs of the country and society. The college students' cultivation needs to be consistent with needs of country development, technological innovation of society and enterprises. It is necessary to cultivate new engineering talents with innovative thinking, practical ability, political identity, and patriotic and professional spirit. With the reconstruction of professional curriculum content, curriculum ideological and political construction, it is urgent to deepen the integration with innovation and entrepreneurship education. 3E integration mode is necessary during the teaching reforms in new engineering disciplines.

2.2. Inadequate Proportion of Professional Teachers Participating in Ideological and Political Education as Well as Innovation and Entrepreneurship Education

According to statistics, there are 1.3158 million full-time teachers in ordinary undergraduate schools in China, while there are about 28,000 full-time teachers and more than 93,000 part-time mentors in innovation and entrepreneurship education in 2022. Teachers in innovation and entrepreneurship education account for less than one tenth of full-time teachers, and a considerable portion of full-time mentors for innovation and entrepreneurship in many universities are held by counselors and teachers of employment centers. These teachers often have insufficient understanding of the development of engineering professional technology, resulting in many students' entrepreneurial projects don't have strong or obvious technological innovation so as to achieve sustainable development. Part-time innovation and entrepreneurship mentors are often professional professors, but they usually don't have enough time to provide one-on-one guidance to project teams.

However, from the student level, the survey data of China College Students Entrepreneurship Report 2020 shows that college students have a positive attitude towards social entrepreneurship, and up to 49.86% of college students have a strong social entrepreneurial intention, but the actual entrepreneurial success rate of college students is less than 5%.

From the perspective of teachers who implement values education through curriculum, the 2020 "Comprehensive Promotion of Ideological and Political Construction in Higher Education Courses Video Conference" by the Ministry of Education pointed out that approximately 80% of university teachers are professional teachers, about 80% of courses are professional courses, and about 80% of students' learning time is professional learning. Most college students believe that professional course and professional course teachers are the first to affect their worldview and outlook on life, and professional course teaching is the most important way for ideological and political education through curriculum. Ideological and political education through curriculum plays a strong guiding role for students to devote themselves to the development and construction of the

country, as well as to face challenges bravely and continuously innovate. However, at present, the proportion of professional courses that truly implement ideological and political education in many universities is less than 10%, and the construction ideas are often not clear. Some ideological and political methods of courses still remain at the primary level such as case explanation or even storytelling. The ideological and political elements cannot organically integrate with the professional knowledge and cannot stimulate the true internal driving force of students' learning awareness resulting in the effectiveness of values education through curriculum cannot meet expectations.

The above data and analysis indicate that professional teaching teachers play an indispensable and irreplaceable role in both innovation and entrepreneurship education and ideological and political education through curriculum. It is urgent to improve the proportion of professional teachers participating in ideological and political education through curriculum as well as innovation and entrepreneurship education to train hybrid teaching staff and create an effective teacher incentive mechanism, which is crucial for cultivating students in new engineering disciplines. This is also the goal of implementing the 3E integration mode.

3. Implementation Methods of the 3E Integration Mode

In order to solve the above problems and realize effective 3E integration, the reform of college students training mode in the new engineering disciplines can mainly be carried out from three levels: curriculum, major, and colleges' policies. The implementation process and framework are shown in Figure 1.

3.1. Curriculum Building

Ideological and political education through curriculum can stimulate the internal driving force of students' learning. Professional education can help students learn knowledge and skills well. And innovation and entrepreneurship education can train students to transform theory and professional skills into practical abilities. In the process of 3E integration, curriculum building is the basis, so the reconstruction of course content is very necessary.

3.1.1. Reconstruction of Course Content

Modular division and reconstruction of traditional course content should focus on the cultivation of students' research ability, practical engineering problem-solving ability, and scientific and innovative thinking. Course content modules can combine relating ideological and political elements to achieve full coverage of key knowledge points by values education. At the same time, in-depth analysis of the practical issues related to the development of science and technology should be included in the reconstructed of course content, which will inspire students to think about the application of the theory they have learned.

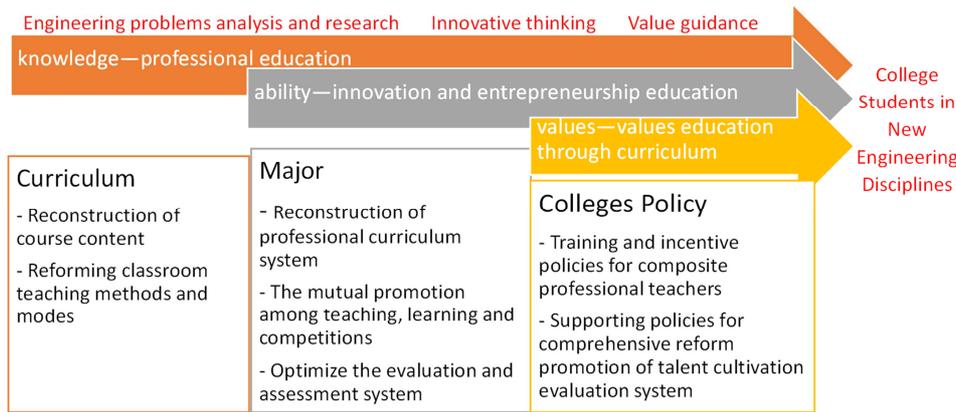


Figure 1. Implementation process and framework of 3E integration mode.

3.1.2. Reforming Classroom Teaching Methods and Modes

3E integration will inevitably squeeze limited classroom theoretical teaching time, so the blended online and offline teaching mode is particularly important in teaching design. Extract the key and difficult content, ideological and political education elements, and innovation and entrepreneurship cases that need to be refined from professional courses to form online resources. Combined with the effective design of online and offline learning activities, which can be guided by theory and practice, driven by tasks or projects, and combined with targeted online course content tutoring and Q&A, allowing students to understand, master, and expand their knowledge at a deeper level.

3.2. Major Construction

3.2.1. Reconstruction of Professional Curriculum System

The revision of cultivation plans should be promoted by increasing the proportion of expansion courses related to innovation and entrepreneurship practice. Professional curriculum system must pay attention to popular technologies, cutting-edge disciplines, innovative thinking training, and national technological development bottleneck, in order to expand students' subject cognitive thinking, promote innovation and entrepreneurship practices, improve college students' comprehensive abilities and enhance of students' socialist core values education.

3.2.2. The Mutual Promotion Among Teaching, Learning and Competitions

Traditional professional education can cultivate students' theoretical abilities, while innovative and entrepreneurial practices have more advantages in cultivating applied talents. So professional teachers should effectively improve students' ability to combine theory with practice through a combination of theory and practice. At the same time, 3E integration should be combined with local industrial needs, investigate regional talent shortcomings, explore unique educational models based on professional characteristics, and fully realize the joint efforts of government, school, and enterprise in cultivating new engineering talents.

On campus, professional course teachers guide students to

identify problems from multiple fields such as technological development, rural revitalization, medical health, so as to instruct students to participate in innovation and entrepreneurship competitions by forming a project-centered and question-guided teaching mode, which can test students' innovation and entrepreneurship thinking and abilities in practice. This method has a promoting and driving force in mobilizing students' enthusiasm for learning, improving the teaching effectiveness of professional courses, promoting the establishment of a diversified assessment and evaluation system for professional courses, deepening of curriculum reform, professional construction, subject construction, engineering certification and other work.

3.2.3. Optimize the Evaluation and Assessment System

Evaluation and assessment system should be optimized, which need enhance the weights of innovation and entrepreneurship practice and ideological and political education assessment indicators in addition to professional skills, in order to establish a comprehensive evaluation and assessment model, further promote the credit transfer system, and encourage students to participate in entrepreneurial team incubation projects, various competitions, forums, social practices, etc.

3.3. College Policy Supporting

Supporting from college policies is particularly important in the implementation of 3E integration.

3.3.1. Training and Incentive Policies for Composite Professional Teachers

Colleges should organize professional teacher training and guide professional teachers to clearly abandon views such as "innovation and entrepreneurship education is a matter of the student work department". They should fully understand the importance of professional curriculum in guiding students' scientific values, life values, and cultivating the talents needed for the country. The construction of the teaching staff can be implemented by participating in innovation and entrepreneurship education training courses. At the same time, professional course teachers can serve as guidance teachers for students' research projects or innovative practice

according to their own research direction to improve their teaching level and practical ability effectively. Colleges should introduce relevant policies to promote teacher development and implement incentive and reward measures for professional teachers.

3.3.2. Supporting Policies for Comprehensive Reform Promotion of Talent Cultivation Evaluation System

Colleges need to continuously improve the comprehensive evaluation system for cultivating innovative students. In a multi-subject evaluation system, evaluators need to cover professional teachers, academic staff, counselors, party committees, youth league committees, etc. Establishment of a scientific and comprehensive evaluation system requires a scientific and comprehensive evaluation of the teaching objectives, process, and effectiveness of personnel cultivation. In the actual evaluation process, it is necessary to combine process evaluation with result evaluation, and colleges must adopt corresponding incentive and coordination mechanisms for various departments.

4. Conclusion

This paper studies college students training method in new engineering disciplines based on the proposed 3E integration mode, which refers to the integration of professional technology education, ideological and political education through curriculum, and innovation and entrepreneurship education. The latter two are important educational modes that undergraduate students and professional teachers should deeply participate in and are usually ignored in the traditional college students training. 3E integration mode is different from the integration of innovation and entrepreneurship education and professional education, or the integration of innovation and entrepreneurship education and values education that many universities or colleges are currently performing. The characteristics of implementation path of 3E integration mode are reflected in the followings.

- 1) Emphasize professional courses and relating reforms. Through a hybrid online and offline teaching mode, effectively integrating professional course content, ideological and political education elements, innovation and entrepreneurship cases in teaching design, and combining interdisciplinary thought, comprehensively guide students think and practice from multiple dimensions such as professional skills and cognitive strategies with new engineering disciplines perspective.
- 2) Provide comprehensive implementation method for 3E integration from levels of curriculum, major, and colleges. It takes into account the common development of teachers and students, and has the breadth and depth of curriculum construction, professional development, school improvement, regional promotion, and national rejuvenation, in order to promote the higher education to meet the needs of country and social development.

- 3) Pay attention to the reform effect of the evaluation system. This paper provides ideas about conducting a scientific and comprehensive evaluation of the teaching objectives, teaching processes, and teaching effects of talent cultivation through establishing diversified evaluation subjects and scientific evaluation content, which is helpful to improve the incentive mechanism, and fundamentally stimulate students' internal driving force and creativity in learning.

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