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Research on Postgraduate Innovative Ability Training of Ternary Transformation, Triple Fusion and Third Order

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Abstract

The postgraduate practice innovation system has still some problems with innovative content, mentor guidance and innovation methods. This paper proposes a postgraduate innovation ability training system, named Ternary transformation and Triple fusion and third order with the goal of enhancing the ability of research, practice and innovation to cultivate high-level applied professionals under the background of science and education integration. This system establishes a diversified training model for students to participate in course production, individualized comprehensive training and scientific research projects, and builds a practical subject system that integrates scientific research and teaching achievements into a multi-disciplinary cross-integration subject. It further proposes a three-stage progressive training system covering basic experimental ability, professional practice ability and scientific research innovation ability. With the help of the diversified practice carriers, the postgraduate practical innovation ability is comprehensively improved, which promotes the cultivation of a new generation of information technology professionals for national development.

Keywords

Integration of Science and Education, Innovation Ability of Postgraduates, Three-Stage Progressive Training, Diversified Training Mode

1. Introduction

With the increasing number of postgraduates, the quality of postgraduates also presents the situation of multi-level differentiation. With the requirements of new engineering construction for personnel training, the collaborative innovation training mode of postgraduates under the background of new engineering is

explored (Xu & Wang, 2020). The lack of practice link and place, and practical teaching resources, the imperfect protection and reward mechanism are the main reasons that students' innovation and practice abilities are not greatly improved (Sun, 2018). The practical innovation ability directly determines the cultivation quality of engineering postgraduates from aspects of the social environment, the cultivation system, and the assessment mechanism and etc. (Tang et al., 2015). The study reveals that Chinese innovation ability has gradually been improved and shows significant regional agglomeration effects and widening regional gaps (Xu et al., 2022). Currently, a lot of companies are thinking about whether the usage of AI and data will impact their business model (Heidrich et al., 2022). A teaching model of "STIPBL" is put forward to improve the ability of scientific research and innovation for post-graduate students based on three elements of the systematic thinking, creative thinking and practical ability (Yin et al., 2017). Research on the cultivation of scientific research and innovation ability of postgraduates major in computer science in local colleges and universities (Li & Li, 2021). The cultivation of the academic competence of postgraduates is investigated and analyzed using the method of the questionnaire survey and the realistic characteristics and influencing factors of the academic competence of graduate students (Zhang & Jiang, 2021). The development of science and technology innovation is a continuous process, which requires the combination of innovation development and achievement evaluation, as well as process evaluation and result evaluation (Wang, 2021). Based on the actual background of the construction of "smart campus" and "mass entrepreneurship demonstration base" of Nanjing University of Science and Technology, the cultivation of college students' innovation and entrepreneurship ability focuses on tracking guidance and innovation and entrepreneurship ideas development and exploring education informatization through theoretical research and case study (Li, Qiu, & Wu, 2018). A scientific research ability cultivating system is proposed for the whole process management of software engineering postgraduates (Yin, Song, & Hu, 2021). Improving the conditions of scientific research training and strengthening the construction of the tutor team are effective countermeasures and also the core proposition of deepening the reform of postgraduate education (Jiang, 2018). China's innovation requirements are constantly improving according to the requirements of developing a country through science and technology (Wang, 2022). An innovative engineering education center is proposed to bridge the gap between university education and industry's demands for talents (Xi, Chen, & Li, 2022).

The postgraduate education of computer majors should focus on cultivating students' innovation, entrepreneurship and practical ability, which can cultivate high-level applied talents using various technologies to solve practical engineering problems comprehensively. Especially with the development of national strategies, the transformation of new and old kinetic energy, and the application and development of cloud computing, big data, and artificial intelligence technologies, an urgent need rises for graduate students in computer science with

practical innovation capabilities as high-level application-oriented talents. Under the background of the integration of science and education, the innovative scientific research and engineering projects have increased, and various public practice training bases, resource platforms, and professional training rooms can be used off-campus. Based on these, it is possible to study and explore a new model for cultivating the practical innovation ability of the postgraduate students of computer science and technology who can meet the needs of society and industry.

2. The Necessity of Cultivating Postgraduates' Innovative Practice Ability

Postgraduate education undertakes the important mission of high-level talent training and innovation and creation. It is an important cornerstone of national development and social progress, and it is the basic layout to deal with global talent competition. Therefore, the cultivation of the innovative practical ability is the core task of postgraduate education.

2.1. National and Social Demand for Computer Talents

Technological innovation is an expression of decisive strength in international competition and an important means of building a strong country. In order to achieve high-level scientific and technological self-reliance and self-improvement, the country must rely on high-level innovative talents. A systematic and innovative talent training has become an important measure to strengthen China's innovation and competitiveness. In addition, it has become an important goal of postgraduate training to cultivate the innovative and high-quality professionals for satisfying the actual needs of the social and industry development.

2.2. Requirement for the Development of the Information Age

The development of a new generation of information technology such as big data and artificial intelligence has put forward new requirements for the engineering practice ability of postgraduate students. Engineering practice is no longer limited to the cultivation of the practical ability of a single subject professional course, but to the cultivation of the practical ability of multi-disciplinary and comprehensive engineering projects to meet the needs of various industries in the society for information technology talents.

3. The Problems in the Innovative Practice Teaching of Domestic Computer Postgraduate Students

The deep integration of big data technology and application fields has become a trend, so the cultivation of interdisciplinary and compound talents of big data has become an urgent need to promote the social development. The universities not only successively set up big data majors in the relevant information disciplines (such as "Data Science and Big Data Technology" in Computer Science,

"Data Computing and Application" in Mathematics, and "Big Data Management and Application" in Management), but also other non-information disciplines and majors, such as medicine, logistics, finance, have set up some big data courses. The practical teaching is indispensable in the cultivation of compound big data talents. Because each subject has different theoretical curriculum foundations, characteristic practical needs and talent training goals, how to build a diversified, systematic, and hierarchical practical teaching system becomes a major challenge for the current multidisciplinary practice teaching.

3.1. Single Teaching Model of Big Data Practice and Non-Comprehensive Training System

The practical teaching is generally carried out in some professional basic experiments and concentrated practices, which is difficult to cultivate students' abilities to penetrate and comprehensively use various technologies and innovation capabilities.

3.2. Traditional Teaching Content of Big Data Practice and Old Curriculum System

Most of the practical teaching content of big data is the verification of traditional knowledge. The teachers generally lack the practical experience and resources, and the real projects in scientific research and industry are difficult to convert into teaching resources. How to fully integrate "science", "teaching" and "production" and build a diversified and systematic practical curriculum system covering basic ability, comprehensive ability and innovation ability is an urgent problem to be solved.

3.3. Single Service Model of Training Platform

The traditional training platforms of big data in universities are mostly private clouds, which have problems such as the limited IT resources, the inability in creating experimental environments on demand, the fixed curriculum systems, and the less curriculum R&D personnel. Theses cause not to continuously support the model innovations of integration of science, education and industry.

4. Reform Measures for the Cultivation of Postgraduate Students' Innovative Practical Ability

With the goal of cultivating students' scientific research innovation ability and engineering practice ability, the practical teaching concept of "Ternary transformation and Triple fusion and Third order" is put forward.

4.1. Ternary Transformation: Participating in Curriculum Production, Personalized Comprehensive Training and Diversified Training Mode of Scientific Research Projects

Our practical teaching philosophy is based on the development of various industries for the talent demand to plan the development goals of graduate stu-

dents. The emphasis talent demands of the regional industries should be investigated and analyzed by the development trend of various industries. Thus, students' development goals and directions are matched with industry needs.

4.2. Triple Fusion: The Integration of Scientific Research and Teaching, the Integration of Courses and Projects, and the Integration of Big Data Technology and Multi-Disciplinary Cross-Integration

The cultivation system can be constructed by transforming scientific research achievements into teaching resources. The basic experimental courses covering can be formed by mainstream big data technology points and comprehensive practice cases. The cross-integration courses can be built by combining some scientific research projects with some enterprise engineering projects according to the characteristics of science, engineering, management, E-commerce, marine, medical. Furthermore, a multi-disciplinary cross-integration big data practice course system can be set up based on these courses and projects.

4.3. Third Order: A Progressive Training of Basic Experimental Ability, Professional Practice Ability and Scientific Research Innovation Ability

The first stage is to focus on the experimental teaching of big data in the first grade to cultivate postgraduates' basic experimental ability of the subject; the second stage is to pass the "double selection" in the second grade to ensure that all students have the opportunity to join scientific research or enterprise projects according to their abilities; the third stage is to help students with the innovative potential to create some innovation achievements. The whole process always runs through the close integration of scientific research and teaching, courses and projects, big data and multi-disciplinary, and always supports students to participate in course production, comprehensive training and scientific research projects.

4.4. Postgraduate Innovation Practice Platform Construction

Based on some innovation platform, postgraduate students of computer science and technology should be cultivated by adopting a diversified cultivation mode under a plan of gradient innovation ability cultivation and the introduction of interdisciplinary mentor team construction. In the innovation practice platform, there are practice courses with different levels and knowledge points of different disciplines. Students can choose the corresponding courses according to their own knowledge reserve level for learning.

5. Implementation Plan for the Cultivation of Innovative Practical Ability of Computer Postgraduates

The teaching concept of "Ternary transformation and Triple fusion and Third order" aiming at cultivating students' scientific research innovation ability and en-

gineering practice ability is put forward shown in Figure 1, which proposed an effective and reproducible solution to innovate and practice the multi-disciplinary practical teaching system of big data for cultivating the compound big data talents. The progression of students' practice innovation ability training is realized through the online practice teaching platform, innovation practice carrier and practice curriculum system.

5.1. Build a Three-Stage Progressive Innovation Practice Ability Training System

After completing the study of basic practical ability of graduate students, all students can participate in the corresponding scientific research or enterprise projects according to evaluating their abilities. The ability of big data innovation and practice is divided into three levels: basic experimental ability of disciplines, professional core practice ability and scientific research innovation ability. In order to ensure the smooth development of the three-level training, a "progressive" incentive mechanism is provided to continuously promote the depth of students' learning by means of "double selection" and "best selection" (see Figure 2).

5.2. Building a Multi-Disciplinary Big Data Practice Curriculum System

The experimental resources of classic textbooks are introduced, and the channel from scientific research projects to teaching resources is opened up based on the construction idea of introduction and self-research, which forms a three-level curriculum system integrating basic experimental courses, comprehensive practical cases and cross-integrated innovative projects. This curriculum system can support the professional practice of big data in marine, e-commerce, medical and other discipline application scenarios (see Figure 3).

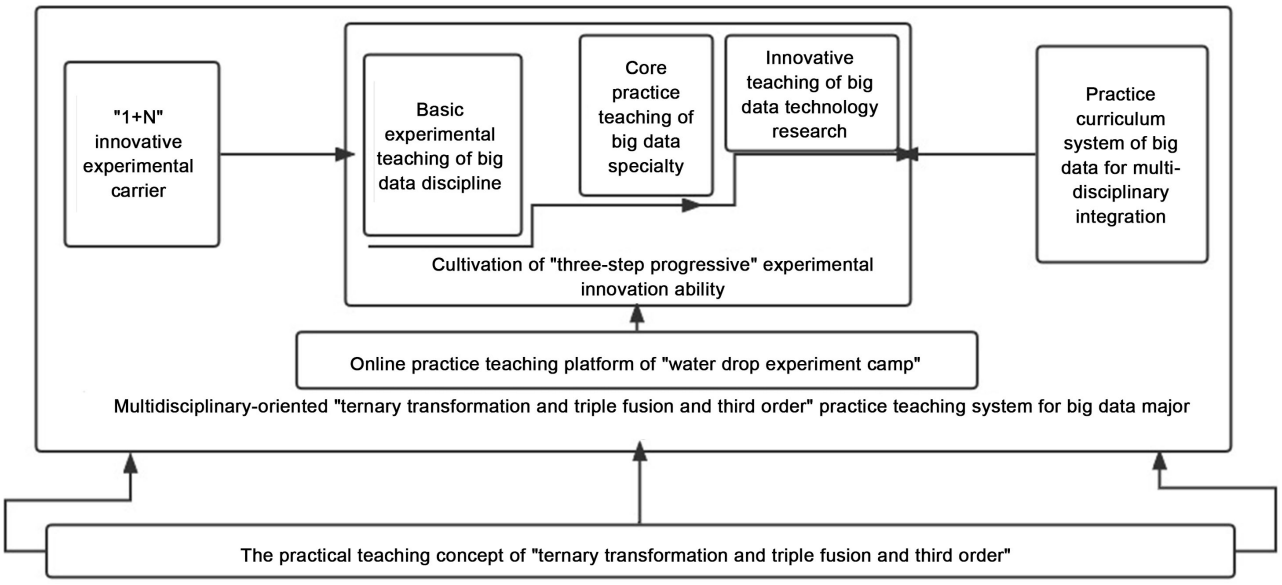

Figure 1. The teaching concept "ternary transformation and triple fusion and third order".

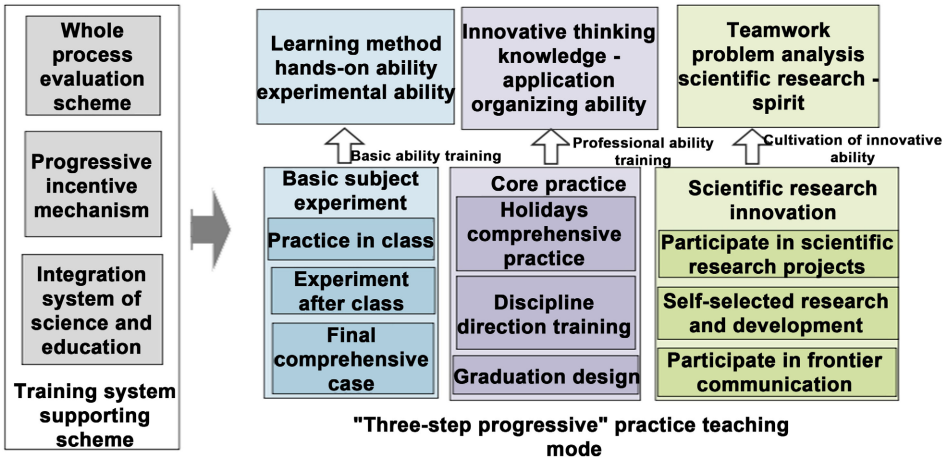

Figure 2. Three-stage progressive innovation practice ability innovation system.

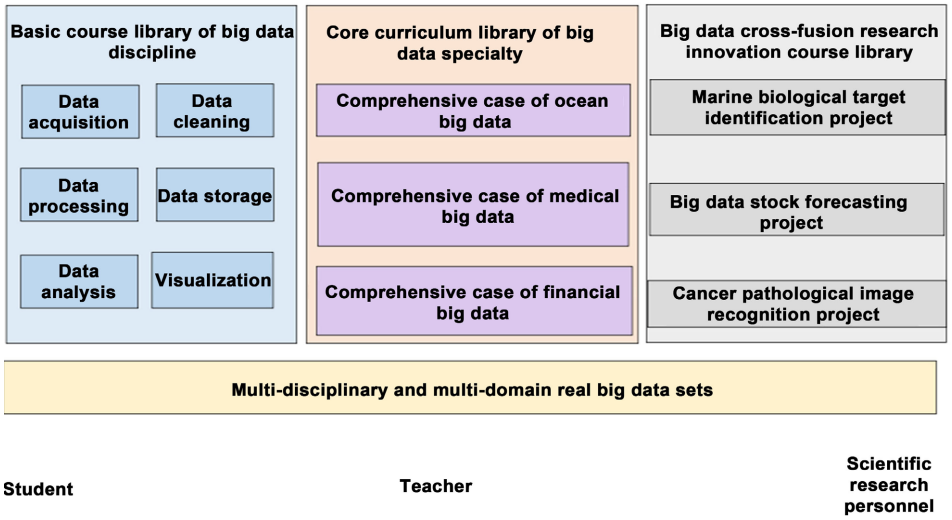

Figure 3. Multidisciplinary practice course system.

5.3. Online Practical Teaching Platform for R & D Resource Sharing

A practical teaching platform is developed using cloud computing technology and rich resources. The innovative construction method assembling online experimental courses provides teachers with a complete set of the functional modules from the practical environment design to the practical results evaluation, which improves teaching efficiency with more practical cases. Teachers can obtain abundant research and development resources on the online teaching platform. Students can not only improve their practical experience and achieve rich knowledge, but also can extract the information knowledge through project researches and practices. The online teaching platform provides a platform for students to learn classes anytime and anywhere, and solves the problem that students have no real data and no real cases to use. The online practical teaching platform not only serves teachers and students, but also provides a bridge for the transformation of scientific research achievements into teaching resources.

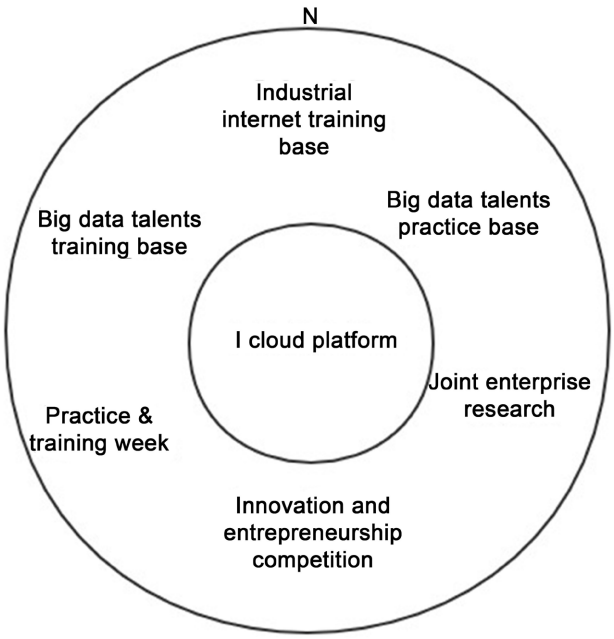

Figure 4. 1 + N innovative practice carrier.

5.4. A 1 + N Practice Carrier to Comprehensively Enhance the Ability of Practice Innovation

The number "1" in "1 + N" denotes a cloud platform or a resource platform, which can undertake various scientific and technological activities, such as the popular science visits, vacation internships, participation in scientific research and seminars, to create an innovation practice platform for students, and the number "N" represents n innovative practice brand activities, such as "Big data talents training base", "Industrial internet training base", "Big data talents practice base", "innovation and entrepreneurship competition", "Practice & training week", etc., which provides the personalized space and innovative ability development for the training of big data compound talents (**Figure 4**).

6. Conclusion

Aiming at cultivating the high-level innovative and applied talents, this paper proposes a concept of Ternary transformation and Triple fusion and Third order for the cultivation of postgraduate innovation ability training. This training system is designed through transforming scientific research achievements and carriers into teaching resources and practice platforms under the background of science and education integration, which not only provides a diversified training mode and builds a practical subject system that integrates scientific research and teaching, curriculum and project, big data technology and multi-disciplinary cross-integration, but also proposes a three-stage progressive training system from basic experiments, professional case training and innovative project practices based on the diversified practice platforms and carriers. The proposed practice mode will improve the innovative practice ability of postgraduates, promote

the reform of postgraduates' innovative practice, cultivate a new generation of information technology professionals, and meet the needs of national strategy and industry development.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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