Nanjing College's Development and Innovation in Digital Education Under the Strong National Strategy of Innovation and Technology

Ge Wu[1], Sranya Saengamporn[2], and Piyapun Santaweesuk[3]

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Abstract

This study aims to examine the mechanisms influencing digital education innovation in higher education institutions within the regional innovation system of Nanjing, China. It focuses on identifying key factors and analyzing the relationships among motivation mechanisms, operational logic, resource matching, and innovation outcomes based on the Triple Helix and Regional Innovation System perspectives. A quantitative research design was employed. Data were collected from administrators and faculty members involved in digital education initiatives, and analyzed using Structural Equation Modeling (SEM). The results indicate that both motivation mechanisms and operational logic have significant positive effects on digital education innovation, with operational logic exerting the strongest influence. Additionally, resource matching fully mediates the relationship between digital education development and innovation outcomes, suggesting that digital initiatives contribute to innovation only when strategic objectives, human capital, financial resources, and technological infrastructure are properly aligned. The model explains 38.2% of the variance in innovation outcomes. The findings highlight the importance of effective governance, collaborative processes, and strategic resource alignment in promoting sustainable digital education innovation in regional higher education institutions. universities should strengthen institutional motivation mechanisms by aligning digital education initiatives with national innovation policies and incorporating digital teaching performance into faculty evaluation and institutional development systems. Such alignment can enhance long-term commitment to digital transformation and policymakers should promote collaborative platforms that support industry–academia partnerships to enhance knowledge exchange. higher education

[1, 2*, 3]Faculty of Education, Shinawatra University, Thailand

Email: 1305706874@qq.com[1], sranya.s@siu.ac.th[2*], piyapun.s@siu.ac.th[3]

institutions should improve operational logic, as governance quality and coordination were found to be critical drivers of innovation. Establishing transparent decision-making processes and strengthening collaboration among universities, industry, and government can enhance the effectiveness of digital education initiatives within a regional innovation system. and technological development. Such cooperation can improve the scalability and sustainability of digital education innovation

Keywords: Digital innovation, Governance, Resources, Motivation, Higher education

Introduction

The rapid advancement of digital technologies and artificial intelligence (AI) has fundamentally reshaped the mission of higher education institutions. Universities are increasingly expected to cultivate students' core competencies, digital literacy, and adaptive skills to prepare them for an automated and interconnected society. In response, China has elevated digital education to a national strategic priority through policies such as the Digital Education Strategic Action Plan and the China Smart Education initiative, which emphasize the integration of AI into teaching, management, and assessment to promote high-quality and equitable lifelong learning (Ministry of Education of the People's Republic of China, 2023).

The China Smart Education platform has rapidly expanded into the largest national repository of digital learning resources, covering all educational levels and disciplines. Recent policy directions have shifted from basic infrastructure development toward service optimization, ethical governance, and talent cultivation. Emphasis has been placed on data security, algorithmic transparency, and the responsible use of AI, as well as on strengthening interdisciplinary AI-related programs to support national modernization and sustainable development goals (Huai, J., 2024; Project Team of Digital Education Fronts, 2025).

Despite these national-level achievements, the implementation of digital education reform at the institutional level remains uneven. Many universities have invested in smart teaching platforms and online learning systems, yet these efforts are often fragmented and limited to pilot projects. Persistent challenges include insufficient strategic coordination, weak platform interoperability, and limited pedagogical integration of digital technologies (Somthawinpongsai, C. et al., 2024). and uneven digital competencies among faculty members.

Consequently, the transformative potential of AI-enabled education has not been fully realized in terms of teaching quality and learning effectiveness (Han, Y., 2024).

Nanjing, as a major hub of scientific research, higher education, and the digital economy in the Yangtze River Delta, has actively promoted digital education reforms in line with national strategies, such as the 14th Five-Year Plan. Universities in the region have collaborated with technology enterprises to develop smart classrooms, virtual simulation systems, and digital learning platforms. However, most initiatives remain exploratory and lack sustainable collaboration mechanisms (Somthawinpongsai, C. et al., 2025). effective incentive structures and scalable innovation models. Misalignment between policy objectives, institutional capacities, and resource allocation continues to constrain the high-quality development of digital education innovation in regional universities. From a research perspective, existing studies on digital education innovation have primarily focused on policy analysis or technological applications, with limited attention to the internal driving mechanisms that translate national strategies into institutional practices. In particular, the interaction between motivational mechanisms, operational logic, and resource matching within a regional innovation system to influence digital education innovation remains underexplored. Although the Triple Helix model and Regional Innovation Systems theory offer valuable analytical frameworks (Etzkowitz, H. & Leydesdorff, L., 2000; Asheim, B. T. et al., 2011), their application to AI-driven digital education at the institutional level is still insufficient.

Therefore, this study addresses the problem of how regional universities can effectively promote digital education innovation under national AI and digital education strategies. Using Nanjing College as a case study, this research examines the interactions among motivational mechanisms, operational logic, resource matching, and innovation outcomes, aiming to provide theoretical insights and practical implications for advancing sustainable digital education reform in regional higher education institutions.

Research Objective

The objectives of this study are as follows:

1. To identify the key factors influencing digital education innovation in higher education institutions in Nanjing.

2. To examine the relationships among motivational mechanisms, operational logic, resource matching, and digital innovation outcomes.

3. To propose strategic recommendations for enhancing collaborative innovation in digital education within regional higher education institutions.

Research Scope

This study investigates digital education innovation in higher education institutions in Nanjing, China, within the framework of the regional innovation system. It focuses on examining the effects of motivation mechanisms and operational logic on digital education development, as well as the mediating role of resource matching in influencing innovation outcomes. The research targets administrators and faculty involved in digital education initiatives and is conducted under China's national digital education strategy (Etzkowitz, H. & Leydesdorff, L., 2000; Ministry of Education of the People's Republic of China, 2023).

Review of Literature and Concepts

The reviewed literature highlights that digital education innovation in higher education is a systemic process shaped by institutional motivation, collaborative operational mechanisms, and the effective alignment of resources within a regional innovation system. Drawing on the Triple Helix Theory, government policies, institutional leadership, and industry participation collectively create a motivational mechanism that drives universities to engage in digital education reform. National innovation strategies and policy incentives function as external "push" forces, while institutional capacity and performance-based evaluation systems act as internal drivers that encourage sustained engagement in digital education innovation (Etzkowitz, H. & Leydesdorff, L., 2000; Ministry of Education of the People's Republic of China, 2023). Prior empirical studies indicate that stronger motivational mechanisms are associated with higher levels of technological adoption and pedagogical innovation, suggesting a direct positive relationship between motivation and digital education development.

Beyond motivation, the literature emphasizes the importance of operational logic in translating strategic intent into effective practice. Collaborative innovation theory and Regional Innovation System perspectives underline that transparent governance structures, efficient communication, and coordinated decision-making processes are essential for enabling universities to implement digital education initiatives effectively (Asheim, B. T. et al., 2011;

Cai, Y. & Amaral, A, 2021). Where operational logic is well defined, collaborative actors are better able to integrate digital technologies into teaching and management processes, thereby enhancing innovation outcomes. Conversely, weak operational logic often results in fragmented implementation and limited scalability. This body of research supports the assumption that operational logic exerts a significant positive influence on digital education development and innovation.

Furthermore, existing studies suggest that the effectiveness of digital education innovation depends not only on motivation and operational processes but also on the degree of resource matching between universities and their external partners. Resource-based and collaborative innovation perspectives emphasize that alignment among strategic objectives, human capital, financial support, and technological infrastructure is critical for transforming innovative inputs into tangible outcomes (Barney, J., 1991; Gasparin, M. & Quinn, M., 2021). In the context of digital education, mismatches between technological platforms and pedagogical needs often weaken innovation performance, even when strong motivation and collaborative intent are present. Accordingly, resource matching is increasingly viewed as a mediating mechanism that channels the effects of digital education development into actual innovation outcomes.

Based on this synthesis, the present study proposes a conceptual model in which motivational mechanisms and operational logic directly influence the development and innovation of digital education, while resource matching mediates the relationship between digital education development and innovation outcomes. Accordingly, the following hypotheses are formulated:

H1: The motivation mechanism has a significant positive impact on the development and innovation of digital education.

H2: The operational logic has a significant positive impact on the development and innovation of digital education.

H3: Resource matching exerts a mediating effect between the development and innovation of digital education and innovation outcomes.

This hypothesis structure provides a coherent theoretical foundation for subsequent empirical testing and contributes to a deeper understanding of how regional universities can enhance digital education innovation through coordinated institutional mechanisms.

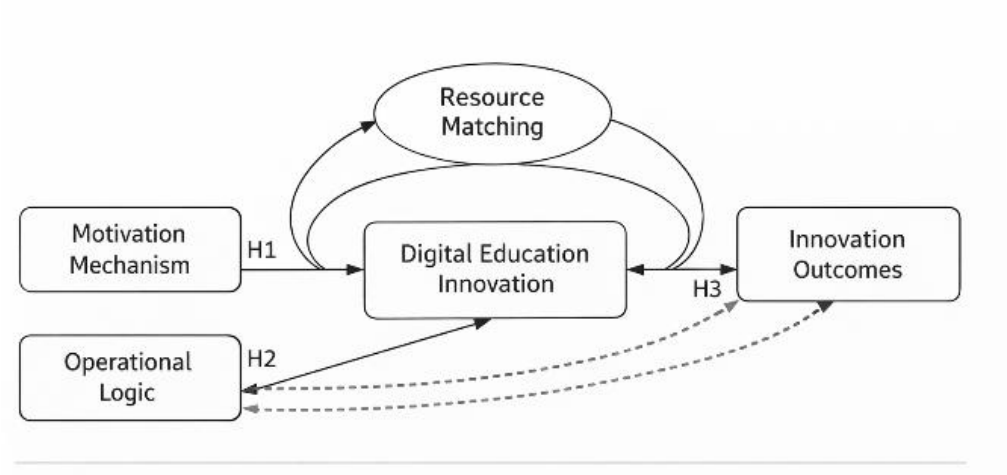

Figure 1. Conceptual Framework of Digital Education Innovation in Nanjing's Higher Education Institutions

Research Methodology

This study employs a quantitative research approach to examine the mechanisms influencing digital education innovation in higher education institutions in Nanjing, China. A structured questionnaire is used to collect data from administrators and faculty members involved in digital education initiatives. The research framework is grounded in the Triple Helix Theory and the Regional Innovation System theory, with motivation mechanism and operational logic as independent variables, resource matching as a mediating variable, and digital education innovation outcomes as the dependent variable. Data are analyzed using Structural Equation Modeling (SEM) to test the hypothesized relationships and mediating effects, enabling a systematic examination of both direct and indirect influences among variables (Etzkowitz, H. & Leydesdorff, L., 2000; Asheim, B. T. et al., 2011).

Research Results

The Structural Equation Modeling (SEM) analysis reveals that digital education innovation in higher education institutions is significantly influenced by institutional motivation mechanisms, operational logic, and resource matching. The results indicate that both motivation mechanisms (β = 0.173, $p < .05$) and operational logic (β = 0.490, $p < .01$) have significant positive effects on the development and innovation of digital education, with operational logic exerting the strongest influence.

Furthermore, the mediation analysis confirms that resource matching plays a significant mediating role between digital education development and innovation outcomes. The indirect effect is statistically significant (z = 2.38, p < .05), while the direct effect is not significant, indicating that digital education initiatives contribute to innovation outcomes primarily through effective resource alignment.

Overall, the model explains 38.2% of the variance in digital education innovation outcomes (R^2 = 0.382), providing empirical support for all proposed hypotheses (H1–H3). These findings highlight that successful digital education innovation depends not only on technological advancement but also on effective institutional coordination and strategic resource alignment within a regional innovation system.

Table 1 SEM Results of Digital Education Innovation in Nanjing's Higher Education Institutions.

Hypothesis	Structural Path	Standardized Coefficient (β) / Effect	Statistical Significance	R^2 / Model Explanation	Hypothesis Testing Result
H1	Motivation mechanism ⟶ Digital education innovation	β = 0.173	p < .05	R^2 = 0.382Adj. R^2 = 0.379	Supported
H2	Operational logic ⟶ Digital education innovation	β = 0.490	p < .01	R^2 = 0.382Adj. R^2 = 0.379	Supported
H3	Digital education development ⟶ Resource matching ⟶ Innovation outcomes	Indirect effect = 0.0007z = 2.38	p < .05 (Indirect)Direct effect = n.s.	R^2 = 0.382Adj. R^2 = 0.379	Supported (Mediated)

Conclusion, Discussion, Suggestion

Conclusion

This study examined the mechanisms influencing digital education innovation in higher education institutions in Nanjing using Structural Equation Modeling. The results confirm that motivation mechanisms and operational logic significantly promote digital education innovation, while resource matching plays a critical mediating role in translating digital education development into innovation outcomes.

Operational logic emerged as the most influential factor, highlighting the central role of governance and collaborative processes in digital education reform. The structural model explains 38.2% of the variance in innovation outcomes, providing robust empirical support for the proposed framework. By integrating the Triple Helix, Regional Innovation System, and collaborative innovation perspectives, this study clarifies how national digital education strategies are implemented at the institutional level and contributes to the literature on sustainable digital education innovation in regional higher education systems.

Discussion

The findings indicate that digital education innovation in higher education is influenced by institutional motivation mechanisms, operational logic, and resource alignment within a regional innovation system. The SEM analysis confirms that both motivation mechanisms and operational logic have significant positive effects on digital education innovation. Motivation mechanism shows a moderate influence ($\beta = 0.173$, $p < .05$), while operational logic exerts the strongest effect ($\beta = 0.490$, $p < .01$). These results suggest that although institutional motivation and national innovation strategies play an important role, effective governance, coordination, and collaborative processes are more critical in driving digital education innovation.

Furthermore, the analysis reveals that resource matching fully mediates the relationship between digital education development and innovation outcomes ($z = 2.38$, $p < .05$), while the direct effect is not significant. This indicates that digital initiatives contribute to innovation outcomes only when strategic objectives, human capital, financial resources, and technological infrastructure are properly aligned.

Based on these findings, all proposed hypotheses are supported. H1 confirms that motivation mechanisms significantly influence digital education innovation. H2 confirms that operational logic has a significant and strong impact on innovation outcomes. H3 confirms that

resource matching plays a full mediating role between digital education development and innovation outcomes. Overall, the structural model explains 38.2% of the variance in digital education innovation, highlighting the importance of governance quality and strategic resource alignment in achieving sustainable digital education reform.

New Knowledge of Research

This study contributes new knowledge by demonstrating that digital education innovation in higher education is driven not only by institutional motivation but more significantly by effective operational logic. The findings highlight that governance quality and collaborative processes are critical in transforming digital initiatives into meaningful innovation outcomes.

Importantly, the study confirms that resource matching serves as a full mediating mechanism between digital education development and innovation outcomes. This indicates that innovation success depends on the alignment of strategic goals, human capital, financial resources, and technological infrastructure rather than technological adoption alone.

By integrating the Triple Helix and Regional Innovation System perspectives into an empirical SEM model, this research provides a clearer understanding of how regional higher education institutions can achieve sustainable digital education innovation through coordinated governance and strategic resource alignment.

Research Suggestion

Based on the findings, several recommendations are proposed to support sustainable digital education innovation in higher education institutions.

First, universities should strengthen institutional motivation mechanisms by aligning digital education initiatives with national innovation policies and incorporating digital teaching performance into faculty evaluation and institutional development systems. Such alignment can enhance long-term commitment to digital transformation (Cai, Y. & Amaral, A, 2021; Ministry of Education of the People's Republic of China, 2023).

Second, higher education institutions should improve operational logic, as governance quality and coordination were found to be critical drivers of innovation. Establishing transparent decision-making processes and strengthening collaboration among universities,

industry, and government can enhance the effectiveness of digital education initiatives within a regional innovation system (Etzkowitz, H. & Leydesdorff, L., 2000; Asheim, B. T. et al., 2011).

Third, universities should prioritize resource matching by ensuring alignment among strategic objectives, human capital, financial support, and technological infrastructure. Effective innovation depends not only on digital adoption but also on the integration of institutional capabilities and resources (Barney, J., 1991; Gasparin, M. & Quinn, M., 2021).

Fourth, policymakers should promote collaborative platforms that support industry–academia partnerships to enhance knowledge exchange and technological development. Such cooperation can improve the scalability and sustainability of digital education innovation (Cai, Y. & Amaral, A, 2021).

Finally, future research should adopt comparative and longitudinal approaches to better understand how governance mechanisms and resource alignment influence digital education innovation over time (Asheim, B. T. et al., 2011).

References

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904. https://doi.org/10.1080/00343404.2010.543126

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Cai, Y., & Amaral, A. (2021). Theoretical perspectives on the relationship between universities and regional innovation systems. *Higher Education Policy, 34*(1), 1–21. https://doi.org/10.1057/s41307-020-00195-3

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From national systems and “Mode 2” to a triple helix of university–industry–government relations. *Research Policy, 29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4

Gasparin, M., & Quinn, M. (2021). Designing digital transformation in higher education: Resource alignment and organizational capability. *Technological Forecasting and Social Change, 162,* 120402. https://doi.org/10.1016/j.techfore.2020.120402

Han, Y. (2024). Collaborative governance and efficiency improvement in digital education in the background of educational digitalization. *China Educational Technology, 3,* 15–23.

Huai, J. (2024). Ethical governance and talent cultivation in intelligent education. *Journal of Educational Development Research, 12*(4), 1–8.

Ministry of Education of the People's Republic of China. (2023). *Digital education strategic action plan.* Beijing, China: Ministry of Education of the People's Republic of China.

Project Team of Digital Education Fronts. (2025). Digital education as a driver of global educational reform and sustainable development. *Educational Research, 46*(2), 3–12.

Somthawinpongsai, C., Vorayotha, C., Yang, C., Lu, L., & Tee, M. (2025). Narrative design for SDG-oriented social innovation: The Koh Kret model. *TPM: Testing, Psychometrics, Methodology in Applied Psychology, 32*(S3), 885–895. Retrieved from https://tpmap.org/submission/index.php/tpm/article/view/550

Somthawinpongsai, C., Zhou, F., Wiwitkunkasem, K., Chanwichian, J., & Xing, J. (2024). Digital communication strategies in promoting sustainable agriculture: Organic products in Central Thailand. *Journal of Ecohumanism, 3*(8), 2822–2838. https://doi.org/10.62754/joe.v3i8.4931