

Research on the Hybrid Teaching Method of Software College under the Background of "New Engineering"

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Abstract: With the arrival of the era of "new engineering", the rapid development of the Internet and new technologies has provided new references for teaching models in universities. Traditional teaching models can no longer meet the needs of contemporary college students. Integrating rain classroom, China MOOCs, Bilibili and other new teaching platforms into the teaching process will play an important role in "1 + 1 > 2". Especially for national strategic disciplines such as cyberspace security and artificial intelligence, it is necessary to closely align with national development needs, actively adjust teaching models, and cultivate new talents in the new era.

1. Introduction

The "New Engineering" is a direction for the reform of engineering education in China, which is based on the new needs of national strategic development, the new situation of international competition, and the new requirements of cultivating morality and talent. The cutting-edge industries represented by new technologies such as robotics and autonomous systems, big data analysis, mobile and cloud computing, cyberspace, energy, smart cities, quantum computing, virtual reality and augmented reality, synthetic biology, etc. The development of these new technologies is changing people's lifestyles, learning methods, and production methods, and has put forward higher requirements for the cultivation of engineering talents. With the development of the Internet and intelligent economy era, the construction of new engineering disciplines has become a necessary issue for talent cultivation in universities.[1] The development of industrial field needs interdisciplinary and multi domain knowledge based talents. Promoting the construction of "new engineering" is an important measure to provide forward-looking and strategic training for leading talents in various fields of engineering science and technology in the future.

The rapid development of the Internet and new technologies has provided a new environment for school teaching models. By utilizing online education platforms, students can easily access professional course knowledge, a large amount of interdisciplinary knowledge, and leading technological content.[2] They can also be exposed to advanced thinking and training models from well-known universities, promoting educational fairness. The blended teaching method organically combines online and offline education methods. With the promotion of "new engineering" education, universities should actively reform their teaching classrooms, explore and practice blended teaching methods, and improve students' abilities of independent thinking, active research and innovation from multiple aspects.[3]

Driven by the "Internet plus" era and the "new engineering" education, the hybrid teaching model of professional basic courses has been widely applied and has made continuous improvement [4]. The purpose of this study is to meet the requirements for talent cultivation in the "New Engineering" field, and to combine the characteristics of basic engineering courses, especially software courses that focus on practical teaching and explore teaching models in depth, in order to adapt to the teaching needs and changes of basic engineering courses in the new era, innovate traditional monotonous teaching methods, and guide students to master more effective learning skills, enhance students' enthusiasm for learning and their level of mastery of knowledge. This study follows the development direction of higher engineering education, conforms to the requirements of the construction of "new engineering subjects" in higher education institutions, and provides reference for the actual effect of promoting the construction of "new engineering subjects". Only by seizing the direction of "new engineering" construction and implementing talent training measures can universities seize new development opportunities.[5]

2. Training and reform of software talents under the background of "new engineering"

The robust development of the software industry relies on high-quality innovative talents. With the implementation of the national innovation driven development strategy, the cultivation of software talents has also received higher attention and requirements. The importance of the software industry is increasing day by day. In order to meet the demand for software talents in China, the country has approved the establishment of 37 demonstration software colleges. In order to meet the needs of Economic restructuring and the urgent needs of the software industry for talents, we must innovate the talent training model, improve the quality of training, and cultivate more software elites with excellent moral quality, professional quality, and outstanding business skills.

Over the past two decades since 2001, the National Exemplary Software College has continuously strived for sustained and healthy development. In various aspects, it has consistently explored and innovated, refined management mechanisms for teaching, research, and disciplinary development, strengthened internal management, improved institutional and regulatory frameworks, and established a scientifically effective management system. The college has continuously bolstered the development of its faculty, attracting and nurturing high-level teaching and research talent to enhance the teaching and research capabilities of its educators and promote the integration of teaching and research. Simultaneously, the college has been intensifying its research efforts, driving the transformation of research outcomes, promoting the integration of industry, academia, and research, and elevating the college's research strength and influence.[6]

The demonstrative software college has taken a new path in software engineering education, continuously accumulating valuable experience, and is at the forefront of higher education in China; The demonstrative software college has led the construction of "new engineering" and is a pioneer and leader in "new engineering"; The demonstrative software college has trained 250000 high-level software talents, covering high-quality enterprises such as Alibaba, Tencent, Huawei, Baidu, etc; The demonstrative software college cultivates new talents for the development of China's industry.

The biggest obstacle to social development is the constraint of core technology on people. In the future, how to solve the key technical issues of national concern, which is the bottleneck problem. Currently, breaking through the key technology of "bottleneck" is an inevitable requirement for promoting high-quality development. China still faces many problems in breaking through the key technology of "bottleneck", but it also has obvious advantages. At a new historical starting point, exemplary software colleges should firmly seize the opportunities brought by the technological revolution, solve technical problems in the development of the software industry, and cultivate more outstanding software talents in a certain field for the country.[7] Firstly, in the process of building a

national demonstration software college, it is crucial to focus on how to stimulate the creativity and enthusiasm of researchers. To achieve this goal, the college needs to undertake reforms in research evaluation and incentive mechanisms, establishing an evaluation system driven by performance and measured by actual capabilities. This fundamental transformation aims to change the short-sighted behavior of some researchers and ultimately enhance the quality of scientific achievements. Secondly, in Chinese universities, the overly distinct disciplinary boundaries and college boundaries must be overcome. It is necessary to promote the collaborative development of disciplines and specialties within universities, actively support interdisciplinary cooperation, and facilitate the formation of large scientific research teams across organizations and specialties to cultivate a new generation of original and innovative talents; Thirdly, it is necessary to promote a culture of innovation, create an open academic environment and innovative atmosphere, and cultivate an innovative ecological environment that can pursue truth, explore freely, promote individuality, and tolerate failure.[8] At the same time, we must abandon those impulsive practices that are eager for quick success and quick success, which go against the requirements of key core technology research and development. In order for researchers to engage in scientific research and technological development work without distraction for a long time, we need to create an environment suitable for the generation of new knowledge in various physical and virtual "knowledge creation fields" such as universities, research institutes, and enterprises. Especially in universities and research institutes, we should encourage researchers to adhere to basic scientific research, as it is the necessary path and fundamental foundation for breaking through key core technologies.[9]

Like the emergence of the Hongmeng operating system, Huawei actively launched the Hongmeng system after years of research and development, despite Google's ban on Huawei's use of the Android system in the United States. This measure not only effectively addresses Google's restrictions, but also demonstrates to the world that China has the ability to independently develop operating systems.

In order to promote the development of the software industry and enhance the innovation and supply capacity of key software technologies, it is necessary to comprehensively promote industrialization and large-scale application, and focus on breaking through key software fields. Software colleges should focus on five key areas of software: basic software, operating system databases, large-scale industrial software, industry application software, new platforms, and embedded systems. The college is committed to implementing an innovation-driven development strategy, expediting the establishment of a new research management system and innovative incentive mechanisms. This initiative aims to enhance the independent innovation capabilities in key core technologies, dynamically allocate innovative resources based on the nature of emerging technology breakthrough opportunities and changes in opportunities, and foster a significant number of high-level software talents who possess both a strong sense of national pride and an international perspective. Secondly, the University should combine its unique disciplines with the geographical advantages of every Province to carry out distinctive scientific research projects, while also paying attention to the trends and dynamics of global technological change. The demonstrative software college has been exploring the establishment of an open and socialized education system since its inception, collaborating with local governments in education, actively communicating and collaborating with local governments to create a new type of college. It has received greater support in various aspects such as funding and land, providing greater space for the healthy and rapid development of the software college.

3. Reform of training programs

3.1. Strengthen the reform of training programs

Universities should promote a wave of educational and teaching reform. Firstly, there is the reform

of the training plan. For the water conservancy specialty, it is necessary to actively reform and reorganize the training plan. The college of science and engineering should do a good job in the establishment of an expert group for revising training plans, broaden its thinking, widely listen to the opinions of experts and alumni from research institutes, leading enterprises, sister universities, actively learn from the opinions of experts from all parties, further improve and reform the training plan, and conduct research on various aspects such as system design training objectives, graduation abilities, education models, teacher assessment, professional courses, teaching methods, etc, fully explore the existing shortcomings and problems, analyze future development trends, deepen the reform and innovation of training models, improve the quality of talent cultivation, and enhance the competitiveness of disciplines and majors. The school should facilitate the joint offering of foundational courses by colleges and professional schools, establish detailed implementation guidelines, and effectively advance the revision of training programs. Through the reform of one college, drive the reform of the entire school, and use one college as the window of the whole school to achieve deep integration with other colleges.

3.2. Grasp the connotation of "New Engineering"

Against the backdrop of unprecedented changes in the world in a century, China's higher education has stood in a very important historical position. Therefore, reform and innovation have become urgent tasks to meet the urgent requirements of the times. In the construction of "new engineering", it is necessary to adhere to the essence of "engineering", which emphasizes practical ability and technological innovation, while grasping the word "new", which emphasizes the comprehensive quality and future development direction of heavy industry professionals. Universities should grasp the essence of "new engineering," confront global technological transformations and the latest industrial revolution, and nurture engineering talents that meet the demands of future development. Using the main approaches of heritage and innovation, intersection and integration, coordination and sharing, we emphasize the preservation and inheritance of professional knowledge, while also stressing interdisciplinary convergence and integration to enhance students' overall competence and innovation abilities, and emphasize collaboration and sharing. Our goal is to cultivate diverse and innovatively outstanding engineering talents for the future, encouraging students to leverage their personal strengths and interests in engineering practice while fostering independent thinking and problems-solving skills.

The "New Engineering" encourages interdisciplinary integration of industry, academia, and research. Intersection and integration are breakthroughs in major engineering technology innovation. The intersection and integration of different disciplines can promote the emergence of new ideas and concepts, and stimulate the spark of innovation. For example, the cross application of computer science and electronic engineering has promoted the development of new technologies such as the Internet of Things and artificial intelligence; The integration of biomedical engineering and material science can accelerate the development and application of new medical materials. The interdisciplinary integration not only promotes technological innovation, but also expands the boundaries of disciplines, improves the comprehensive quality of talents, and promotes the coordinated development of disciplines. As a national demonstration software college, University needs to make good attempts and practices in demonstration and innovation leadership. It is necessary to check one by one whether there is a crossover between the disciplines of the School of Software and other majors at University. The training plan of the college should reflect the characteristics of the local and local economy, otherwise it will have no advantages. When teaching, teachers should combine the characteristics of the school and give lectures based on actual cases. For example, Beijing Jiaotong University combines its own school characteristics of "rail transit" to provide relevant case explanations and course lectures.

3.3. Emphasize the cultivation of teacher teams

As a team of teachers who educate and disseminate knowledge, they should constantly update their knowledge reserves and teaching methods, keep up with the development of the times, and adapt to the needs and changes of students. Teachers should participate in more training and learning, which can expose them to the latest educational concepts, teaching techniques, and teaching resources. At the same time, it can broaden their horizons and knowledge, and provide more ideas and methods for teaching. Therefore, teachers should actively participate in various forms of training and learning, and continuously improve their education and teaching level. Training and learning help teachers understand new areas of knowledge, facilitate the teaching of new courses, and keep up with the changes of the times and the needs of society.

At the same time, software majors attach great importance to practicality, and software development is a highly practical job. For engineering education teachers, necessary practical skills and industry experience are required, which will affect their understanding of engineering practice and teaching effectiveness. Software colleges can collaborate with enterprises to conduct research and development activities, which helps deepen teachers' understanding of enterprise needs and industry trends. At the same time, it can promote teachers' and students' understanding and application of the latest technology, achieve intellectual property transformation, promote industrial upgrading, and help promote the development of local economy. In addition, it is possible to combine the geographical characteristics of every province to support small and medium-sized software enterprises to deeply cultivate specific industries and fields, and form specialized products with market competitiveness. Therefore, the colleges of science and engineering in double first-class universities need to collaborate with enterprises for research and development, in order to achieve a win-win cooperation approach.

4. Reform of blended teaching methods

4.1. Change teaching methods and methods

Blended teaching is a "online" and "offline" teaching method that combines the advantages of online teaching and traditional teaching. Teachers should focus on reflecting ability development in their teaching, shifting from knowledge transfer to ability development, and at the same time allowing teachers to produce more educational reform results in the teaching process. Teachers should clearly define the educational goals during the teaching process, adhering to the principle of "education first, skills first." Through four years of learning, enable students to have lifelong learning ability, communication and expression ability, problem-solving ability, and international perspective ability.

Cultivating talents with innovative thinking and practical abilities has become one of the important tasks of higher education, enabling students to have the ability to learn independently, and placing the cultivation of students' innovative thinking, independent thinking ability, and critical spirit in academic research in a prominent position. The traditional indoctrination teaching method is no longer able to meet the needs of modern education. Teachers are unable to mobilize students' enthusiasm and meet the learning requirements of students at different levels. Large class teaching cannot solve the problem of large individual differences among students. The full classroom teaching method can affect students' self-learning ability, and the contradiction between information technology and curriculum integration is prominent. To reflect student-centered teaching design, it is necessary to consider how to integrate information technology with the curriculum. Schools should provide a more open and free learning environment, and colleges should strengthen the exploration of blended teaching models for professional basic courses. Students should have more opportunities to choose and make independent decisions. Compared with traditional offline experimental practice courses, online experimental practice teaching has different characteristics and challenges. Due to the lack of necessary experimental equipment, students may be affected to some extent during the online

learning process, including learning efficiency, learning environment, and learning atmosphere. At the same time, online experimental practice also requires higher self-discipline requirements, and teachers also need to adopt different teaching methods to adapt to the characteristics of online teaching. This article proposes the following teaching mode:

(1) Teachers construct or select MOOC resources before the start of classes, and through online learning, students can learn independently and solve individual learning problems. Students can fully choose appropriate learning methods based on their own learning situation, select excellent course resources, and arrange their own learning progress. Teachers can conduct research on students' learning situation in advance, grasp the difficulties and pain points encountered during the learning process in advance, in order to highlight the teaching focus in the subsequent teaching. Teachers can carefully design classroom content based on the actual situation of students and the characteristics of online teaching when formulating teaching plans, ensuring that the teaching content is concise, clear, and easy to understand. Finally, add online discussions and evaluations to enhance the evaluation methods of the course. Before class, students should log in to Rain Classroom, China MOOCs, and Bilibili platforms to watch and learn one or two MOOCs comprehensively. The teacher guides students to consolidate and strengthen their knowledge points in class, and solve the pain points of that chapter.

(2) Carry out classroom flipped teaching mode, with students preparing in advance according to relevant literature in chapters and giving lectures in class. Outside of class, teachers record teaching videos, publish materials, initiate assignments, and students watch teaching videos, participate in group discussions, and complete assignments. In the classroom, teachers and students jointly use intelligent teaching tools to achieve flipped classroom through face-to-face communication. Before class, the teacher provides students with a learning method plan, how to register for online courses, how to watch videos, and the process of completing homework. Compared to the traditional classroom approach of teaching first and then learning, blended teaching transforms the teaching structure of churches and utilizes a learning first and then teaching approach. In the classroom, PBL (problem-based learning) teaching method is adopted. First, students are given the latest hot event or research report to raise questions. According to the problem discussion and experimental reasoning, students grasp relevant knowledge points in the process of solving problems. The teacher selects some difficult cases and development projects in the classroom, and allows students to have group discussions and experiments to complete the projects. Teachers extract ideological and political elements in advance, integrate them into teaching, and teach them to students. They can explain them through case studies and use point, line, and surface teaching methods. Literature guidance is a learning method that encourages students to expand their knowledge by consulting relevant literature. Each student needs to consult a certain amount of literature every semester, without the need for intensive reading. They only need to understand the main idea of the literature.

(3) Practice is an important component of extracurricular learning, organizing excellent students to join research groups and participate in competitions, or conducting experimental and practical exercises and other activities. Establish social media platforms such as Weibo, Tiktok, official account and Bilibili between students and the research team to strengthen communication and exchange. Promote students' participation in social service activities and make contributions to society. Modern science and technology have become increasingly dependent on the intersection and integration of different disciplines and fields. Teachers should encourage students to learn and research across disciplines in their teaching, and cultivate their comprehensive qualities and innovative abilities. Schools can break down barriers between disciplines and colleges, support interdisciplinary and cross organizational cooperation, provide students and teachers with more opportunities to engage in different fields and practices, and encourage students to break through conventional practices in learning and scientific research.

(4) The school can ensure that students have acquired the necessary knowledge and skills by assessing the learning outcomes of this course. Assessment can be conducted in various forms such as written exams, experimental reports, project reports, speeches, group discussions, etc. At the same

time, feedback and evaluation can be used to continuously improve course content and teaching methods, and improve teaching quality. In the first few classes, the teacher summarized the key points of the course using a mind map, and later students can summarize them. In the final stage, teachers should evaluate the teaching content, teaching materials, and teaching activities, whether the teaching behavior meets the teaching objectives, whether individual differences are met, and whether the teaching level can be improved.

Conducting blended teaching can cultivate students' hands-on practical abilities, enhance their innovation awareness, and teamwork awareness. Students enhance their classroom participation and self-learning abilities through problem-solving and completing experimental training. By combining online and offline teaching modes, students can more easily remember the content of the textbook. At the same time, students can also consolidate their theoretical knowledge through practical operation. Experimental and practical teaching is an important component of university teaching, which carries the cultivation process of transforming theoretical knowledge into practical application ability, accelerates the process of students mastering and applying professional knowledge, and is an important aspect of cultivating students' practical and innovative ability. Since the launch of the "New Engineering" construction, various universities have accelerated the reform of blended teaching, aiming to strengthen the cultivation of innovative thinking and practical abilities of college students, comprehensively improve their experimental and innovative abilities, and thus ensure the quality of talent cultivation. Teachers should conduct in-depth analysis of the characteristics and difficulties of online teaching, and optimize the setting and presentation mode of course online resources and experimental practice projects to ensure that students can focus on overcoming and understanding the key and difficult points of knowledge content in online teaching, and achieve truly efficient teaching without affecting the achievement of teaching objectives and the quality of cultivation.

4.2. Taboo "Water course, water teacher, water specialist"

The revolution in higher education quality clearly requires the improvement of the level of higher education talents, and the solution to water courses, water teachers, and water specialties. Water courses refer to the elimination of courses that are not suitable for industrial development. Shuishi is a teacher who has poor teaching quality and deceives students. Water courses refer to courses that are not suitable for employment and do not conform to industry development. Therefore, how to create first-class majors, first-class courses, and first-class majors is a major issue that universities must consider. Carry out first-class courses around first-class majors and adopt a mixed teaching approach from multiple perspectives. The knowledge learned by contemporary college students should not only be limited to textbooks, but should shift the focus of the classroom from teachers to students, allowing students to become the protagonists in class, allowing students to learn and teach independently, and cultivating their learning ability.

For science and engineering students, it is very important to solve what problems and how to use the knowledge they have learned to solve them. To this end, for science and engineering students from Double First Class universities, the college should include practical training courses for college students in the designated training plan. Each semester, a professional practical training should be arranged, and a team should be formed to complete a project development. The graduation project report should be combined with the enterprise, and each report should be a true enterprise project. After completing each learning stage task, students can organize results sharing and communication online. In addition, universities can invite technical experts to comment on the students' reports, starting from the perspective of actual production, to help students better understand the specific situation of enterprise project implementation in actual production. When designing online teaching, teachers need to actively explore experimental teaching projects related to the course, combine multi domain and interdisciplinary experimental teaching with course content, innovate course teaching, improve student interaction, and help students better understand the course content and expand their knowledge, thereby maximizing the depth and breadth of students' learning.

4.3. Actively cultivate excellent teaching outcomes and use them as classroom leaders

Through the cultivation and promotion of teaching achievements, the quality and effectiveness of teaching can be improved, teaching reform and innovation can be promoted, teachers' teaching enthusiasm and creativity can be stimulated, and excellent teaching resources and services can also be provided to society. One is to deeply explore teaching innovation and teaching achievements. Scientific research is aimed at better teaching, incorporating research achievements as case studies into teaching and improving teaching quality. The second is to establish a sound evaluation and reward mechanism for teaching achievements, fully recognize and reward excellent teaching achievements, motivate teachers to work harder in teaching work, guide teachers to regard teaching achievements as important indicators, and actively strive for provincial-level and national level teaching masters. The third is to strengthen the publicity and promotion of teaching achievements, promote the widespread application and promotion of teaching achievements, and provide excellent teaching resources and services for society.

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