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The Exploration and Practice on Improving Students' Practical Innovation Ability under the Background of New Engineering

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Abstract: The rapid development of computer technology has brought great changes to education, and it is urgent to reform the traditional practice curriculum, utilize the computer science technology to cultivate and improve students' innovative ability to meet the needs of new engineering construction. Herein, taking textile engineering as an example, a scientific and comprehensive practice teaching system, practical teaching quality monitoring and evaluation system, and assessment and evaluation system is proposed, and an evaluation system of the achievement of students' learning ability is also established based on the analysis of the problems existing in the practice teaching system. Moreover, an evaluation method of student learning ability achievement is established to cultivate compound and application-oriented senior talents with innovative thinking, innovative meaning, and innovative ability to meet the needs of social economy development the demand for innovative talents in textile industry.

1. Introduction

In recent years, many achievements have been obtained in the field of engineering science and technology, including lunar exploration, Mars exploration, and deep-sea exploration. Colleges and universities, as the main frontier of science and technology, must adapt to the current development of science, technology and society to better respond to emerging technologies and industrial revolutions, and serve a series of national strategies, such as the "Yangtze River Delta Integration Construction", "One Belt One Road", and "Made in China 2025" [1]. Therefore, higher education must carry out comprehensive and in-depth reform and innovation. Higher engineering education cultivates all kinds of engineering application talents in our country. However, the content of engineering education is still outdated, and the content and methods of curriculum design lag behind the needs of the development of the new era, and the improvement of students' comprehensive ability of innovation is minimal [2]. Aiming at the current situation of higher engineering education and the needs of national strategic development, the state proposes to build new engineering disciplines and carry out engineering education curriculum reform to meet the needs of the country's modernization development. The key to the connotation of new engineering is to implement the basic task of morality education, take "responding to changes and shape the future" as the concept, the main way is crossover and integration, inheritance and innovation, coordination and sharing, cultivating innovative and outstanding engineering talents [3]. In addition, the new engineering is strategic, innovative, systematic, and open-ended. A series of consensuses such as "Fudan Consensus", "Tianda Action" and "Beijing Guide" have profoundly revealed the connotation and development direction of engineering education in China.

The education ministry has decided to promote the construction of new engineering, aiming at promoting the transformation from engineering education big country to strong country, cultivating high-level engineering and technical talents with strong innovation ability in all fields, satisfying the requirement of rapid economic and social development, serving the needs of innovative national construction and the strategy of strengthening the country through talents, and the country's new industrialization development and continuous improvement in the quality of engineering education. Practical education, as a crucial link in the cultivation of students' practical innovation ability, cultivates students' innovation ability through production and practical activities, such as experimental courses, practical courses, playing an important role in cultivating students' innovation capability, innovative consciousness and innovative thinking [4]. As a result, the quality of practical teaching is directly related to the realization of training objectives, the improvement of students' innovative ability and the achievements of new engineering construction.

Textile engineering is based on the chemistry, mechanics and materials science to cultivate the high-quality applied talents in chemical industry, dyeing and finishing, textile, garment and scientific research fields who can engage in process design, product development, quality control, production and technical management, scientific research and domestic and foreign trade. In addition, textile engineering cultivates students with all-round development of morality, intelligence, sport, art and labor, and master complete theoretical knowledge, basic methods and basic skills, have good comprehensive quality and strong professional ability. According to the connotation of textile engineering, the quality of practical education is crucial to the cultivation quality of textile engineering major, which directly affects students; practical innovation ability, manipulative ability, and the ability to participate in engineering and solve complex engineering problems. Therefore, it is necessary to utilize the computer science technology to reform the traditional education mode, and improve the students' creativity, so as to satisfy the requirement of new engineering construction.

2. Methodology

2.1. Construction of Multidimensional Practical Teaching Curriculum System

At present, the practical curriculum system of textile engineering major mainly includes concentrated practical teaching links, graduation design (thesis) and experimental curriculum system, mainly including comprehensive process experiments and engineering design innovation experiments. Combined with the training objectives of textile engineering, it is very important to build a multi-dimensional comprehensive practical teaching system that is compatible with the training objectives [5]. Figure 1 shows the construction principles of practical teaching system, which combines the theory and practice, stated and systematic. Moreover, in order to cultivate the students' social practice ability, engineering practice ability, innovation awareness, we built a multi-dimensional practical teaching system as shown in Figure 2, which includes one whole (practical teaching), two platforms (class 1 and class 2), three combinations (combination of theory and practice, combination of compulsory and elective courses, combination of scientific research and experimental teaching), and four levels (fundamental, professional, integrated and innovative). The class 1 is still all aspects of the current practical teaching, mainly including experiments, curriculum design and practice, etc. The class 2 refers to various comprehensive and diverse practical activities that can improve students' innovative ability and team spirit, including scientific and technological activities, subject competitions, "innovation and entrepreneurship project", "internet +" and social practice.

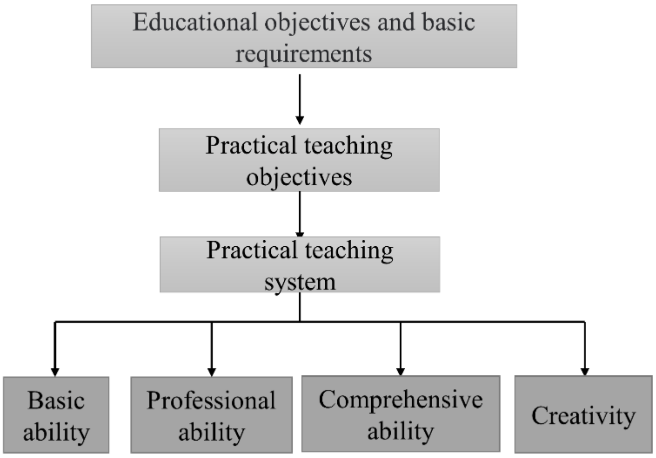

Figure 1: Construction principles of practical teaching system for textile engineering

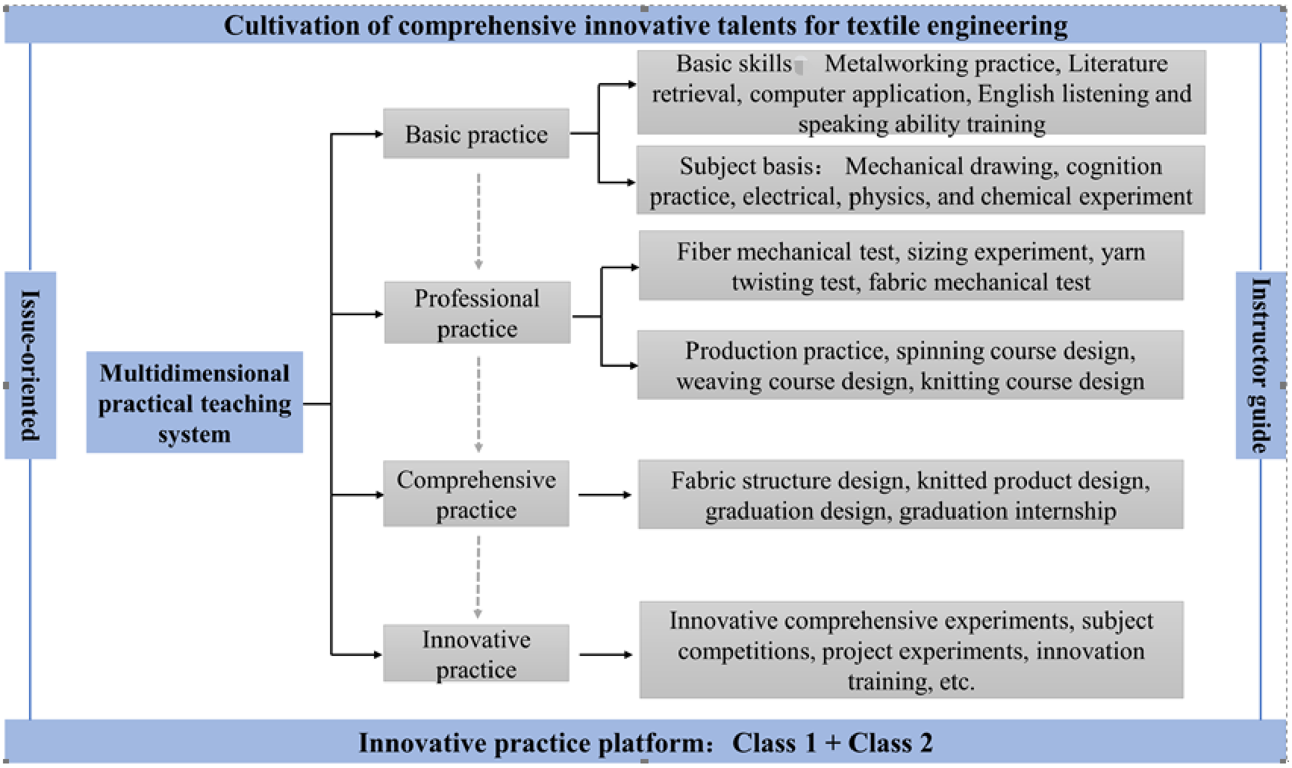

Figure 2: Multidimensional practical teaching system for comprehensive innovative talents of textile engineering

Given the differences in practical ability and knowledge reserves of different grades, we carried out multi-dimensional practical teaching from basic, professional, comprehensive and innovative step by step. At the same time, we implemented the "student-centered" engineering education concept to ensure that students' subjective initiative can be fully exerted, encourage exploration and research between teachers and students, and among classmates, help students integrate basic knowledge in practice, and improve innovative thinking and innovation ability. In addition, we must take engineering certification as an effective means in the process of cultivating composite innovative talents in textile engineering [6], and adhere to the concept of problem-oriented and goal-oriented engineering education, constantly improve the practical teaching system, and promote the improvement of students' innovative ability and innovative consciousness in the whole process of practical teaching.

2.2. Construction of Multidimensional Practical Teaching Faculty

The overall quality and structure of the teacher directly determines the quality of practical teaching and the improvement of students' practical innovation ability [7]. Teacher of the practical courses should have the following characteristics: (i) Strong scientific research ability and rich experience; (ii) Strong ability to guide the practical operation and production practice; (iii) Rich theoretical teaching experience. During the construction of the new engineering discipline of textile engineering, the number of practical education teachers should also be increased, and the college should allocate practical teaching teachers in accordance with the echelon of professors, associate professors, and lecturers. In addition, a certain number of young doctors should be added into the practice teaching team to strengthen the training of the engineering education background of the teaching team.

The following strategies can be adopted for increasing the engineering education background of teachers: (i) The college can organize teachers to go to the enterprises to engage in product exploitation and technical supervision, and the strict assessments should be conducted to improve their engineering capabilities and awareness. (ii) The college should encourage teachers to cooperate with other scientific research affiliations and enterprises, and sign industry-university research project. At the same time, teachers and the related enterprises can work together to overcome the major scientific problems, scientific and technological research, and new product exploitation, so as to promote the improvement of teachers' engineering technology application ability and engineering practice ability.

2.3. Construction of Multidimensional Practical Teaching Base

One of the basic requirements for improving students' practical ability and innovative spirit is to establish a certain number of stable and high-quality internship training bases. The construction of the practical teaching base must basically meet the needs of students' practice in terms of quantity, and ensure the improvement of students' practice level in terms of quality. It is necessary to strengthen the cooperation with enterprises, industries, and society to ensure the scientific advancement of construction of practical teaching base. In addition, it is necessary to reform the traditional teaching mode, and construct the school-enterprise cooperation and joint cultivation teaching mode, so as to ensure the improvement of students' innovative ability and innovative thinking.

2.4. Application of Information Technology

The development of information technology promoted the development of the "Internet +" education mode, and reformed the traditional education mode [8]. One of the biggest advantages of the information technology is that students can utilize the modern information technology tools to study anytime [9], such as "Rain classroom", "Learning pass", "Tencent conference", and "MOOC". Meanwhile, the open course website can also be built to construct complete practical teaching network resources, and practical teaching video can be recorded to establish complete network resources for pre-class preview and post-class consolidation [10], which plays an important role in improving the quality of practical teaching and cultivating students' innovative ability. In addition, virtual simulation lab, as a typical representative of information technology, benefits for stimulating students' interest in courses, improving students' practical ability and comprehensive quality, and cultivating high-quality engineering and technical talents [11]. Therefore, it is necessary to construct a certain number of virtual simulation labs to improve students' practical ability.

The traditional teaching model is teacher-centered and teaching-centered, however, the online/offline hybrid teaching mode is student-centered and learning-centered [12]. Therefore, the teaching design of the online/offline hybrid teaching mode is particularly important. In order to fully utilize the characteristics and advantages of network resources and online platforms, and realize the teacher-student interaction, student-student interaction, and human-computer interaction, the online teaching can be conducted by using the teaching video, virtual simulation experiments, and case-based teaching resources [4], and the offline teaching is guided by the CDIO concept, and conducted by using the experimental tasks [13]. As a result, utilizing the advantages of information technology tools and the online/offline teaching mode is feasible to improve the students' cooperating ability, thinking ability, independent learning ability, etc.

2.5. Practice Teaching Quality Monitoring and Assessment System

2.5.1. Construction of the Quality Control Mechanism of Practice Teaching

It is necessary to persist in comprehensive quality concept and awareness and strict quality standards, so as to fully guarantee the main task of improving students' practical ability and innovation ability in practical teaching [14]. Until now, the Anhui Polytechnic University has established a scientific and complete practical teaching quality decision-making command system, quality operation management system, quality standard system, quality condition guarantee system, quality monitoring system, quality evaluation system and quality feedback improvement system. Meanwhile, it is necessary to strictly control the quality monitoring system, continuously improve the quality awareness and teaching management awareness of practical teaching, promote the management of practical teaching in an orderly, standardized and scientific manner, and fully realize the complete quality control of "supervision-evaluation-feedback-adjustment" system to achieve a closed-loop effect on the quality of practical teaching.

A complete quality monitoring system is consisted of multidimensional quality monitoring network, including student monitoring, department monitoring, school monitoring, and supervisory monitoring [15]. According to the requirements of new engineering construction, it is also necessary to promote the reform of practical teaching evaluation and assessment standards, work procedures, organizational management, regulatory requirements and management systems, improving the practical teaching management process and system, and strengthening and standardize the supervision and process of practical teaching. In addition, practical teaching supervision system is very important to improve the practical teaching quality, and the complete supervision system should be consisted of school supervision, college supervision, department supervision and internship training unit supervision. It is also an important guarantee for the quality of practical teaching to establish a practical teaching assessment and evaluation system that meets the requirements of the new engineering discipline [16]. Therefore, it is necessary to continuously revise and improve various rules and regulations for the quality monitoring of practical teaching, to ensure the continuous improvement of the quality of practical teaching process and monitoring standards, and to fully guarantee the student evaluation system in practical teaching.

2.5.2. Construction of the Guarantee Mechanism of Practical Teaching Organization

The fundamental purpose of quality monitoring is to improve and enhance the quality of practical teaching, which determines the closed-loop, circular and effectiveness of the sub-system of practical teaching quality monitoring. Moreover, a complete teaching management organization is an effective human guarantee for the completion of teaching quality monitoring. Given the complexity of practical teaching and the guarantee of the practical teaching quality, it is necessary to establish a teaching management organization system composed of school leaders and off-campus experts, to give full play to the decision-making, guidance and argumentation roles of leaders and experts at all levels and functional departments inside and outside the school in practical teaching work, and to form synergies and linkages inside and outside the school. In addition, the school can establish a support mechanism, reward mechanism and accountability mechanism, which will also be possible to continuously improve the quality of practical teaching.

2.5.3. Construction of Practical Teaching Evaluation System

The evaluation of students' learning ability achievement is very important for the quality monitoring of practice teaching [17]. Therefore, it is necessary to fully consider that the objectives of practical teaching, which is to cultivate result-oriented innovative talents. Moreover, it is important to build a scientific evaluation index for the achievement of students' learning ability, formulate a complete and scientific evaluation system for the achievement of students' learning ability, and coordinate with the training of result-oriented innovative talents. Consequently, we can realize the feedback closed-loop effect on the quality monitoring system, and achieve the goal of training innovative talents. In addition, it is necessary to formulate a series of comprehensive evaluation indicators for the achievement of students' learning ability, emphasizing the multi-dimensional evaluation method that "emphasizes both results and processes", and establish and improve a positive feedback mechanism for the evaluation results of students' learning ability achievement, so as to achieve the purpose of "promoting through evaluation".

3. Conclusion

In summary, we came up with a multidimensional practical teaching system of "one whole, two platforms, three combinations, and four levels" in terms of the requirements of the construction of new engineering disciplines in engineering majors and the problems in the training process of practical innovation ability of engineering professionals. In addition, we also constructed a complete quality monitoring system and assessment system of "supervision-evaluation-feedback-adjustment", and establish a student learning ability achievement evaluation method consisting of "multi-dimensional evaluation content, diversified evaluation subjects, and diversified evaluation methods", so as to cultivate compound and applied senior talents with innovative ability, innovative consciousness and innovative thinking, and meet the needs of social and economic development for innovative talents in engineering fields.

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References

[1] Z. Yan, J. Hu, Energy internet in the Yangtze River Delta: opportunities, challenges, and suggestions, Frontiers in Energy 12 (2018) 484-492.
[2] J. Voas, R. Kuhn, C. Paulsen, K. Schaffer, Computer Science Education in 2018, It Professional 20 (2018) 9-14.
[3] F. Farahmand, Integrating Cybersecurity and Artificial Intelligence Research in Engineering and Computer Science Education, IEEE Security & Privacy 19 (2021) 104-110.
[4] J.A. Macias, Enhancing Project-Based Learning in Software Engineering Lab Teaching Through an E-Portfolio Approach, IEEE Transactions on Education 55 (2012) 502-507.
[5] T. Oliveira, D. Stringhini, J. Craibas, A Practical and Systemic Curricular Approach to Teach Computer Systems, Ieee Latin America Transactions 17 (2019) 1349-1362.
[6] S.K. Land, S. Reisman, Software Engineering Certification in Today's Environment, It Professional 14 (2012) 50-54.
[7] L. Porter, C. Lee, B. Simon, M. Guzdial, Preparing Tomorrow's Faculty to Address Challenges in Teaching Computer Science, Communications of the Acm 60 (2017) 25-27.
[8] H.-H. Liu, Y.-S. Su, Effects of Using Task-Driven Classroom Teaching on Students' Learning Attitudes and Learning Effectiveness in an Information Technology Course, Sustainability 10 (2018) 3957.
[9] L. Sun, C.E. Pan, Effects of the Application of Information Technology to E-Book Learning on Learning Motivation and Effectiveness, Frontiers in psychology 12 (2021) 752303-752303.
[10] S. Caballe, A Computer Science Methodology for Online Education Research, International Journal of Engineering Education 35 (2019) 548-562.
[11] S. Ros, A. Robles-Gomez, R. Hernandez, A.C. Caminero, R. Pastor, Using Virtualization and Automatic Evaluation: Adapting Network Services Management Courses to the EHEA, IEEE Transactions on Education 55 (2012) 196-202.
[12] R. Zhang, Research on online-offline hybrid teaching method of computer course based on mobile APP, Basic & Clinical Pharmacology & Toxicology 127 (2020) 211-211.
[13] J. Haiyi, T. Dejun, A CDIO-based teaching quality monitoring system for computer science and technology specialty at private universities, in: 2010 International Conference on E-Health Networking Digital Ecosystems and Technologies (EDT), 2010, pp. 156-159.
[14] L.C. Begosso, P.R.d. Silva, Teaching computer programming: A practical review, in: 2013 IEEE Frontiers in Education Conference (FIE), 2013, pp. 508-510.
[15] Y. Li, P. Li, F. Zhu, R. Wang, Design of higher education quality monitoring and evaluation platform based on big data, in: 2017 12th International Conference on Computer Science and Education (ICCSE), 2017, pp. 337-342.
[16] Y. Chen, L.B. Hoshower, Student Evaluation of Teaching Effectiveness: An assessment of student perception and motivation, Assessment & Evaluation in Higher Education 28 (2003) 71-88.
[17] H.Y. Wang, I. Huang, G.J. Hwang, Effects of an Integrated Scratch and Project-Based Learning Approach on the Learning Achievements of Gifted Students in Computer Courses, in: 2014 IIAI 3rd International Conference on Advanced Applied Informatics, 2014, pp. 382-387.