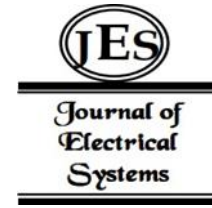


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Research and Practice of Online Postgraduate Quality Management Systems in Local Institutions with the Context of Digital Network



Abstract: - In the digital era, there is an urgent need to reconstruct the talent cultivation system with the support of computer technology, and it is crucial to create and build a quality control system for postgraduate education that meets the development of the times. The system is usually operated online using digital network technology. Most of the postgraduates admitted to the research group come from the same level of institutions or non-graduate training authorization units, and their scientific research ability is relatively weak, hence they need more guidance and help from the university and supervisors in the cultivation process. Relying on the university's "Intelligence +" academic characteristics, the group has explored and practiced digital transformation in terms of accurate publicity, quality improvement, and differentiation cultivation, which mainly includes the following two aspects. The first, take the online teaching management platform as the core, cooperate with the enrollment platform, the practice results platform, and the graduation work platform through the network, with the user experience of teachers and students as the test standard, mine data on the habits of teachers and students, realize the orderly operation of the data-driven postgraduate education process. The second is to improve the teaching management ability and innovation consciousness of teachers under the intelligence education conditions through data platform and online or underline staged training. At the same time, the Group will continue to pay attention to data security and privacy protection issues in the postgraduate QMS, and deeply explore the integration and application of big data technology and education management, so as to improve the management level of postgraduate education and adapt to the new situation and requirements of postgraduate education.

Keywords: Digital Network; Intelligence +; Online Management; Quality Assurance System; Postgraduate Education

I. INTRODUCTION

In the new era, modern information technologies such as big data, artificial intelligence, virtual reality and other modern information technologies are deeply integrated with postgraduate education. This integration has sparked a global movement towards digital transformation and upgrading of educational systems. The empowerment of digital technology has emerged as a crucial driver for the high-quality development of postgraduate education[1]. With the advent of the big data era, the postgraduate education management model is facing major challenges[2]. In recent years, China has introduced some policies aimed at accelerating the process of informatization of education, and these policies have played a positive role to data security and privacy education. At the 2022 National Education Work Conference, the crucial directive to "implement strategic measures for the digitalization of education" was put forward. In the Circular on Strengthening the Informatization of Education Management in the New Era issued in 2021, the Ministry of Education (MOE) emphasized the use of new-generation information technology to shift education decision-making from experience-driven to data-driven, education management from unidirectional management to collaborative management, and education services from passive response to proactive services[3-5].

This series of policy documents clarifies the primary objective of digital transformation in education, emphasizing that the core driver of digital transformation is data. In addition, the "14th Five-Year Plan for Beijing Education Informatization" released in 2022 Beijing Municipal Commission of Education stipulates that higher education should provide teachers and students with a novel of digital, personalized and intelligent education and teaching environment, and serve the cultivation of high-level composite talents. The above documents show that modern technology used to accelerate the reform of talent training mode, and to realise the organic combination of large-scale education and personalized training[6,7].

During the "14th Five-Year Plan" period, relying on the "Intelligent +" disciplinary characteristics in the fields of intelligent information, intelligent control, intelligent manufacturing, intelligent construction, etc., the university is committed to building a new type of "Internet + education" management service platform and extensive data support system. This initiative is based on the needs of teachers and students, fully leveraging the

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power of data to promote scientific decision-making, accurate management, and personalized services in education. It aims to deepen the integration of information technology with education and teaching, and to support the cultivation of high-level innovative talents [8].

The group has experimented with and explored digital transformation in graduate education. In terms of cultivation methods, it adheres to the concept of differentiated cultivation to stimulate the potential and interest of each graduate student to promote their individual development. Through precise thinking, each graduate student evaluated individually to help them achieve satisfactory results in their respective fields of specialization. With the help of data-driven methods, taking massive data as a starting point [9], a closed-loop quality control system for monitoring and early warning against the quality problems of postgraduate dissertations [10] has established to ensure that the academic performance of postgraduate students meets high-quality standards. The use of big data thinking mode for postgraduate management in colleges and universities is an effective way to effective means of improving the efficiency and quality of postgraduate management [11].

II. CONSTRUCTION OF A QUALITY CONTROL SYSTEM FOR GRADUATE STUDENTS IN THE CONTEXT OF DIGITIZATION

The esteemed academic, Professor Zongkai Yang emphasized, “The pressing issue in higher education is that the educational infrastructure from the industrial era is inadequate to meet the demands of talent development in the information technology era”. It is necessary to promote the overall reconstruction of the talent cultivation system with the support of information technology to meet the needs of the new situation [12]. At the same time, the development of graduate education quality also faces new challenges, including the challenges of improving education quality brought about by national strategy and competition among universities, and the challenges of ensuring education quality brought about by scale growth and educational change [13,14]. For example, scholar Meilin Quan et al. suggested that in the era of big data, universities should actively implement a systematic talent management mechanism. In response to the challenges of expanding data scale and insufficient data management level, they should integrate intelligent technology systems and enhance the integration effect of digital media and information technology to achieve comprehensive management goals [15,16]. Haiwen Chi et al. suggested that in the digital era, one of the challenges facing colleges and universities is to cultivate high-end accounting talents. To meet this challenge, the education of master's degree accounting students should focus on cultivating digital literacy, combined with the existing high-demand professional literacy, with the aim of cultivating master's degree accounting students with professional literacy, digital literacy and communication literacy [17]. Yongfei Li et al. had successfully constructed a series of interdisciplinary curriculum systems with the unique characteristics of "digital characteristics + civic and political education" through multidisciplinary crossover and industry teaching fusion, taking the new round of the country's digital revolution and industrial transformation as an opportunity for the professional curriculum system of transportation [18]. Meanwhile, some scholars had conducted in-depth research on the quality control of postgraduate students, for example, Shuguang Zhang et al. constructed the “Five Integration and Five Construction” quality assurance system by focusing on the core elements of building the ideological position, incentive orientation, control system, quality defence and integrity bottom line [19]. Ziling Song et al. summarized nine factors that affect the quality of a dissertation, including management factors, incentive mechanisms, dissertation content and format specifications, structural requirements, evaluation and supervision mechanisms, dissertation evaluation systems, postgraduate knowledge and research ability, quality of supervisor guidance, level of disciplinary sites and research conditions, and implementation of various systems and control measures [20]. Wang Lan et al. highlighted the key points of dissertation quality control links, such as preliminary writing stage, pre-defence, academic misconduct check, double-blind review and formal defence, and emphasize the two core elements of time constraints and quality evaluation. It also specifies the corresponding rules of quality control links to build the quality evaluation system of postgraduate dissertations [21]. Therefore, in order to address these challenge, this paper investigates and develops a comprehensive set of digital quality control system strategies for postgraduate talent development, as illustrated in Figure 1. It bases on the core principle of “nurturing individuals with ethical values, meeting the demands, enhancing the standard, and striving for excellence”. It streamlines the restructuring of the operational process from enrollment promotion to degree conferral.

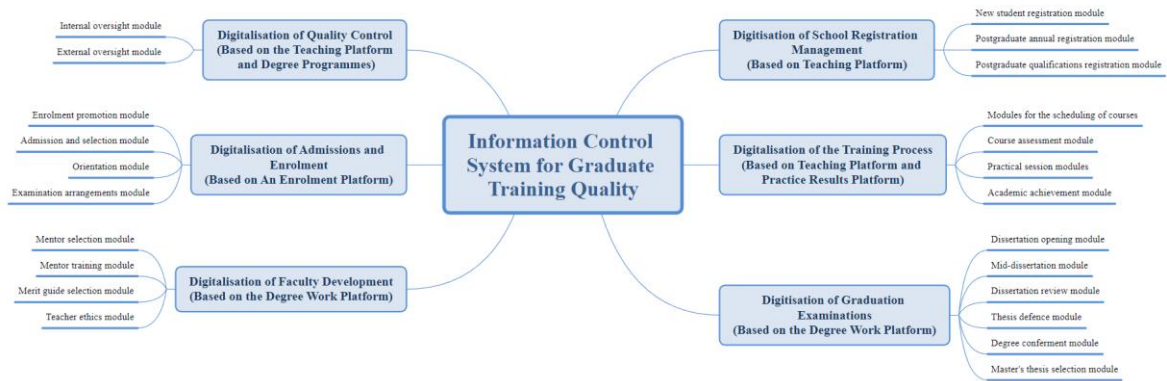


Figure 1: Diagram of the Quality Control System for Postgraduate Training

A. Core Elements of the Quality Assurance System for Postgraduate Education

The traditional management mode can be overtaken by the widespread adoption of information construction in higher education institutions. Utilizing cutting-edge technologies like the Internet and big data, information construction has revitalized postgraduate education and teaching reforms, and promoted the modernisation of education and teaching [22]. The quality control of postgraduate students is crucial, commencing at the enrolment stage and maintaining consistent supervision throughout the student's journey, encompassing registration, training, faculty development, graduation evaluation, and other vital aspects. In each unit, a large amount of data needs to be analyzed and integrated, making digital tools essential. Using the teaching environment as an example, this paper outlines the "one-core and three-star" platform, prioritizing user experience as the benchmark for testing. The data-driven business operates in an organized manner to support the development of postgraduate talents, as depicted in Figure 2. The teaching platform serves as the core, facilitating the interaction between the graduate student enrollment platform, the graduate student practice platform, and the graduate student work platform. It also integrates the essential business processes, regulations, and operational mechanisms of graduate student cultivation into the graduate student management information system. Accordingly, an information support platform covering the whole process of graduate student business by the cultivation quality assurance created. The informatization of the platform's process management and operation mechanism can ensure that each cultivation link strictly adheres to the quality management rules and regulations, avoiding the arbitrariness of human factors and management loopholes. At the same time, it can timely grasp the status of postgraduate cultivation management, which is conducive to strengthening the weak links and quality tracking.

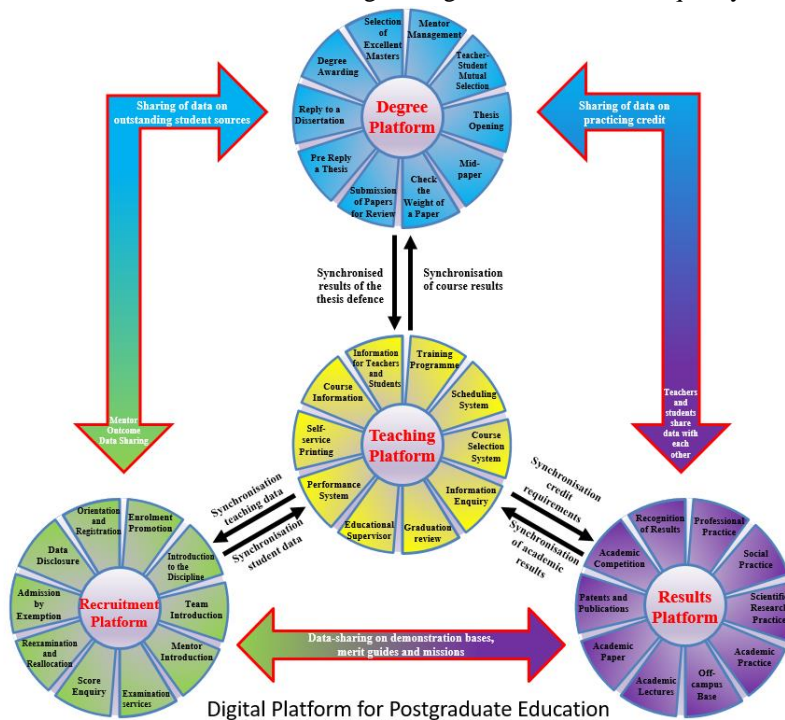


Figure 2: Schematic Diagram of the Platform

Studies have shown that the quality assurance system is crucial in postgraduate teaching management. The university has established a multi-level teaching supervision network, including a university-level supervision group, faculty-level teaching guidance group, and class-level postgraduate teaching liaison officers. Additionally, a relatively perfect talent cultivation support system and cultivation system have been put in place. This optimization of the operation mechanism and working mode is more in line with the needs of postgraduate teaching management, ensuring comprehensive safeguarding of the postgraduate teaching cultivation process and promoting sustainable improvement in the quality of postgraduate cultivation, as shown in Figure 3. To ensure the quality of postgraduate cultivation without any slippage, process management means such as examination on opening report, monitoring the least competent in mid-term, fully-concealed evaluation of dissertation, group defense, etc. should be added to the cultivation process.

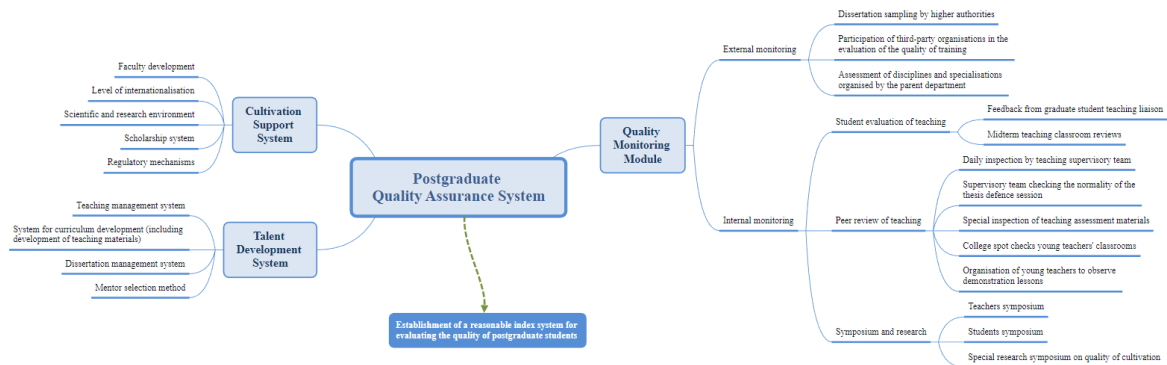


Figure 3: Postgraduate Quality Assurance System

Personalized education is an essential future direction in education. Digital education enhances in-depth analysis of students' learning based on data about their abilities, potential, creativity, and learning progress. Through bi-directional data feedback, it can diagnose and assess the teaching process, assist teachers in guiding students scientifically, and create personalized learning programs for students [23]. Digital education carries out comprehensive evaluation based on data, provides powerful support for learning diagnosis and academic planning, and realizes the process and developmental assessment of postgraduate cultivation, as shown in Figure 4.

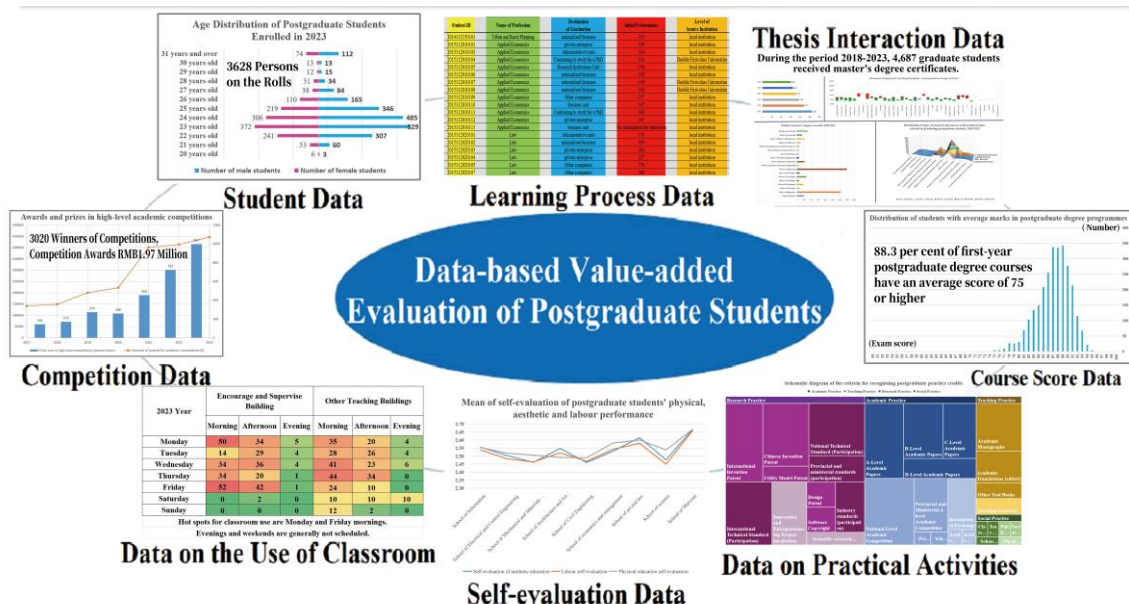


Figure 4: Comprehensive Evaluation

B. Digital Measures for the Quality Control System of Postgraduate Education

1) Promoting Activities for Precision Enrolment: By prioritizing top-tier institutions and majors and utilizing third-party companies, the enrollment platform achieves accurate placement of enrollment advertisements. According to the operating level of the source institutions and the student's enrolment in previous years, the platform adopts a hierarchical publicity and positioning approach. It invests publicity energy in a phased, organized, and targeted manner to maximize the input-output benefits and further promote the influence and

targeting of the school's postgraduate student enrolment publicity. The team examined the postgraduate recruitment situation at their institution over the last decade, utilized the pertinent characteristics of the source institution as search criteria, and developed the corresponding promotional plan, as depicted in Table 1.

Table 1: Positioning Table for Enrolment Campaigns

Search condition	Number of colleges and universities targeted	Positioning for publicity
Continuous Enrolment for Ten Years	22	Long-term cooperation object
Average annual enrolment > 5	12	Key cooperation objects
First-time applicant for the current year	65	Potential partners
Non-consecutive enrolment	decentralized	Seeking cooperation
High-level universities (Double First-class Universities)	88	Targets of cooperation
Universities with qualifications for doctoral authorisation	269	Targets of cooperation

The school's online platforms, such as the school's research website and WeChat official accounts, provide candidates with full-time, high-quality services and introduce the school's characteristics of graduate education and application information in a fully way. In addition to traditional telephone and email counseling, these online platforms offer a more convenient way for candidates to learn about the school. The WeChat official accounts include sections such as "Interpretation of Specialties," "Excellent Teacher Style," "Excellent Team Style," etc., which provide detailed information about the development and academic strength of applied specialties, teachers and students, and the school's overall development through illustrations and text. By showcasing the development of applied majors, academic strength, daily student learning, and teacher research experience, the goal is to bridge the gap between candidates and the school and help candidates make a well-informed decision. These efforts not only improve the school's enrollment impact but also give candidates a more comprehensive understanding of the opportunities available, helping them make more accurate and informed choices when selecting a school.

2) *Measures to control the quality of the thesis:* The Degree Platform has played an active role in standardizing awarding degrees. By strengthening the monitoring process of the dissertation, the progress of the dissertation writing interlocked, and the dissertation data queried and tracked, which helps achieve the academic goal by moving the quality monitoring forward. During the stage of the thesis proposal stage, the topic checked to confirm whether it has research value and feasibility. During the mid-term review of the dissertation, the progress of the project monitored through the platform. Graduate students with insufficient scientific research ability identified in time, and their supervisors reminded to provide guidance and help. If graduate students are unable to improve their research skills with the help of their supervisors, they can sort out for triage. Prior to the dissertation defense, an online double-anonymized examination and an offline pre-defense are utilized to ensure that the dissertation content, the standard of research, and the degree of innovation meet the established requirements for the degree award. The results of the double-anonymized review have a significant impact on the defense qualification and the supervisor's enrollment quota for the following year, so it is crucial to ensure the fairness and objectivity of the evaluation. During the dissertation defense, the defense team will conduct a comprehensive evaluation based on the graduate student's performance, the level of the dissertation, and the research findings, and provide appropriate comments and conclusions on the defense. The conferral of the degree is the final link in the whole examination process, which holistically examines and tracks whether the graduate student's previous examination records meet the proper standards, as shown in Figure 5.

3) *Closed-loop Measures of Process Control:* The interconnection of platforms not only standardizes the various links in the process of postgraduate education but also realizes the control of the whole education process. The interconnection between these platforms and the role of data valves make each business link form a close connection and mutual constraints, thus ensuring the overall improvement of the quality of postgraduate training. Firstly, the interconnection between platforms allows data to be shared and transferred in real time between different business connections, eliminating the problems of repeated data entry and incorrect transmission, and improving work efficiency and data accuracy. Secondly, the role of data valves makes the direction of business processes more standardized and controllable. For example, if the teaching platform shows that the students fail to meet the credit requirements, the dissertation business in the degree platform does not start, thus avoiding the phenomenon that individual students try to avoid academic supervision by chance. If the double selection data in the degree platform is incomplete, it is not possible to start the resulting audit of the practical results platform, which ensures the authenticity and validity of the practical results of postgraduates. If the audit of practical

activities in the platform of practical results not to carry out in time, it will lead to the failure of the audit of graduation qualification in the platform of teaching, which ensures the accuracy and fairness of the graduation qualification of graduate students. The enrollment platform, on the other hand, accurately selects high-quality source institutions based on feedback of comprehensive academic data from other platforms, providing vital support to the university in selecting high-quality students.

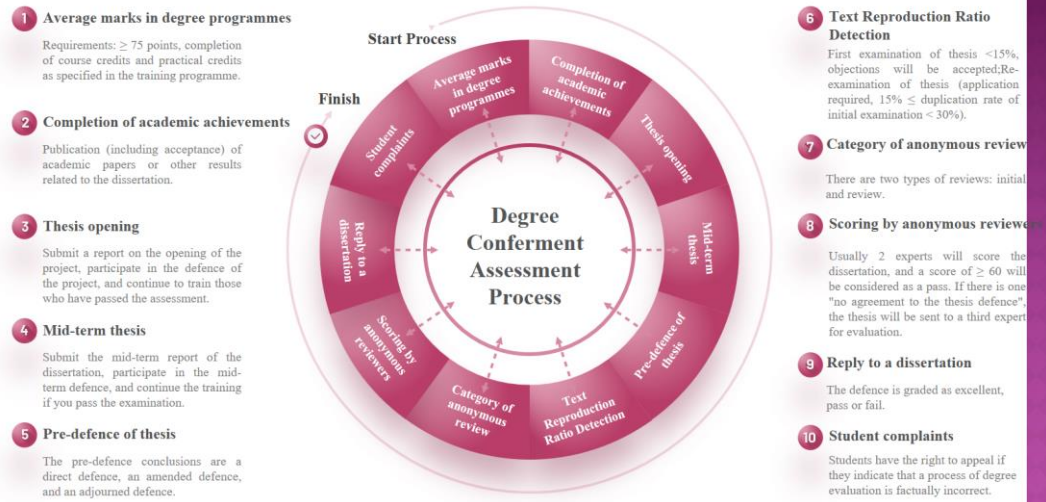


Figure 5: Degree Award Evaluation Elements

4) *Measures to Improve Practical Skills:* To enhance the comprehensive and systematic academic training and practice opportunities for graduate students, and to better prepare them to meet social needs and establish a strong foundation for future academic research and career development [24], the group has optimized the postgraduate practice credits module. In addition to traditional training such as academic salon, academic lectures, disciplinary competitions, and teaching assistantships, diverse training contents including innovation and entrepreneurship projects, professional qualification examinations, publication of academic monographs, patent applications, and publication of academic papers have been added to stimulate postgraduate students' innovative thinking and practical ability. The Academic Conference Funding Application Module will provide more opportunities for graduate students to participate in high-level international conferences, seminars, and short-term academic visits to broaden their horizons and enhance their international competitiveness. Taking the cultivation of application skills as the core, the school has carefully designed practical courses such as Academic Frontiers, Career Guidance, Interdisciplinary Cross-Curriculum, Academic Ethics and Academic Writing, which require students to focus on strengthening the cultivation of basic social and practical skills, such as the ability to read literature and write papers [25]. The base management module aims to strengthen cooperation between industry, academia, and research, and the newly selected joint training demonstration bases integrating research, production, and education can provide more opportunities for postgraduate students to practice innovation. Company cooperation projects can help graduate students to apply theoretical knowledge in practice, thus improving their practical skills and research level [26], as shown in Figure 6.



Figure 6: Interface of Practice Results Platform

5) *Differentiated Training:* Education in the age of artificial intelligence should really make good use of the analytical function of big data, pay more attention to teaching students according to their aptitude, and provide

independent one-on-one training according to their individual differences [27]. The essence of difference management lies in the targeted management of various layers or levels to ensure the rational allocation of resources and the effective promotion of work. The practical implementation of difference management is through stratified or hierarchical management. Postgraduates pursuing an academic degree and those pursuing a professional degree should be cultivated in a categorized manner. For instance, postgraduates pursuing a professional degree, who are required to have more than six months of professional practice, are awarded six practice credits. In contrast, postgraduates pursuing an academic degree can only receive five practice credits through training subjects such as general competence and professional competence practice activities. The university has built a big data monitoring platform, which adopts the deep learning model in big data technology [28] to graphically display the intrinsic relationship between various data in the process of postgraduate cultivation, and conduct in-depth mining of individual and group information of postgraduates, which compiled into self-portraits of individual students and teams. Through the platform data to explore the potential of postgraduates, we tailor-make the individual training plans for them by screening dimensions such as thesis progress, disciplinary competition awards, patents and monographs, foreign language proficiency, writing ability, professional practice evaluation, course study, subject research, frequency of social practice activities, professional qualification certificates, high-level thesis, pre-professional background, and career planning. Precise management bases on hierarchical or tiered management [29] and thanks to the feedback of process monitoring data, tutors can provide personalized guidance to graduate students to achieve tailored teaching, as shown in Figure 7. The platform also records graduate students' learning experiences during the school period. It sends an academic alert to graduate students with academic problems promptly while reminding tutors to offer them precise academic assistance. For example, graduate students who haven't submitted their academic results on the platform or reached a certain number of years of study will receive an early warning.

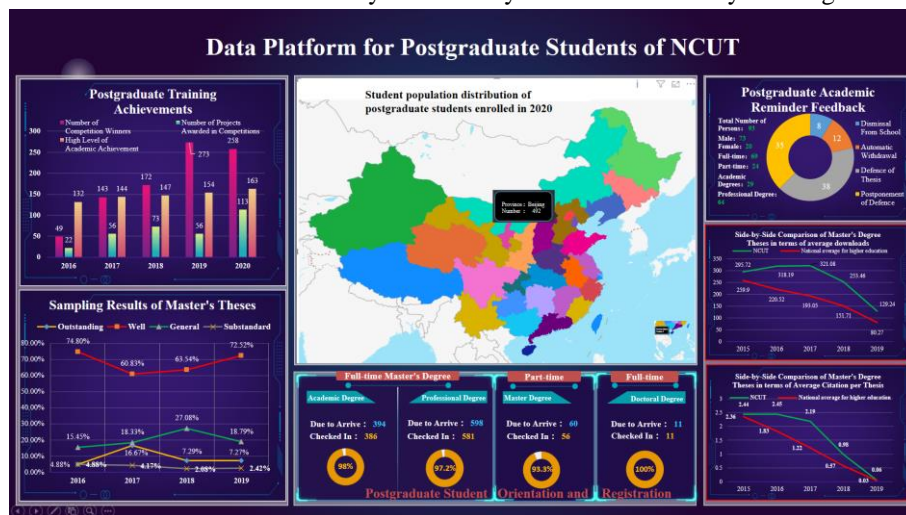


Figure 7: Postgraduate Data Platform Display

III. EFFECTIVENESS OF THE DIGITAL IMPLEMENTATION OF THE QUALITY ASSURANCE SYSTEM FOR POSTGRADUATE STUDENTS

Based on the data, this paper initiated the optimization and re-engineering of critical processes, opening up the business system, providing convenient services, standardizing the workflow, and improving the quality of business. It achieved good results in terms of usage and effectiveness in educating people.

A. Postgraduate Students Undergo a Significant Transformation in Their Learning Style, and Their Practical Accomplishments are Validated

Learning mode transitioned from traditional offline lectures to a blended online-offline approach, resulting in a tenfold increase in online engagement for postgraduate students during the 2021-2022 academic year. This shift has led to continuous enhancements in students' motivation, initiative, time commitment, and satisfaction, with 85% of postgraduate students self-assessing positively in Physical, Aesthetic, and Labor Education, as depicted in Figure 8.

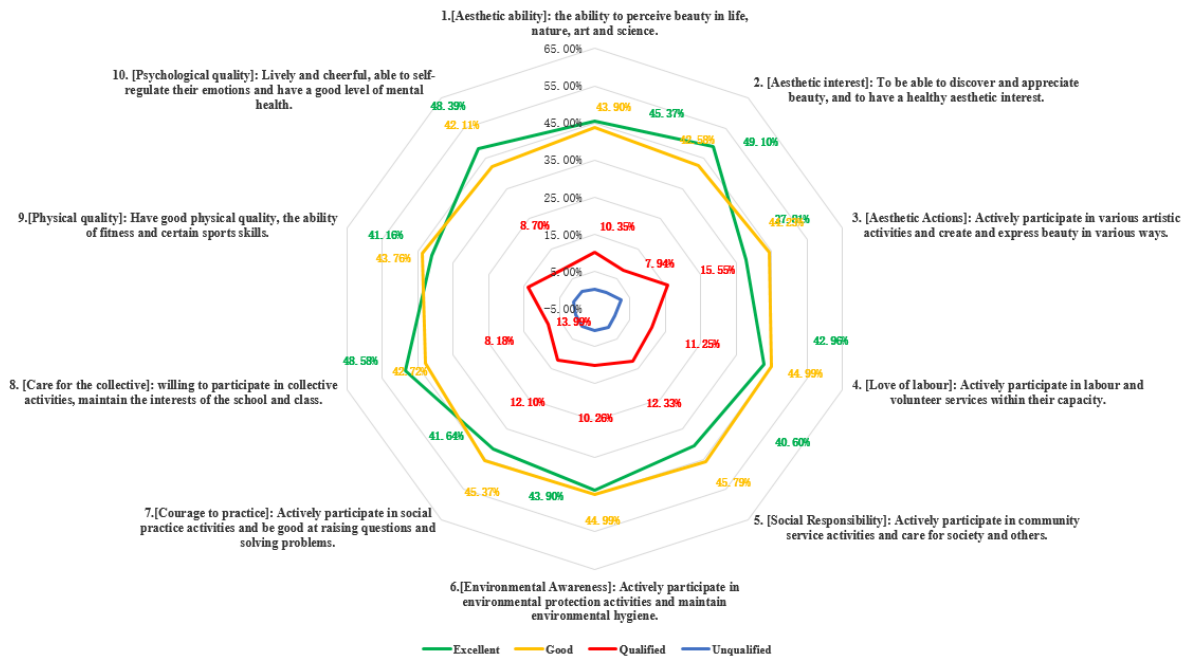


Figure 8: Graduates' Self-assessment of Physical, Aesthetic and Labor Education

The average overall satisfaction of teachers and students in using the platform is 94.6%. Postgraduate students are looking forward to enterprise practice, as shown in Figure 9. 185 off-campus joint training bases have been built, including Beijing Industry-University-Research Joint Cultivation Bases and Jiangsu Postgraduate Workstations, and the degree of convergence between the core curriculum of postgraduate courses and the actual demand is high.

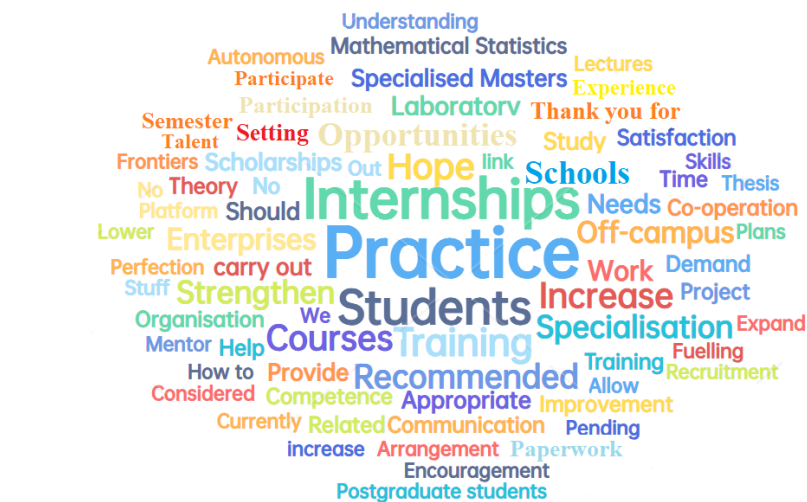
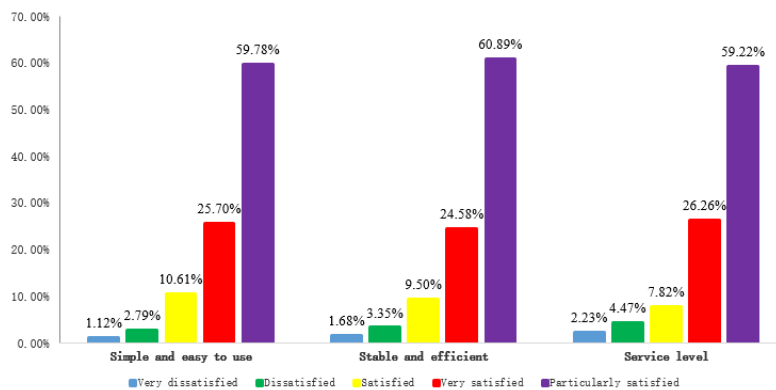


Figure 9: Teacher and Student's Satisfaction with the Use of Information Platforms

B. Teachers' Computer Literacy is Improved

All postgraduate courses in the last three years have implemented online teaching methods, with over 400 classes in the 2021-2022 academic year utilizing online resources like Enterprise WeChat, Tencent Conference, Mooc, and others. Teachers of postgraduate courses have excellent teaching ability and have awarded one national model course of ideology and politics, two Beijing model courses of ideology and politics, ten university-level model courses of ideology and politics, and sixteen excellent teaching cases; two Beijing Higher Education Teaching Achievement Awards and 32 university-level postgraduate teaching achievement awards.

C. Work Efficiency has been Greatly Enhanced

By simplifying the business process, improving the efficiency of teachers and students' procedures, and enhancing user experience, teachers are gradually eliminating cumbersome tasks such as form filling and signing, resulting in a significant reduction in their workload. Between 2018 and 2022, there were over 58,600 student affairs, more than 20,000 independent transcript printings, and approximately 10,000 people using self-service terminals.

D. Continuous Improvement in the Quality of Master Applicants

The university saw a significant increase in postgraduate enrollment and the number of applicants, with a 474 and 2,123 increase in enrollment and applicants in 2022 compared to 2017, resulting in an average annual increase of 12.3% and 26.9% respectively. Among them, the proportion of quality students in full-time master's programs in 2022 was as high as 61.09%. In the same year, the number of quality students in full-time master's degree programs reached 752, an increase of 194 compared with 2017, with an average annual growth of 8.7%.

E. Dissertation Quality has been Enhanced

The Degree Platform submitted 2,797 dissertations for examination between 2018 and 2022. The number of dissertations sent for examination has increased significantly, with 884 being anonymously submitted for review in 2022, marking a 459% increase compared to 2018. The quality of dissertations is now more closely monitored through five stages: text copy ratio detection, anonymous submission for review, pre-defense, defense, and graduation detection. The new graduation detection stage specifically addresses the issue of academic plagiarism and misconduct in graduate dissertations. This new evaluation mechanism has heightened the awareness of quality among teachers and students, reinforced the self-discipline of supervisors and students, and fostered a positive environment for the pursuit of high-quality theses.

F. Student Capacity has been Significantly Improved

From 2018 to 2022, postgraduate students published 4,611 academic papers. They collaborated with their supervisors to publish 11 academic monographs and secured 230 approved patents, including 149 invention patents, 70 utility model patents, and 11 design patents. They won 839 prizes in all competitions, including 323 awards at the national level, with the number of awards won in competitions increasing by an average of 54.37% per year, which enhances the various skills of the graduates, as shown in Figure 10.

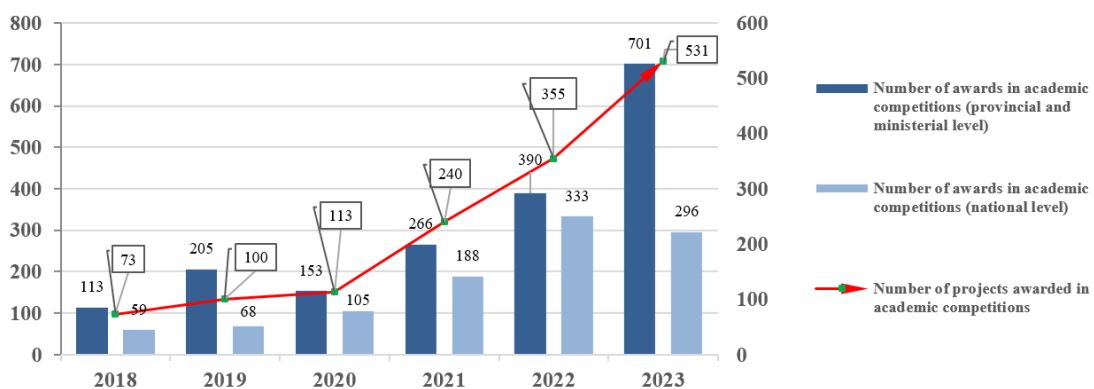


Figure 10: Awards for Postgraduate Students in Academic Competitions

IV. CONCLUSION

Digital transformation is one of the essential trends in the development of graduate education. At present, the university is currently transitioning from focusing on scaling growth to prioritizing quality development. The

digitalization of education is playing a crucial role in accelerating the pace of quality development in graduate education at the university. By leveraging essential data analysis and artificial intelligence technology, the university has established a digitalized system for controlling the quality of graduate education. The system is an essential component of the university's "Smart+" information construction project. This is primarily manifested in the following three aspects. Firstly, in terms of targeted promotion, the use of big data and artificial intelligence technology is employed to identify the needs of potential graduate students and institutions, and to develop precise enrollment strategies. Secondly, in terms of enhancing quality, intelligent platforms are utilized to monitor the progress of students' dissertations and the outcomes of dissertation defenses, as well as to address research issues faced by graduate students. Lastly, in terms of tailored training, artificial intelligence technology is utilized to analyze students' learning behavior, academic performance, and learning outcomes, in order to create personalized training plans and programs, and to offer graduate students personalized and diverse development opportunities.

Advances in big data and artificial intelligence technology have made it easier to collect and analyse teaching data. By analysing teaching data, it is possible to improve the teaching and training methods of postgraduate students and improve the quality of education. However, the collection and use of data also requires special attention to data security and privacy issues. Therefore, the next phase of research will focus on the issue of data security and privacy protection. Establish data protection mechanisms to ensure that the students' personal information and data not to misuse or leak. At the same time, data management and supervision will strengthen to ensure the accuracy and completeness of data. It can consolidate the achievements of university information construction, improve the information application ability of teachers and students, and adapt to the new situation and graduate education requirements.

ACKNOWLEDGEMENTS

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