

FUTURE-PROOF ENGINEERING: A CROSS-FUSION OF DISCIPLINES IN INNOVATIVE EDUCATION

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Abstract

In response to the need for cultivating high-quality comprehensive talents and adapting to national economic and social development, colleges and universities are embracing a multi-disciplinary cross-fusion cultivation mode in their undergraduate education reform efforts. This mode aligns with the Ministry of Education's "New Engineering Research and Practice" initiative, which emphasizes the integration of engineering disciplines with other fields to advance interdisciplinary training and foster versatile engineering talents. The "Guidelines for New Engineering Research and Practice Projects" further underscores the importance of this approach in promoting a comprehensive engineering education concept and exploring innovative models for multi-disciplinary cross-fusion engineering talent development.

In light of these policies, local educational institutions have initiated transformative processes to align with the changing landscape. This paper delves into the implications and strategies associated with this shift in educational paradigms, shedding light on the evolution of higher education towards a more integrated and forward-thinking approach.

Introduction

The implementation of multi-disciplinary cross-fusion cultivation mode is a beneficial attempt for colleges and universities to actively adapt to the needs of national economic and social development and cultivate high-quality comprehensive talents for the country, which has become a trend in the reform of undergraduate education in colleges and universities. In 2017, the Ministry of Education of my country issued the "Notice on Carrying out New Engineering Research and Practice", which pointed out that facing the urgent needs of current and future industrial development, promote the cross-integration of engineering majors with other disciplines, and carry out new engineering research and practice. In the same year, Education released the "Guidelines for New Engineering Research and Practice Projects", which clearly pointed out that "establish a comprehensive engineering education concept, promote interdisciplinary training, and explore a multi-disciplinary cross-fusion engineering talent training model. New engineering is based on new ideas, new structures, new model, new quality, new system as the goal, with the concept of facing the future and demand, taking inheritance and innovation, intersection and integration, openness and synergy as the main ways, based on cultivating diversified, innovative and excellent engineering talents[1-2]. Under the guidance of this policy, local colleges and universities have started to transform and develop one after another.

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Since 2017, Xi'an Jiaotong University has divided the existing 83 undergraduate majors into seven major categories including science, medicine, humanities, and foreign languages, and several experimental classes. After students enter the school, they will undergo 1-2 years of integrated training. Freshman to sophomore year at NYU Shanghai implements the integrated training. Before the end of the second year, students can choose majors according to their interests and aspirations[3]. In recent years, Wuhan University, Nanjing University and other colleges and universities have implemented the training mode of major science classes and major liberal arts classes in recent years[4]. Among them, the first two years are implemented the integrated training, and the second two years are followed by professional learning. Peking University explores the "Yuanpei Training Program Experimental Class".

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In the first year and a half of enrollment, students receive mainly general education, regardless of liberal arts or science. In the second half of the second year, students determine their own major according to their personal interests and social needs. Nanjing University implements the "three-three system" training model [5-7]. Nanjing University implements the "three-three system" training model [5-7]. The abovementioned colleges and universities formulate (revise) teaching management systems such as the reform plan for cultivating talents, the incentive method for teacher construction, the management method for professional diversion, the implementation rules for the separation of teaching and examination, the online selection of courses across colleges and disciplines, and the recognition of credits, etc., which provide a solid guarantee for interdisciplinary talents training.

Different from my country's implementation of integrated training methods, American colleges and universities implement the credit system, emphasizing the minimum number of credits required for graduation, without clearly specifying the number of years of study [8]. The teaching plan of this credit system is relatively flexible. Students can arrange their own study plans according to their abilities and interests. It is also allowed to change majors at any time, so there is a lot of room for choice. At present, colleges and universities that implement the credit system in the United States have shown the characteristics of procedure, systematization and maturity in the operation mechanism. The credit system is also very popular in European universities. MIT, Nanyang Technological University and Munich Technical University are all famous for their engineering. Whether it is MIT's generalist education model, Munich Technical University's professional education model, or Nanyang Technological University's elite education model, which all focus on student-oriented. They attach importance to the cultivation of students' subject foundation, so that students have a high degree of consistency in multidisciplinary basic knowledge and comprehensive quality. At the same time, they emphasize the consciousness and initiative of students' contact with society and integration, aiming at students' practical ability and innovative consciousness. , so that students can truly adapt to social development.

In order to promote the cross-integration of disciplines and majors, while adhering to the characteristic development of each major, in March 2020, the School of Artificial Intelligence of Hezhou University explored and implemented the "three-way, three-in-one, two-top" school-enterprise cooperation talent training model, that is, in the national undergraduate Under the framework of quality standards, the first 3 semesters of each major will be integrated training, the school-enterprise cooperation joint training will be implemented in the middle 3 semesters, and post internships will be carried out in the last 2 semesters. Among them, the integrated training is an important part of the "three-way, three-in-one, two-top" multi-disciplinary cross-integrated talent training model of the School of Artificial Intelligence. It is an important way to focus on students' sustainable development capabilities and cultivate students' broad disciplinary foundation and professional ability. The integrated training refers to the talent training mode in which all the students of undergraduate majors in the college have the same teaching content in the first three semesters after entering the school, the teaching breaks the professional barriers, breaks the administrative class, organizes the teaching uniformly, and conducts professional diversion according to the students' volunteer and achievements after the end of the third semester. However, the integrated training is a system teaching management engineering, need close cooperation between various departments, will bring impact and challenges to the current teaching management system and challenges, therefore need to be more

active in the aspect of teaching management system reform and practice, to promote the college teaching management and service level upgrade, improve the quality of new engineering personnel training.

This paper takes Hezhou University College of Industry as an example to analyze the difficulties and challenges brought by the multi-disciplinary cross-fusion training mode to the traditional teaching management mode. On this basis, theoretical exploration and practice are carried out on the teaching management system of the integrated training mode.

1. The problem of the traditional teaching management mode

The multidisciplinary cross-fusion training mode is an important way to cultivate high-quality, compound and innovative talents. On the one hand, the implementation of integrated training can broaden the professional caliber of students, make students' subject foundation more solid, and their knowledge wider. On the other hand, through the basic training in the first three semesters, the penetration, intersection and combination of disciplines have been strengthened, and the teaching content of the three aspects of "general education, basic teaching, and professional teaching" can be organically combined, which is conducive to strengthening students' awareness of Professional cognition enables students and parents to better understand the dynamics of social development's demand for various talents and the employment situation in the market. In addition, it is also conducive to the independent and individualized development of students, stimulates their potential for independent development, and can better meet the needs of social development in the choice of majors, truly embodying the principle of ondemand training.

However, the integrated training mode is a systematic teaching management project that requires the close cooperation of relevant departments, which is a huge challenge to the current teaching management system. It is difficult for the traditional teaching management mode to meet the multidisciplinary crossfusion talent training mode under the background of new engineering, which is manifested in the following aspects:

- (1) The concept of teaching operation management is outdated. The concept of teaching management in Chinese colleges and universities is still using the previous concept of teaching management, such as emphasizing the importance of collective spirit, ignoring the independence and individual development of students; blindly making students obey the school's arrangements, limiting students' autonomy potential for development.
- (2) The teaching software and hardware facilities are insufficient, and the composition of the teaching team is not perfect. At present, my country's application-oriented colleges and universities generally have insufficient teaching staff and incomplete hardware and software equipment, which increases the complexity of class arrangement in the integrated training and reduces the quality of training.
- (3) The way students choose courses independently and separate teaching and testing increases the difficulty of testing standards and teaching quality monitoring. For example, when opening unified courses, there are many teachers involved in teaching, it is difficult to arrange teaching classrooms, and the classroom teaching situation is complicated, and it is more difficult to monitor the quality of classroom teaching.
- (4) In the process of the integrated training, the management of student status of students is very difficult, and at the same time, the complicated management of professional distribution is added. Compared with the traditional model, the integrated training model may lead to changes in student status matters such as administrative classes, suspension, resumption, and graduation qualification review, while the traditional student status management method is prone to errors and omissions.

Therefore, it is necessary to carry out more active reform and practice in the teaching management system, promote the upgrading of the college's teaching management and service level, and improve the quality of new engineering talents training.

2. Establishment of teaching management mechanism under the training mode

Aiming at the challenges brought by the multidisciplinary cross-fusion training mode to the current teaching management mechanism, this paper formulates a corresponding teaching management system. First of all, establish a people-oriented teaching management concept, take students as the main body of teaching, and stimulate students' creativity, enthusiasm and independence through various methods or means. Secondly, improve the management system of unified courses, so that in the case of insufficient teaching staff, school classrooms, laboratories and other hardware facilities, unified courses can be carried out more smoothly. Then,

build a teaching quality assurance loop in secondary colleges and form a continuous improvement mechanism to improve teaching quality. Finally, enhance the efficiency of student status management and optimize the student major distribution system, allowing students to choose majors independently. These measures can improve the teaching management system and escort the college to cultivate high-quality, application-oriented, compound and innovative talents. Among them, the teaching management plan adapted to the multi-disciplinary integration training mechanism is shown in Figure 1.

The construction idea of the teaching management mechanism under the integrated training mode aims to strengthen the cultivation of talents, and is driven by reform and innovation, which meets the requirements of my country's "new engineering" construction. It enriches the theoretical research and practice of the integrated training and teaching management system, mainly including the teaching operation management system, the unified course management system, the teaching quality monitoring system, the student status management system, the professional diversion system, etc. The specific measures are as follows:

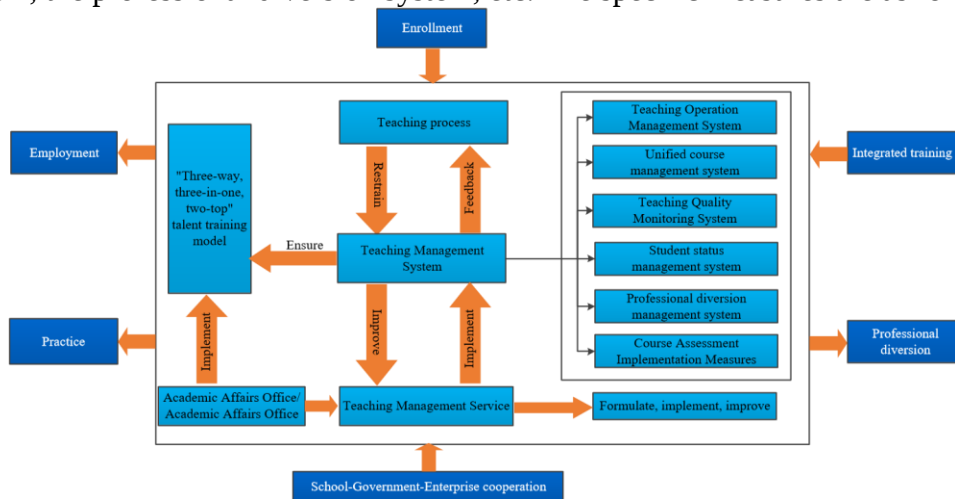


Figure 1: Schematic diagram of the teaching management mechanism of the integrated training mode

3.1. Improve the teaching operation management system of the college

The integrated training mode requires student-oriented and innovative teaching concepts. In the first three semesters, students mainly receive basic knowledge training, requiring a large number of general education courses and basic compulsory courses. This provides students with more adequate and comprehensive knowledge content. However, at present, teachers' investment in teaching and students' enthusiasm for learning are not enough, and the idea of emphasizing scientific research and neglecting teaching still exists. At the same time, teachers lack the initiative to participate in teaching reform, design excellent courses, and innovate classroom models and teaching methods. Therefore, it is necessary to improve the teaching operation and management system of the college, encourage teachers to invest in teaching and students to invest in learning, and pay attention to students' independence and individuality. **3.2. Improve the management system of unified courses**

The implementation of the integrated training model enhances the generalization ability of students, it also increases the number of courses accordingly. However, the lack of teaching staff and teaching hardware facilities in the college will undoubtedly bring new problems and challenges to the daily course selection and scheduling and other related educational affairs management. In particular, the opening of unified courses requires teachers to register for classes, and students choose courses independently, and adopts a teaching mode that separates teaching from examination, which greatly increases the difficulty and complexity of course scheduling and course selection management. Therefore, it is necessary to continue to explore and improve the daily teaching management system, course arrangement and course selection plan of the unified course in practice.

3.3. Reform and improve the quality control and management system of the college

Compared with the traditional talent training mode, the types and scope of courses that students learn under the integrated training mode have been greatly expanded, and these courses of different types and subjects are often undertaken by different teachers of different majors, which will lead to students' lack of education in class. The

location changes greatly and is complicated. Because the content taught by different types of courses is different, and the teaching methods and methods of different teachers are also different, it makes it difficult for the relatively single classroom teaching quality evaluation method under the traditional model to adapt to this changing new situation, which requires the college to must Take effective measures to reform the working mode of classroom teaching quality monitoring. In the process of formulating relevant methods, it is necessary to take effective measures to monitor the quality of classroom teaching according to the teaching reality, and to continuously improve to ensure the quality of talent training.

3.4. Improve the management system of student status

Compared with the traditional model, the model of integrated training has led to multiple changes in various student status matters such as students' administrative classes, suspension of school, resumption of school, and graduation qualification review, which requires educational administrators to always pay attention to and follow up with each student The status of student status changes at different stages, and the traditional student status management system cannot meet the current needs. Therefore, it is necessary to improve the college student status management system, so that student status matters can be managed conveniently and effectively, and errors and omissions in student status management can be prevented.

3.5. Improve the professional diversion management system of the college

After completing the first three semesters of training, it is necessary to implement professional diversion management for students according to their wishes and mastery of professional foundations, so that students can better adapt to the study of professional knowledge. The biggest problem facing professional diversion is the unreasonable distribution of professional diversion. When students choose majors, they are prone to "cluster together", that is, a large number of students will choose popular majors with good employment prospects and strong teachers, while less popular majors will choose less. This "clustering" phenomenon can easily lead to the idleness and waste of teaching resources. Therefore, it is necessary to design and improve the college's professional diversion system or program, so that students can follow their own wishes, choose their majors according to their love and the needs of society.

3. Conclusions

The integrated training is an important part of the "three-way, three-in-one, two-top" multidisciplinary cross-fusion talent training model of the School of Artificial Intelligence. It is an important way to focus on students' sustainable development capabilities and cultivate students' broad disciplinary foundation and professional ability. It is also a systematic teaching management project, which requires close cooperation between multiple teaching departments, which has brought impact and challenges to the current teaching management system.

This paper takes the Industrial College of Hezhou University as an example to analyze the difficulties and challenges brought by the multidisciplinary cross-fusion training mode to the traditional teaching management mode. On this basis, the teaching management system under the training mode is actively explored and practiced, and the existing teaching management mode is improved from five different aspects to meet the requirements of the multi-disciplinary cross-fusion training mode, which has important theoretical references value and practical significance.

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References

Lin Jian. In-depth and solid promotion of new engineering construction - the organization and implementation of new engineering research and practice projects [J]. Higher Engineering Education Research, 2017 (5): 18-31.

- Pei Yuxin, Wang Huifen, Li Qiang. Exploration and Practice of Interdisciplinary Talent Cultivation under the Background of New Engineering [J]. Higher Engineering Education Research, 2021. [3] Li Lijuan, Yang Wenbin, Xiao Ming, et al. Exploration and Practice of the New Engineering Talent Training Model of Interdisciplinary and Multi-Professional Integration [J]. Higher Engineering Education Research, 2020(1): 6.
- Zhang Yongli. Research on the Optimization of Educational Administration in Colleges and Universities under the Mode of Large-scale Enrollment and Training [J]. Beijing Education: Higher Education Edition, 2020(4): 3.
- Zhang Wenjia. The Construction of the Institutional System of Education and Teaching Management in Colleges and Universities—Comment on "Research on Innovation and Practice of Teaching Management in Undergraduate Colleges" [J]. China University Science and Technology, 2022(3): 1. [6] Min Zhaoyan. Institutional Analysis of the Changes of my country's University Teaching Management System [J]. Talent, 2021.
- Zhao Tianzhe, Long Xiangyun. Path Exploration for Improving the Quality of Teaching Management in Colleges and Universities under the Background of New Engineering Construction [J]. University, 2021.
- Zhou Xueqin. Research and Exploration of College Teaching Management System under the Background of New Engineering Major Construction [J]. Computer Knowledge and Technology, 2020, 16(15).