The Innovative Construction of Integrated Undergraduate-Graduate Cultivation Platform Driven by Informatization: A Case Study of Wuhan University of Technology

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Abstract. With the rapid technological revolution, it has raised higher demands for comprehensive qualities of high-level talents. At the same time, the vigorous development of information technology also provides solid technical supports for the innovative education transformation. For that, WUT actively explores a new cultivation model for innovative talents guided by the principle of "value-first, competency-oriented, knowledge-based"and establish an intelligent and information-based platform breaking down barriers between graduate and undergraduate education. Building on disciplinary strengths and characteristics, WUT has pioneered a management mechanism for experimental classes of graduate and undergraduate integration and made personalized cultivation plans to fully develop core competencies of students such as innovative ability, critical thinking, sustainable development and so on. This innovative initiative not only contributes to the personalized growth and sustainable development of students but also injects new vitality into educational and teaching reforms and enhancing the quality of talent cultivation. Moreover, it cultivates more strategic and leading talents to meet the needs of technological development and national strategic demands, thereby providing solid talent supports for strengthening comprehensive national strength.

Keywords: Informatization, Integrated Undergraduate-Graduate Cultivation, Higher Education, Academic Teaching Management System

1 Introduction

Under the background of domestic economic transformation and industry upgrading, we have made higher demands for innovative talents, the depth and multiplicity of knowledge structures and talent cultivation models. In order to break through the bottlenecks in core technologies and strengthen independent development in science, it is imperative to establish creative talent cultivation plan to provide powerful supports for national strategic needs. Nowadays higher education in China has entered the new stage

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focusing on connotative development and structural optimization, during which the undergraduate and graduate integration is playing a initiative role. It refers to a kind of new educational model that outstanding students are selected to cultivate innovative talents with integrated educational resources and unified arrangement of courses, research practices and teaching management and evaluations [5].

Globally, Germany, the birthplace of doctoral education, and the United States, a model for graduate education, both regard undergraduate and graduate integration as a crucial path for cultivating high-level talents [1]. Domestically, many "Double First-Class" universities have successively launched undergraduate and graduate integration initiatives to explore new models for talent cultivation [4]. Besides, for continuous undergraduate-graduate cultivation, some universities have implemented experimental classes in pilot school, such as "Zhiyuan College" in Shanghai Jiao Tong University, "Honors School" of Harbin Institute of Technology and "Xu Teli School" in Beijing Institute of Technology [2]. These extensive practical explorations have fostered a shared consensus: undergraduate and graduate integration serves as an effective model for cultivating top talents in fundamental disciplines and innovative talents in cutting-edge fields.

Wuhan University of Technology (WUT), as a national key university directly under the Ministry of Education and "Double First-Class" initiative, has actively responded to the development of nation and world driven by informatization of higher education reform. Building on its distinctive features and disciplinary strengths, WUT has initiated the talent cultivation reform of undergraduate and graduate integration and established an information-based platform where it has consolidated educational resources, streamlined cultivation processes, and and created a smoother and more efficient growth channel for high-level talents. Through this platform, it has effectively improved the quality of talent cultivation and capability of research innovation, which plays an irreplaceable and significant role in accelerating the cultivation of innovative talents urgently needed by the nation and boosting the core competitiveness of the higher education system. Since WUT implemented the "undergraduate and graduate integration" in 2022, we have realized that it is an important trend in responding to rapid technological advancement and innovative talent cultivation. However, in practice, we also meet some challenges such as disjointed academic transitions, fragmented management processes, and difficulties in data sharing and so on. For that, we hope to systematically review institutional framework and technological practices of WUT to provide a practical and forward-looking reference for peer institutions, collectively advancing the quality of high-level talent cultivation.

This paper focuses on two core issues in the implementation of undergraduate and graduate integration. One is the institutional framework: How to break down the barriers between undergraduate and graduate education and achieve integration in curriculum system, mentor mechanism, and major specialization to ensure continuity and flexibility in talent cultivation, as detailed in Chapter 2. The other is technological support: How to deploy information technology to put institutional framework into efficient and executable management and service processes and then to address cross-stage information silos, management coordination and other practical challenges, as detailed in Chapter 3. Taking the practice of WUT as a case study, this paper not only manifests

the importance of undergraduate and graduate integration but also systematically elaborates on the complete implementation pathway from institutional framework to technological platform, especially providing detailed introduction to the architecture, function, and integration logic of the platform, forming a "framework+technology" dual-drive model.

2 Framework for Integrated Undergraduate-Graduate Cultivation Platform

To further standardize the cultivation of innovative talents at the university, improve the talent training model driven by technological development and national strategic needs, and strengthen the targeted cultivation of first-class innovators urgently needed by the country, WUT has established Experimental Class for Integrated Undergraduate-Graduate Education. This program is guided by the goal of cultivating innovative undergraduate talents in "Four New" Disciplines (new engineering, new medicine, new agriculture, new liberal arts), focusing on cutting-edge technologies and emerging industries critical to national and regional development by means of innovating training models and optimizing resource allocation. By deepening digital and intelligent empowerment and strengthening interdisciplinary integration, this Experimental Class explores a new paradigm "value-first, competency-oriented, knowledge-based" for cultivating first-class innovators. It aims to cultivate high-quality talents with solid professional foundations, exceptional innovative capabilities, and global perspectives, thereby serving major national strategic needs as well as regional economic and social development.

Experimental Class for Undergraduate-Graduate Integration formulates personalized training plans for students by leveraging the disciplinary strengths and cultivation features of relevant fields. It adopts a "3+1+X" training model which follows a phased approach to integrated undergraduate and graduate education. Specifically, "3" refers to the foundational course phase, primarily offering general education courses, disciplinary foundation courses and professional courses. Through blended learning and innovative experimental practices, this phase consolidates disciplinary foundations and initiates preliminary research-based learning. "1" refers to the undergraduate-graduate transition study phase, where students complete their undergraduate studies, select their research direction in related disciplines, then study about graduate courses and engage in research-based learning. "X" represents the graduate's degree phase, during which students fulfill all cultivation requirements as stipulated in training program. This phase focuses on scientific research practices and course studies at the master's level, culminating in the completion of research achievements summary and dissertation writing. In this stage, students who meet the degree conferral requirements can apply for the dissertation defense, as shown in Figure 1.

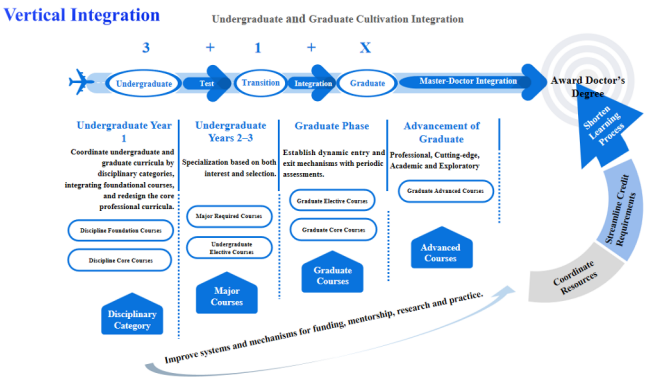

Fig. 1. Undergraduate-Graduate Cultivation Module.

The Experimental Class adopts mentor system. Professors with strong teaching and research capabilities as well as great moral integrity are appointed as student mentors, who are responsible for formulating personalized training plans for students, guiding their participation in academic activities, and creating opportunities for study and exchange overseas. They also provide access to domestic and international academic resources, guide students to propose research topics and supervise the implementation and completion of related research.

Moreover, students in the integrated undergraduate-graduate experimental class receive academic evaluation once per academic year, with results classified into two grades: “Qualified” and “Unqualified”. Students “Unqualified” if their average Grade Point Average (GPA) of courses is below 2.5 in the first or second academic year, or if they fail more than one compulsory courses and their average GPA is below 3.0. Overall, the experimental class implements elimination system whereby students who receive “Unqualified” in two consecutive academic evaluations will be transferred out of the experimental class.

3 The Implementation Approach to Integrated Undergraduate-Graduate Cultivation Platform Assisted by Information

To support the smooth implementation of undergraduate and graduate integration and improve the development of students, WUT has been building an talent cultivation platform for undergraduate and graduate integration since 2022, which bridges academic management systems for undergraduate and graduate.

A University Resource Management and Integration Center has been established between the academic management systems for undergraduate and graduate to break down resource barriers between undergraduate and graduate education. This center aims to develop unified metadata standards and interface specifications for core teaching resources such as course, mentor and equipment, ensuring data interoperability. Additionally, a centralized and transparent resource information database (shown in

Figure 2) has also been created to dynamically aggregate shareable resource information within university, along with establishing standardized online application, approval, and intelligent matching and scheduling processes. Ultimately, this forms a unified resource information release and scheduling hub open to the entire university, further supporting the implementation of undergraduate and graduate integration.

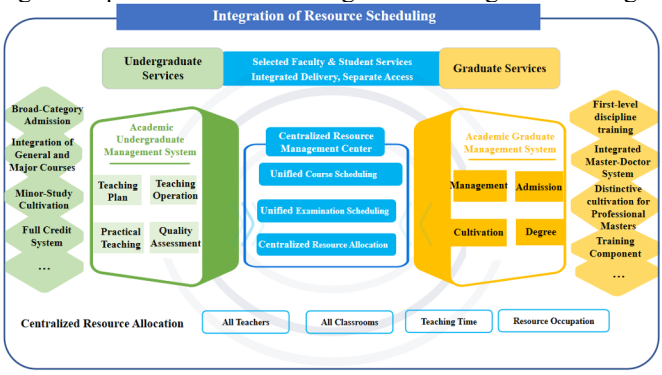

Fig. 2. Integrated Resource Scheduling.

Under the premise of maintaining zero modification to the academic graduate management system, parts of administrative data of undergraduate will be migrated to this newly platform in phases (Figure 3). It is mainly achieved through an "semi-isomorphic inner-layer design" (the undergraduate modules will reuse the core data standards of graduate system while retaining its independent business logic) and an "unified outer-layer framework" (an API gateway and service bus will be constructed to encapsulate the interfaces of the dual systems, providing unified identity authentication, resource directory engine, and intelligent scheduling services externally). Finally, it will form a "dual-core operation and unified portal" resource management center, which performs one-stop scheduling of teaching resources of undergraduate and graduate education without perception from teacher and student interface and realizes smooth transition and consistent experience enabling.

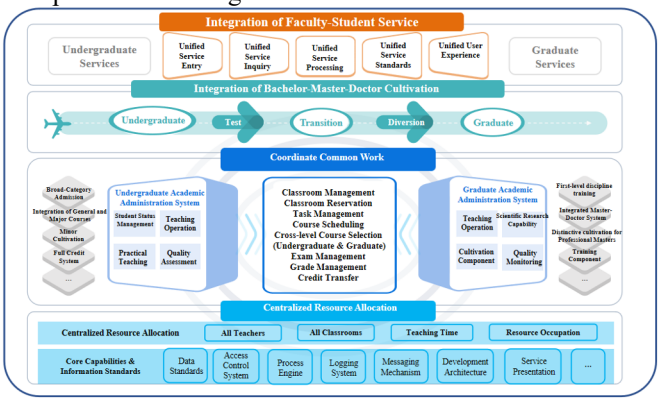

Fig. 3. The Structure of Talent Cultivation Platform for Undergraduate and Graduate Integration.

The Integrated Talent Cultivation Platform has achieved precision cultivation, efficient management and bachelor-master-doctor connectivity with data integration, resource convergence and process optimization. The most distinctive features lie in its innovative technical architecture (semi-isomorphic inner-layer design) and practical implementation strategy (zero modification to the graduate system, phased migration, and dual-core operation). This platform provides a seamless one-stop service and efficient resource scheduling while maximizing the protection of existing systems and minimizing risks simultaneously. Its features are shown as follows: (1) Eliminating data silos to achieve a comprehensive profile. By integrating academic, research, and practical data scattered across undergraduate and graduate systems, the dynamically updated "digital student profile" is presented to provide data foundation for precise selection and personalized cultivation of students. (2) Reconstructing the resource network for open sharing. By breaking down information barriers among course database, mentor database, research platform, instrument and equipment information and other teaching resources, it is essential to achieve cross-level and cross-disciplinary on-demand sharing and intelligent matching. (3) Optimizing management procedures to enhance integration efficiency. Some procedures related to teaching management such as credit transfer, mutual selection between mentor and student and research project initiation can be handled online and automatically, significantly reducing institutional costs and improving administrative effectiveness. During the process of building this platform, more efforts are dedicated to establishing an integrated talent cultivation platform system that simultaneously simultaneously covers the teaching management of undergraduate students, graduate students, and even international students, achieving full-process and all-around integration in talent cultivation and integrated management of undergraduate, graduate and international students, thereby forming a cohesive administrative strengthen, as illustrated in Figure 4.

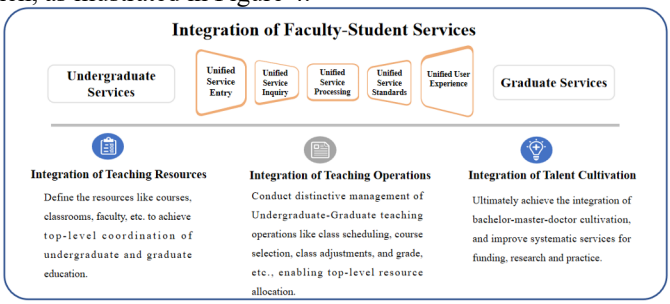

Fig. 4. Design Goals.

4 Achievements of Integrated Undergraduate-Graduate Talent Cultivation Platform

The construction of Integrated Undergraduate-Graduate Talent Cultivation Platform helps to facilitate the formation of integrated undergraduate-graduate education model, promoting the comprehensive establishment of the integrated talent cultivation system

which covers undergraduate, master's and doctoral programs. It seeks to break the traditional fragmented and closed talent cultrivation model, integrate resources, keep pace with the times, and transform educational philosophy. Thereby, establishing an integrated undergraduate-graduate platform which encompasses both undergraduate and graduate teaching management can realize the integrated management of graduate and undergraduate students. This integration enables the integration of teaching resources, academic operations, talent cultivation, and faculty-student services, then achieving a remarkable synergy in management.

4.1 Integration of Teaching Resources

The integration of teaching resources serves as a fundamental link in promoting the reform of integrated undergraduate-graduate teaching. Currently, the undergraduate academic management system and the graduate system have achieved integrated sharing of university-wide resources (including classrooms, faculty, and other teaching resources), with overall planning for undergraduate and graduate courses arrangement.

4.2 Integration of Talent Cultivation

The integration of talent cultivation consists of two dimensions: the connection of curriculum system and the connection of cultivation levels. In terms of the connection of curriculum system, it is necessary to conduct integrated planning of course progression across undergraduate, masters, and doctors, which helps to coordinate teaching content and vertical links among courses, thereby opening up university-wide curriculum resources and realizing barrier-free course selection [6]. In terms of the connection of cultivation levels, barriers between undergraduate and graduate education should be broken down. From the perspective of fully integrating the cultivation paths of undergraduate, masters and doctors, an overall plan for talent cultivation should be designed. Simultaneously, achieving the establishment of supporting systems for integrated cultivation of undergraduate, masters and doctors such as cultivation environment, cultivation mechanisms, and cultivation methods.

At present, course selection between undergraduate and graduate has been realized, which means senior undergraduate students are allowed to independently select graduate courses for study, with credit transfer. In concrete measures, the Graduate School of WUT has opened relevant graduate courses from 11 pilot schools for graduate education reform including School of Transportation and Logistics Engineering and School of Marxism, totaling 576 courses. In the current academic year, 273 undergraduate students have taken graduate courses, with a total of 574 courses.

4.3 Integration of Faculty-Student Services

The integrated undergraduate-graduate system is designed to provide faculty and students with smoother and more convenient integrated services [3]. Presently, resource interconnection and information sharing have been realized in aspects such as curricu-

lum inquiry and classroom reservation. Specifically, teachers can check the undergraduate and graduate courses they teach in the integrated undergraduate-graduate system, while students can also check all undergraduate and graduate courses they are taking. When reserving a classroom, students can view all teaching arrangements for that classroom, including undergraduate courses, graduate courses, and courses for international students.

5 Conclusion

This paper, taking the practice of WUT as a case study, demonstrates how the information-based platform of undergraduate and graduate integration is constructed and applied into practical teaching management for continuous talent cultivation. It has practically proven that the platform effectively supports seamless connection of knowledge system and personalized development of students with shared courses, credit transfer, mutual selection between mentor and student and research project initiation across undergraduate and graduate stages. It has significantly enhanced the continuity and efficiency of the cultivation process. This innovative practice not only strengthens preliminary research and fosters academic interest among students but also optimizes the allocation of educational resources, which provides technological and institutional supports for the early screening and systematic cultivation of innovative talents.

Looking ahead, the platform and talent cultivation model will advance toward deeper and broader dimensions. Firstly, it is essential to deepen the application of data intelligence by learning analysis and academic early-warning system to achieve dynamic tracking and precise intervention in growth of students. Secondly, the function of platform will be expanded to embrace interdisciplinary projects, collaborative university-enterprise programs and others to meet the complex demands of future technology and industries for versatile talents. Thirdly, inter-university collaboration and resource sharing will be strengthened to explore the establishment of credit systems and continuous cultivation across the region or even nation, thereby fostering the construction of a high-quality education system. In the end, through sustained institutional innovation and technological empowerment, the integrated undergraduate-graduate cultivation model can truly become a core engine for national strategy and leading talents.

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