



Integrating Scientific Studies and Education: A Strategic Approach to Enhancing Learning Quality and Innovation in Higher Education

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Abstract

To accelerate the development of a strong nation in education, science, and technology while achieving self-reliance in high-level scientific and technological advancements, the integrated "trinity" of education, science, and talent cultivation is necessary. This study focuses on the significance of integrating education and scientific studies in higher education, emphasizing the role of universities in fostering a holistic educational ecosystem. This study employs a descriptive analysis of policies and practices related to integrating science and education at the School of Food Science and Engineering, Nanjing University of Finance and Economics. Data were collected through a literature review, an analysis of the university's internal policies, and an evaluation of its study platforms, study teams, scientific projects, and study outcomes. The findings indicate that implementing the integration of study and education in this university has significantly contributed to enhancing the quality of learning and the effectiveness of study-based moral education. This approach supports students' academic development and strengthens graduates' competitiveness in emerging technologies. The key contribution of this study lies in mapping a model of study-education integration that can serve as a reference for other higher education institutions. Academically, the study highlights that collaboration between education and scientific studies is an effective strategy for improving learning quality, fostering innovation, and enhancing national competitiveness in the global knowledge-based economy.

Keywords: *Implementation path, New engineering, Scientific research, Education.*

A. Introduction

In the early 19th century, Wilhelm von Humboldt introduced the principle of the "unity between teaching and research" at the University of Berlin, asserting that "only through academic study, engagement with science, and reflection on the world as a whole can the best talents be cultivated" (Humboldt, 1810). Since then, higher education institutions, particularly research universities, have developed various models to integrate scientific studies with teaching. Examples include MIT's Undergraduate Research Opportunities Program (UROP), which is widely regarded as one of the most successful initiatives for training undergraduate students in research (Lopatto, 2004), as well as the seminar-based learning models implemented at Harvard University and Duke University, which have gained international recognition (Healey & Jenkins, 2009).

Despite these advancements, a critical gap remains in implementing research-integrated education, particularly in evolving engineering education paradigms. Since 2012, "science-education integration and collaborative education" has gained increasing prominence in Chinese higher education policies. The State Council, the Ministry of Education, and the Ministry of

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Science and Technology have issued numerous directives emphasizing the need for collaborative models of education and scientific studies (State Council of China, 2012; Ministry of Education of China, 2017). The 2017 directive by the Central Committee of the Communist Party of China and The State Council explicitly called for embedding ideological and political values throughout all aspects of higher education, from teaching and research to management, service, and culture (CPC Central Committee, 2017). More recently, the report from the Party's 20th National Congress reinforced the idea that "science and technology are the primary productive force, talent is the first resource, and innovation is the primary driving force" (CPC Central Committee, 2022), highlighting the need to align education with national innovation and talent development strategies.

However, while these policy initiatives underscore the importance of integrating education with scientific studies, existing literature offers limited empirical analysis of how this integration can be effectively implemented, particularly in the context of new engineering education reforms. Research on the practical pathways through which universities can bridge scientific studies with teaching remains scarce (Graham, 2018). The challenges and opportunities associated with implementing such integration, particularly in applied fields like engineering and technology, require further exploration. Much of the literature primarily focuses on Western models, leaving a gap in understanding how these concepts can be adapted to China's rapidly evolving higher education landscape (Xie & Li, 2021).

This study addresses this gap by examining the implementation pathways for integrating scientific studies with education, particularly within China's "new engineering" initiative. It investigates how universities can cultivate innovative talent through research-based education while simultaneously fulfilling the government's ideological and political education mandates. By analyzing institutional strategies, curriculum design, and industry collaborations, this study seeks to provide a comprehensive framework for implementing research-integrated education in higher education institutions.

The significance of this research lies in its potential to offer actionable insights for universities seeking to enhance their education models in response to national innovation strategies. It contributes to the ongoing academic discourse by providing an empirical and theoretical foundation for integrating scientific studies and education, helping universities adapt to the demands of the modern economy while fostering a new generation of highly skilled, innovative, and interdisciplinary professionals.

B. Methods

This study employs a descriptive qualitative research design to analyze the integration of education and scientific studies in higher education. The research focuses on the policies, institutional practices, and outcomes of implementing research-based education at the School of Food Science and Engineering, Nanjing University of Finance and Economics. By adopting a qualitative approach, this study aims to provide an in-depth understanding of how universities can effectively integrate scientific studies with education to enhance learning quality, foster innovation, and develop highly skilled graduates. The research also seeks to map an integration model that can serve as a reference for other higher education institutions aiming to implement similar strategies (Creswell & Creswell, 2018; Zhang, 2024).

To achieve this objective, the study follows a structured research procedure. The first step involves identifying key challenges and opportunities in integrating education and scientific studies within higher education institutions. A comprehensive literature review is then conducted to examine previous studies on research-based education models, higher education reform

policies, and international best practices (Healey & Jenkins, 2009; Lu, Zhang, & Yu, 2023). Subsequently, data collection is carried out through institutional document analysis, policy reviews, and case study evaluations, focusing on research platforms, faculty engagement, and student participation. The collected data is then systematically categorized into key themes such as policy frameworks, implementation strategies, and educational outcomes, ensuring a holistic understanding of the subject (Graham, 2018).

The data collection process utilizes multiple techniques to ensure comprehensive and reliable findings. Firstly, document analysis is conducted on national policies and university reports on research-based education (State Council of China, 2012; Ministry of Education of China, 2017). Secondly, a literature review examines scholarly articles, government directives, and case studies from leading universities that have successfully integrated education with scientific studies (Xie & Li, 2021; Zhou, Liu, & Zhang, 2024). A case study evaluation of the School of Food Science and Engineering also provides empirical insights into implementing such integration. Where possible, informal interviews and observations with faculty members, students, and administrators are also considered to enrich the study with qualitative perspectives from key stakeholders (Lopatto, 2004).

A qualitative content analysis approach is applied to data analysis. Thematic analysis is used to identify key trends and patterns in integrating scientific studies and education, such as institutional strategies, student engagement, and curriculum development (Braun & Clarke, 2006). A comparative analysis is then performed to contrast the findings with international models, highlighting best practices and areas for improvement (Zhang, 2024). Additionally, policy evaluation is carried out to assess the influence of government and institutional regulations on the integration process (CPC Central Committee, 2022). By employing these analytical methods, this study aims to contribute valuable insights to the ongoing academic discourse on research-education integration, offering practical recommendations for universities and policymakers.

C. Findings and Discussion

The findings of this study indicate that scientific research in colleges and universities inherently serves as an imperceptible educational process. However, while significant emphasis has been placed on the "research" aspect, research's "educational" function remains underdeveloped. Integrating research and education carries profound theoretical implications and substantial contemporary value, yet current talent cultivation models and scientific research management face significant contradictions and inefficiencies. These challenges include the underutilization of research resources, weak synergy between teaching and research, inadequate teacher-student collaboration, and a lack of clear value orientation in integrating research into education. In the context of new engineering education, universities face the urgent task of transforming their scientific research capabilities into a competitive advantage in talent cultivation. High-level scientific research must be leveraged to support the development of first-class engineering professionals, fostering a strong synergy between science and education. However, several persistent issues hinder this goal, including gaps between academic discipline development and emerging scientific and technological advancements, the absence of efficient collaborative research platforms, a shortage of outstanding scientific and technological talent, an inefficient transformation of research achievements into educational content, and an incomplete management system for organized research and education.

Furthermore, the study highlights that many universities lack a practical framework for structured research-education integration. Although interdisciplinary and research-based learning models are widely promoted, they often lack systematic implementation strategies. The absence of cohesive institutional mechanisms has resulted in fragmented efforts, limiting the potential of organized scientific research in shaping high-quality education. To bridge this gap, universities must establish efficient organizational systems, develop collaborative education models, and strengthen the link between scientific research, teaching, and talent cultivation. These findings underscore the critical need for reform in integrating scientific research and education. Addressing these challenges is essential for enhancing engineering talent development and aligning higher education with global scientific and technological advancements. Implementing structured, research-driven educational models will enable universities to maximize their research potential and foster innovation-driven talent cultivation in the era of new engineering education.

1. Strive to Build a Sound Scientific Research Ecology and Enable Scientific Research and Education to be Effective

Integrating scientific research and education at the School of Food Science and Engineering, Nanjing University of Finance and Economics, demonstrates a structured and systematic approach to fostering research-driven learning and innovation. By aligning research activities with educational goals, the institution has successfully leveraged its disciplinary strengths to enhance the development of both faculty and students. Implementing key strategies, such as institutional reforms, platform development, and academic exchanges, highlights the school's commitment to bridging the gap between scientific inquiry and talent cultivation. These efforts strengthen the role of education research and empower students to actively engage in knowledge creation, fostering a culture of academic curiosity and independent inquiry (Zhang, 2024). This aligns with findings from Healey and Jenkins (2009), who argue that integrating research and teaching is essential for developing student engagement and inquiry-based learning in higher education.

One of the most significant contributions of this approach is the establishment of structured research-oriented mechanisms, including the Implementation Plan for the Academic Salon of Young Teachers and the Measures for the Supervision of Scientific Research Funds. These policies create a well-regulated environment where research is encouraged and systematically managed to ensure efficiency, transparency, and accountability. Regularly organizing academic salons for young faculty members is an essential platform for knowledge exchange, interdisciplinary collaboration, and professional growth. Additionally, inviting renowned scholars from domestic and international institutions further enriches the academic environment, exposing faculty and students to cutting-edge research developments and broadening their intellectual perspectives (Lopatto, 2004). Previous studies have emphasized that structured research environments enhance student learning outcomes and faculty development (Graham, 2018; Xie & Li, 2021). This suggests that the institutional mechanisms implemented at Nanjing University of Finance and Economics align with global best practices in higher education reform.

Moreover, the ideological, political, and academic dimensions embedded within the research process illustrate a holistic model of research integration. By emphasizing value orientation, political direction, and academic integrity, the institution ensures that research activities contribute to scientific advancements and align with ethical standards and societal responsibilities. The formation and evaluation of research teams based on academic

achievements and their educational contributions underscore the importance of balancing research excellence with teaching effectiveness. This approach reflects a broader trend in higher education, where the impact of research is increasingly measured not only by scholarly output but also by its ability to enhance learning experiences and societal progress (Creswell & Creswell, 2018). Such a framework is also supported by Zhou, Liu, and Zhang (2024), who highlight the significance of integrating research with education to cultivate highly skilled graduates with interdisciplinary competencies.

Despite these advancements, there remain challenges in fully realizing a seamless integration of research and education. Ensuring sustained faculty engagement, expanding interdisciplinary collaborations, and enhancing student participation in high-level research projects require continuous improvement. Future efforts should focus on further institutionalizing research-driven education, strengthening international partnerships, and developing more inclusive research initiatives that cater to a broader range of students. By addressing these areas, the School of Food Science and Engineering can continue to serve as a model for research-education integration, paving the way for a more dynamic, innovative, and student-centered academic ecosystem (Lu, Zhang, & Yu, 2023).

2. Focus on Improving Our Ability to Serve Science and Technology and Promote the Transformation of Scientific and Technological Achievements

The findings from the School of Food Science and Engineering at Nanjing University of Finance and Economics highlight the institution's active role in integrating scientific research with regional economic and social development. By strengthening collaboration with other universities, industries, and enterprises, the university has significantly improved its ability to transform scientific and technological achievements into practical applications. This aligns with the broader goal of enhancing scientific and technological service capabilities, ensuring that research efforts contribute to academic advancements, industrial innovation, and local economic growth. Such efforts underscore the importance of university-industry-government collaboration in fostering innovation-driven development (Etzkowitz & Leydesdorff, 2000).

The concept of "new quality productivity," driven by scientific and technological innovation, is central to China's ongoing transition toward an innovation-based economy. The university's achievements in food science and technology innovation—such as award-winning research on mycotoxin detection, postharvest quality assurance for edible fungi, and deep processing technologies—demonstrate how scientific breakthroughs can enhance industrial efficiency and food safety. These research initiatives, recognized by national and provincial science and technology awards, illustrate a successful model of research-driven economic transformation, where scientific discoveries are systematically translated into practical applications for the food industry. This aligns with the broader national strategy of shifting from quantitative scientific output to qualitative, systemic technological advancements (Ministry of Science and Technology of China, 2022).

A key driver of the university's success lies in its strategic investment in research infrastructure and interdisciplinary collaboration. Establishing the National Engineering Research Center for Grain Storage and Transportation (Rice Platform) and the Collaborative Innovation Center for Modern Grain Circulation and Security in Jiangsu Province provides researchers with cutting-edge facilities to conduct applied research. Additionally, partnerships with government agencies, industry leaders, and research institutes—such as the National Food and Strategic Reserves Administration and Jiangsu Coastal Development Group—further strengthen the university's ability to address real-world food security

challenges. These collaborations highlight the importance of a multi-stakeholder approach in addressing complex global food and agricultural challenges, ensuring that research findings are effectively implemented at an industrial scale (Gereffi, Humphrey, & Sturgeon, 2005).

The university aims to establish a more integrated and multi-level scientific and technological innovation system, focusing on fundamental, strategic, and industry-driven research. By adopting a structured innovation model that connects "frontier exploration - basic research - focused research," the university seeks to build a full-chain innovation ecosystem linking science, engineering, and industry. This systematic approach accelerates the commercialization of research outputs and ensures a sustainable knowledge-driven economy. Future research directions should focus on enhancing interdisciplinary collaboration, scaling up technology transfer mechanisms, and fostering talent development programs that equip graduates with the necessary skills for the evolving technological landscape. Such efforts will further solidify the university's role as a scientific and technological innovation hub, ensuring long-term contributions to developing new quality productivity in China and beyond.

3. Improve the Evaluation Mechanism and Stimulate the Vitality of Education

The crucial role of scientific research evaluation reform is to enhance research quality and efficiency in universities. Implementing multi-dimensional and evidence-based evaluation frameworks has been instrumental in stimulating innovation and improving the impact of scientific research platforms and outcomes. By introducing policies such as the management measures for scientific and technological innovation platforms, the classification system for research projects, and the management framework for research achievement transformation, universities have been able to align research objectives with industry needs and national development goals (Graham, 2018; Zhang, 2024). The shift towards classified evaluation methods—considering the varying needs of disciplines and positions—has also led to a more inclusive and effective assessment process, fostering an environment where quality and impact are prioritized over sheer output quantity (Xie & Li, 2021).

A key contribution of these reforms is their role in embedding scientific research into the educational experience. Integrating scientific thinking, research methodologies, and real-world innovation into the curriculum allows students to engage directly with cutting-edge advancements, preparing them for research-oriented careers and interdisciplinary problem-solving (Healey & Jenkins, 2009). The university's focus on bringing the scientist's spirit into the classroom has improved academic engagement and contributed to the cultivation of a research-driven academic culture. By incorporating landmark achievements into learning materials, universities ensure that students are exposed to the latest discoveries and innovations, bridging the gap between theoretical education and practical research applications.

Moreover, the institutional emphasis on academic salons, research group discussions, and laboratory-based collaboration has proven effective in fostering a dynamic academic ecosystem where students and faculty regularly exchange ideas. These platforms provide students with firsthand exposure to scientific discourse, enabling them to refine their critical thinking, experimental design, and problem-solving skills (Lopatto, 2004). Additionally, initiatives such as demonstration case selection for research-education integration allow universities to showcase best practices and successful models, encouraging widespread

adoption of effective pedagogical strategies across departments. This structured approach promotes a culture of excellence and mentorship, ensuring that scientific research serves as a knowledge-generating mechanism and an educational tool (Ministry of Education of China, 2017).

Despite these advancements, challenges remain in scaling these reforms across disciplines and institutions. The success of research-education integration varies by field, and some disciplines may require customized frameworks to optimize learning outcomes. Additionally, while academic salons and collaborative research platforms have proven beneficial, sustaining student engagement and ensuring equitable research opportunities require continuous policy refinements. Future studies should explore the long-term impact of these reforms on student learning outcomes and career trajectories and investigate how different universities, particularly those with varying levels of research funding and resources, can effectively adopt these strategies. Expanding international collaborations and learning from global best practices will also be essential in refining and enhancing research-based education models in the future.

D. Conclusion

This study aimed to explore integrating scientific research and education in higher education, particularly within the framework of new engineering education. Given the increasing complexity and interdisciplinary nature of modern engineering and technology, there is a pressing need to move beyond the traditional separation of research and teaching. By embedding scientific inquiry into the classroom, students can develop critical problem-solving skills, research-oriented thinking, and innovative capabilities essential for the future workforce. However, the study also identified several challenges in implementing research-integrated education at the undergraduate level, including a lack of conceptual clarity, low engagement among faculty and students, underdeveloped integration models, and inadequate institutional mechanisms for fostering research-based education. The findings of this study highlight key strategies for strengthening research-education integration in engineering disciplines. At the macro level, it is essential to improve institutional policies that support organized scientific research and create an enabling environment for undergraduate research engagement. At the micro level, fostering a research-oriented academic culture, enhancing collaboration between faculty and students, and incorporating high-level scientific research projects into undergraduate curricula are crucial steps. The study further emphasizes the importance of adopting diverse training pathways that nurture innovation, entrepreneurship, and interdisciplinary competencies in engineering graduates. By transforming high-level research achievements into core undergraduate courses, institutions can establish a systematic and sustainable model of integrating scientific research into education, ultimately reshaping the landscape of new engineering education.

The contributions of this study lie in its practical and theoretical implications for higher education reform. Theoretically, it provides a structured framework for research-based education, bridging gaps in existing literature that primarily focus on individual aspects of research integration rather than a comprehensive disciplinary system. Practically, the study offers a roadmap for universities to implement effective research-education integration strategies, thereby enhancing the quality of engineering talent cultivation. These insights are particularly relevant for policymakers, university administrators, and educators seeking to advance engineering education in alignment with national and global innovation demands. Despite its contributions, this study has several limitations. Firstly, it primarily focuses on engineering, which may limit its applicability to other academic fields. Secondly, while it

provides a general framework for integrating research and education, the study does not include extensive empirical validation through case studies or long-term impact assessments. Future research should explore discipline-specific models for research-education integration, conduct comparative studies across different universities, and assess student learning outcomes over time. Expanding the research scope to include international perspectives would offer valuable insights into global best practices and further enrich the discourse on integrating scientific research and education in higher education.

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