

## New Quality Productivity: Factors and Paths for Digital Transformation of Yunnan’s Higher Education

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### Abstract

*Taking into consideration the natural association between emerging productive forces and total factor productivity growth, this study conducts an in-depth analysis from the perspective of educational economics. Through literature review and Delphi consultation, 16 factors on the new quality productivity concept that support higher education digital transformation were identified. A hybrid Decision-Making Trial and Evaluation Laboratory-Interpretative Structural Modelling integrated framework was then used to identify fundamental driving elements and build a hierarchical structure. Results show that teaching pedagogies, such as the modernisation of teaching content, diversity of instructional approaches, better assessment mechanisms, and intelligent campus management form the core drivers of digital transformation. These factors can be categorised into four interlinked layers, from basic conditions to advanced application dimensions. Based on the findings, this study proposes policy directions for promoting the digital transformation of higher education in Yunnan Province which includes strengthening digital infrastructure, promoting collaborative innovation platforms, enhancing research integration, and optimising governance and decision-making systems.*

**Keywords:** DEMATEL-ISM, digital infrastructure, digital transformation, educational innovation, higher education, intelligent governance

## 1. Introduction

Amid the accelerated evolution of digital technologies, higher education institutions are undergoing an increasingly irreversible digital shift. From an international perspective, digital transformation in higher education has been widely discussed in relation to digital capability, innovation ecosystems, and institutional change. However, existing studies often focus on fragmented dimensions such as digital readiness or technological adoption without fully capturing the systemic productivity implications of digital transformation. In May 2023, China's General Secretary Xi Jinping emphasised at the fifth collective study session of the Political Bureau of the Chinese Communist Party (CPC) Central Committee that "the digitalisation of education represents a strategic breakthrough for China to open up a new track for education development and shape new advantages in education development" (Xinhua News Agency, 2024). This policy orientation offers strategic guidance for advancing digital transformation across China's higher education sector, aiming to achieve digital transformation and innovation in all business and processes such as university environment, educational applications, and organisational management through the all-round and in-depth integration of digital technology and school education (Zhang & Ma, 2024).

Yunnan Province, a major educational province in China, has successively carried out various pilot projects for the digital transformation of higher education. In 2024, the Yunnan Provincial Party Committee, Education Working Committee, and the Provincial Education Department Party Committee's Theory Study Centre Group held a special study meeting to emphasise "accelerating the promotion of educational digitalisation" (Xi & Wang, 2024). However, during the presently ongoing digital transition of higher education in Yunnan Province, such problems as lack of guidance on the implementation mechanism of transformation, low digital competence of the subjects, and disparities in digital development across urban and rural regions also occur. Further quality enhancement thus remains necessary to achieve digital transformation in Yunnan Province.

In September 2023, General Secretary Xi Jinping pointed out that "we should integrate scientific and technological innovation resources, lead the development of strategic emerging industries and future industries, and accelerate the formation of new quality productivity" (Xinhua News Agency, 2024).

In this study, new quality productivity (NQP) is conceptualised as a system-level productivity transformation paradigm driven by the integration of technological innovation, institutional restructuring, and human capital development. It extends beyond digital readiness or capability perspectives by emphasising the dynamic interaction among these elements in generating sustainable productivity growth. The NQP concept offers both conceptual insights and practical pathways for the digital transformation of higher education. Through efforts in scientific and technological innovation, resource integration, model innovation, intelligent management, interdisciplinary integration, talent training, fair development and internationalisation, the quality and level of higher education can be comprehensively improved, and the digital and modern transformation of higher education can be realised (Zhu et al 2024). However, empirical studies that systematically examine the internal causal structure and hierarchical relationships among NQP factors in higher education digital transformation remain limited.

Against this background, this study explores the specific factors that enable the digital transformation of Yunnan higher education from the NQP perspective. Through a Decision-Making Trial and Evaluation Laboratory-Interpretative Structural Modelling (DEMATEL-ISM) hybrid model, the researchers analyse the importance of and correlation with each factor in order to glean actionable policy insights for the digital transformation of Yunnan higher education. Thus, in order to ensure this research is more explicitly aligned to the Delphi-DEMATEL-ISM process, the following research objectives are proposed: (a) to identify key

factors of “new quality productivity” influencing digital transformation in higher education; (b) to determine the causal structure and hierarchical interactions among these variables using the DEMATEL-ISM approach; and (c) to provide strategic pathways and policy recommendations for promoting digital transformation in regional higher education systems. These refinements ensure greater clarity and replicability, thus addressing the reviewer’s concern regarding methodological rigour and transparency.

## 2. Literature Review

To reinforce the conceptual grounding and international relevance of this study, the literature in this section is organised around three interrelated themes: (a) policy-oriented digital transformation frameworks, (b) institutional capability models, and (c) theoretical perspectives on innovation adoption. Through such structuring, the NQP concept is situated within a broader analytical context, rather than being treated as an isolated policy construct.

First, from an international policy perspective, digital transformation in higher education is commonly understood as a systemic and multi-dimensional process. This process extends beyond technology itself, encompassing also the ways pedagogy and organisational structures evolve alongside it. Frameworks developed by the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasise this interplay between infrastructure, teaching practices, and governance arrangements. For example, OECD’s Digital Education Outlook 2021 highlights the importance of human and institutional capacities, alongside infrastructure, in achieving resilience and inclusiveness (Organisation for Economic Co-operation and Development, 2021). UNESCO, in its ICT Competency Framework for Teachers, places particular emphasis on digital pedagogy, data literacy, and ethical awareness as enabling conditions for transformation (UNESCO, 2018). That said, these policy-oriented frameworks, while offering strategic guidance, often remain at the macro level. The actual mechanisms through which transformation occurs are not always clearly specified. In this sense, NQP can be seen as extending these perspectives, as it places stronger emphasis on the integration of technological progress, talent development, and innovation capacity in the digital transformation process, especially within the Chinese context.

Second, institutional capability frameworks often attempt to translate these broad visions into more operational terms by focusing on how universities can build capacity for digital change. Digital maturity, from this perspective, is generally framed as a combination of skills, data-informed decision-making, and governance structures (Kähkipuro, 2018). Examples include Jisc’s “Building Digital Capability” model and EDUCAUSE’s transformation guidelines. Compared with earlier approaches that focused primarily on technological adoption, more recent frameworks have shifted their attention to organisational culture, leadership, and internal processes (Tiwari, 2024). Even so, much of the existing literature still tends to examine these capability dimensions separately. The relationships among technological, human, and institutional elements are acknowledged, but not always systematically analysed. This suggests a limitation in current research and points to the relevance of a more relational perspective—one that is consistent with the systemic orientation of NQP.

Third, theoretical perspectives from research focusing on innovation and technological adoption provide a more fine-grained explanation at the micro level. Widely used models, such as the innovation diffusion theory (Rogers, 2003) and the Technology Acceptance Model (TAM) (Davis, 1989), explain how individuals and organisations adopt digital tools. Factors such as perceived usefulness, ease of use, and organisational readiness have been identified as key determinants (Jejenywa et al., 2024; Haga, 2023). At the same time,

however, these models, although analytically robust, are not always sufficient for capturing broader system-level transformations. The interaction between policy environments, institutional arrangements, and human agency tends to be underexplored. More recent studies, therefore, have begun to adopt an ecosystemic perspective, suggesting that successful digital transformation depends on the joint evolution of technological affordances, governance mechanisms, and experiential learning practices (Wang & Zhang, 2025; Johnston et al., 2018). Even with these developments, an integrative framework that clearly connects macro-level policy discourse, meso-level institutional capacity, and micro-level behavioural dynamics is still lacking. How NQP aligns with or extends existing theoretical models has not been sufficiently clarified in the literature.

Recent studies have also emphasised the barriers and structural challenges associated with digital transformation in higher education institutions (Carmo et al., 2025; Gkrimpizi et al., 2023; Singun, 2025). For instance, a systematic review based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines identified multiple interrelated dimensions hindering digital transformation, including digital strategy, leadership, organisational structure, resources, competencies, stakeholder engagement, culture, academic transformation, and digital ethics. These findings highlight how digital transformation is not merely a matter of technological readiness but involves complex systemic constraints across institutional and human dimensions. This perspective further supports the distinction between NQP and related concepts such as digital readiness, as the former encompasses a broader integrated framework addressing innovation capacity, governance, and talent development beyond technological preparedness.

Therefore, this study positions NQP within a multi-level analytical framework, linking it with innovation diffusion theory, digital capability models, and governance-oriented perspectives. Rather than presenting these strands separately, the study brings them together to offer a more synthesised understanding of digital transformation in higher education. This also provides the basis for applying the DEMATEL-ISM model to examine the interconnections among key driving factors for digital transformation in higher education specifically in the context of China's Yunnan Province.

### **3. Research Method**

#### **3.1. Research Design**

Using the mixed method, this study combines the Delphi technique and DEMATEL-ISM model to identify and prioritise key factors for digital transformation of higher education in Yunnan Province. To improve methodological transparency, the Delphi procedure was explicitly defined in this study, with clearly established composition of the expert panel, number of Delphi rounds, and consensus criteria. Following best practices designed in previous Delphi research (Velu, 2022; Suradi et al., 2024), this study involved three iterative Delphi rounds. In each round, participants independently rated potential influencing factors to indicate their levels of importance on a five-point Likert scale. The aggregated results were reported anonymously and shared with all participants before each subsequent round to facilitate convergence of opinions.

Expert selection began with inviting 10 experts to participate as members in the Delphi panel. This panel comprised three senior administrators from higher education institutions, three experts in digital transformation policy, two researchers in educational technology, and two industry representatives with more than 10 years of professional experience in the field of digital education. This composition ensured diversity in perspectives and at the same time maintained relevance to the research domain. Expert inclusion was based on established

selection guidelines that focused on professional experience, publication record, and decision-making responsibility (Giannarou & Zervas, 2014).

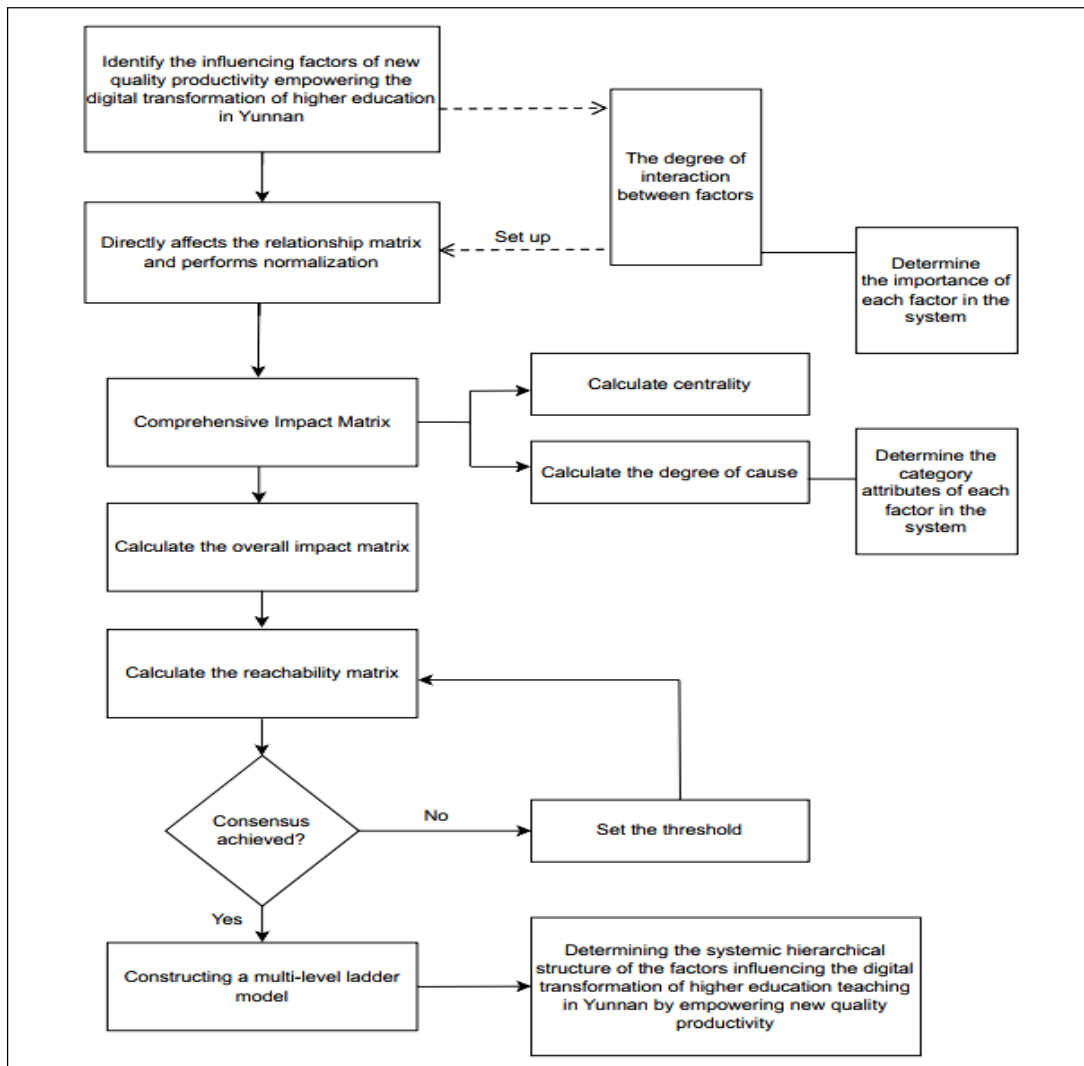
To determine convergence, a commonly used 75% agreement threshold was adopted (i.e., when at least 75% of experts rated an item as “important” or “very important”), following suggestions by Mozelius et al. (2023); Strachan and Baker (2024). Items not meeting this criterion were re-evaluated and refined in subsequent rounds. Stability in responses was achieved after the third round, thus indicating satisfactory consensus.

### 3.2. DEMATEL-ISM Model

First, important influencing NQP factors that can both enable and provide a strong guidance for the digital transformation of higher education were systematically sorted. Subsequently, the hierarchical structural relationship between various factors were clarified to identify the key components that would ultimately help colleges and governments implement precise policies (Figure 1).

**Figure 1**

*A Research Technology Route for Enabling Digital Transformation of Higher Education with NQP based on the DEMATEL-ISM Model*



### **3.3. Determining the Collection of Influencing NQP Factors Empowering the Digital Transformation of Higher Education**

The concept of NQP as an important theoretical basis for modern economic and social development provides crucial guidance for the digital transformation of higher education. Combined with previous research, it specifically includes the following five aspects:

#### **3.3.1. Technological Innovation and Integration of Educational Resources**

NQP emphasises technological innovation as one of the main means of increasing productivity. In the context of higher education, the colleges in Yunnan can better integrate advanced technologies, such as big data, artificial intelligence (AI), and the Internet of Things (IoT), to create a smarter and more digitalised educational ecosystem (Liu & Xiong, 2024).

#### **3.3.2. Innovation of Educational Model and Teaching Reform**

NQP brings into focus the necessity to reshape modes of production and production relationships. Digital transformation is not limited to the use of technical tools but also implies a rethinking of educational philosophies and teaching methods. Regional universities are encouraged to experiment with new formats of instruction such as blended and personalised learning facilitated by online platforms and data technologies. Moreover, blended teaching combines face-to-face teaching with digital learning environments and adds both flexibility and instructional effectiveness (Yang & Yan, 2024).

#### **3.3.3. Intelligent Education Management**

NQP prioritises modern approaches in governance and for improving the efficiency of institutions. Achieving digital transformation requires the development of intelligent education management systems that can enhance operational efficiency and service quality. Such systems based on big-data analytics and AI tools can allow comprehensive data collection as well as informed decision-making in educational management. At the same time, with the support of IoT infrastructure, smart sensors, and integrated data analysis, campuses can introduce real-time monitoring and coordinated management of facilities and personnel (Gao & Huang, 2024).

#### **3.3.4. Interdisciplinary Integration and Collaborative Innovation**

NQP stresses cross-disciplinary convergence as a pathway to comprehensive innovation and high-quality development. Provincial higher education should actively promote interdisciplinary integration and collaborative innovation, break down disciplinary barriers, and promote cross-disciplinary cooperation. At the same time, provincial higher education should build a collaborative innovation platform to advance deeper collaboration among industry, academia, and research sectors to improve the translation of knowledge into practice. Through partnerships with enterprises and research organisations, an innovation ecosystem with universities at the core can promote scientific and technological innovation and achieve digital transformation (Huo, 2024).

#### **3.3.5. High-Quality Talent Training System**

Digital transformation requires the construction of a talent training system that can adapt to the requirements of the new era and cultivate high-quality talents with an innovative spirit and practical abilities. Practical competencies should be strengthened, and under the framework of NQP, universities can be expected to cultivate globally oriented talent and enhance educational quality (Chen, 2024).

In consideration of the foregoing, this study further collected relevant literature on education and digital transformation of higher education in China and internationally, as well as categorised NQP factors that can influence the digital transformation of higher education.

The Delphi method was employed to consult the expert panel regarding the relevance and rationality of the initially identified factors. Responses from ten experts who completed all Delphi rounds were retained for subsequent analysis, while incomplete responses were excluded to ensure data consistency. Based on their feedback, certain factors were refined, added, or removed, and a preliminary set of influencing factors affecting the digital transformation of higher education in Yunnan Province under the NQP framework was established (Table 1). Accordingly, in the second round of the Delphi method, the multi-subject evaluation method was used to solicit expert opinions, and the degree of influence of each secondary indicator on other secondary indicators was judged one by one, and a specific point value was assigned for each indicator: between zero and three points were given, demonstrating an indicator's gradually increasing degree of influence on other indicators.

**Table 1**

*Factors Influencing the Digital Transformation of Higher Education Enabled with NQP*

First-level influencing factors	Secondary influencing factors
A1 Technological innovation and educational resource integration	B1 Improvement of technology R&D capabilities
	B2 Digital resource integration and sharing mechanism
	B3 Information infrastructure construction
A2 Education model innovation and teaching reform	B4 Modernisation of teaching content
	B5 Diversification of teaching methods
	B6 Improvement of teaching evaluation system
A3 Intelligent education management	B7 Innovation of education management system
	B8 Data-driven decision support
	B9 Intelligent campus management
A4 Interdisciplinary integration and collaborative innovation	B10 Interdisciplinary and fusion mechanisms
	B11 Interdisciplinary research team building
	B12 Collaborative innovation platform construction
A5 High-quality talent training system	B13 Talent cultivation model integrating industry and education
	B14 Professional development of the teaching staff
	B15 Innovation and entrepreneurship education system
	B16 International talent cultivation strategy

### **3.4. Systematic Structural Analysis of the Factors Affecting Digital Transformation of Higher Education Enabled with NQP**

This study employs the hybrid DEMATEL-ISM approach to identify and structure the key drivers influencing digital transformation in higher education. DEMATEL is a particularly useful method for uncovering causal linkages among variables within complex systems to help decision makers identify key influencing factors and causal paths, thereby offering an analytical foundation for the development of effective digital transformation strategies.

Meanwhile, ISM is suitable for structured and hierarchical analyses of complex systems. Through systematic thinking, ISM understands the hierarchical relationship and action path of each factor, thus helping decisionmakers analyse and solve problems layer by layer, and promoting the overall optimisation of the system.

By integrating the causal analysis of DEMATEL with the structural modelling of ISM, this study provides a comprehensive understanding of the complexity of digital transformation in higher education driven by NQP from multiple perspectives and levels. This study identifies key factors and hierarchical structures between the factors to clarify the effective way of achieving digital transformation of higher education in Yunnan Province.

In the DEMATEL method, experts assessed the degree of influence among factors using a scale of zero to three, which was used to construct a direct-relation matrix. This matrix was then normalised to obtain the total-relation matrix, from which the prominence (D+R) and relation (D–R) values were calculated to identify cause-and-effect factors.

At the ISM stage, a reachability matrix was derived by applying a threshold value to the total-relation matrix. Factors were then partitioned into hierarchical levels based on their reachability and antecedent sets, thus allowing the construction of a multi-level structural model. The integration of DEMATEL and ISM enabled both causal analysis and hierarchical structuring of factors affecting digital transformation.

### 3.5. Validity and Reliability

To ensure validity and reliability, expert-based content validity was established through a structured Delphi process with multiple rounds to achieve consensus. Reliability was enhanced by aggregating multiple expert judgments and using standardised evaluation scales in the DEMATEL-ISM analysis. These procedures improved the robustness and consistency of the results.

## 4. Findings and Discussion

### 4.1. Findings

Based on the experts' judgment of the 16 indicators, a direct impact matrix between the indicators was preliminarily constructed (Table 2).

**Table 2**

*The Initial Direct Impact Matrix*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	...	B16
B1	0	0	0	0	0	1	0	1	0	...	0
B2	0	0	0	0	0	0	1	1	0	...	0
B3	0	0	0	0	2	0	2	0	0	...	0
B4	0	0	0	0	0	0	1	1	0	...	0
B5	0	0	0	0	0	1	2	1	0	...	0
B6	0	0	0	0	0	0	0	1	0	...	0
B7	0	0	0	0	0	0	0	1	0	...	0
B8	0	0	0	0	0	0	0	0	0	...	0
B9	0	0	0	0	0	0	0	1	0	...	0
...	...	...	...	...	...	...	...	...	...	...	...
B16	0	0	0	0	0	0	2	0	0	...	0

**Table 3**

*DEMATEL Analysis Results of Factors Affecting the Digital Transformation of Higher Education Enabled with NQP*

Factor	Impact	Influence	Centrality	Cause	Weight	Sorting	Factor attribute
B1	0.61228	0.125	0.73728	0.48728	0.03887	13	Cause
B2	0.43313	0.22396	0.65709	0.20917	0.03464	16	Cause
B3	0.1272	0.50114	0.62834	- 0.37394	0.03313	17	Cause
B4	1.23719	0	1.23719	1.23719	0.06522	2	Outcome Factor
B5	0.52639	0.62624	1.15263	- 0.09985	0.06077	3	Outcome Factor
B6	0.97686	0	0.97686	0.97686	0.0515	7	Outcome Factor
B7	0.22113	0.38567	0.6068	- 0.16454	0.03199	18	Cause
B8	0.22113	0.08333	0.30446	0.1378	0.01605	22	Cause
B9	0.40898	0.54008	0.94906	-0.1311	0.05003	9	Outcome Factor
B10	0.32289	0.27908	0.60197	0.04381	0.03174	19	Cause
B11	0.32289	0	0.32289	0.32289	0.01702	21	Cause
B12	0.82479	0.08333	0.90812	0.74146	0.04788	10	Outcome Factor
B13	0.1272	0.17361	0.30081	- 0.04641	0.01586	23	Cause
B14	0	0.14945	0.14945	- 0.14945	0.00788	26	Cause
B15	0.52639	0.27141	0.7978	0.25498	0.04206	11	Outcome Factor
B16	0.7541	0	0.7541	0.7541	0.03976	12	Outcome Factor

Tables 2 and 3 present the DEMATEL-based analysis of the factors influencing the digital transformation of higher education under the NQP framework.

Specifically, Table 2 displays the initial direct-impact matrix, in which each element represents the degree to which one factor directly affects another, as assessed by the experts. The larger the value, the stronger the perceived direct influence. This matrix was standardised and processed through the DEMATEL method to derive each factor's row sum (R), representing its overall influence on others, and column sum (C), representing the total influence it receives from others.

Based on these values three important indicators were calculated for better interpretation:

1. Centrality (R + C): This measures the centrality or importance of a factor in the entire system. The higher the centrality score, the more systemic the relevance of a particular factor.
2. Net cause-effort value (R - C): If this value is positive, the factor has a predominant role of driver ("net cause"). Conversely, if this value is negative then the factor's predominant role is that of outcome ("net effect").
3. Normalised weight: This is calculated from the centrality of each factor and represents the relative contribution of a factor to the overall digital transformation frame.

As shown in Table 3, the following key points can be identified.

- Causal structure and system dynamics: Several factors, such as B1 (“Improvement of R&D capability”), B4 (“Modernisation of teaching content”), B12 (“Construction of collaborative innovation platforms”), and B16 (“International talent cultivation strategy”), have positive (R-C) values, which identify them as net causes. They are thus the primary forces driving digital transformation in higher education.

In contrast, such factors as B3 (“Information infrastructure construction”), B5 (“Diversification of teaching methods”), and B9 (“Intelligent campus management”) have negative (R-C) values. This indicates that they act as net effect, i.e., they are more likely to be the results of influence of other factors, rather than being themselves independent factors.

- Importance and interaction patterns: High centrality factors (e.g., B4, B5, B6) show strong interaction with other elements and therefore may have both influential and receptive roles in the system. High-weight factors (e.g., B4, B5, B9, B12, B15, B16) are critical leverage points where policy or resource investment would have the greatest system-wide impact.
- Interpretation of systemic pathways: The results of the DEMATEL analysis indicate that enhancing R&D capability (B1), constructing collaborative innovation platforms (B12), and developing international talent strategies (B16) are the initial drivers that indirectly stimulate improvements in teaching content (B4), methods (B5), and intelligent campus management (B9).

This chain presents a causal propagation from the strategic and structural dimension (causes) to operational and outcome dimension (effects).

- Policy and practice implications: The findings reveal that universities should first strengthen the “net cause” dimensions (i.e., enhancing innovation capacity, collaboration mechanisms, and global engagement) to naturally drive progress in downstream “net effect” areas, such as pedagogy and infrastructure. High-centrality factors like teaching content modernisation (B4) and teaching method diversification (B5) should be treated as performance indicators to assess the effectiveness of digital transformation.

## 4.2. Discussion

### 4.2.1. Hierarchical Analysis of Factors Influencing the Digital Transformation of Higher Education Enabled with NQP

To further explore the hierarchical structure of each factor and clarify the role of NQP in empowering the digital transformation of higher education, the reachable and antecedent sets of the factors, as well as their intersection are calculated according to the direct impact matrix. Based on this principle of “reachable set = intersection”, the system elements are divided into four causal levels based on the principle of “reachable set = intersection”.

**Table 4**

*Hierarchical Decomposition of Factors Influencing the Digital Transformation of Higher Education Enabled with NQP*

Level	Elements
Level one	B3, B9
Second floor	B1, B2, B12
Third floor	B4, B5, B10, B14
Fourth floor	B6, B7, B8, B11, B13, B15, B16

**4.2.2. Core Foundation Layer: The Cornerstone of Digital Transformation**

The core foundation layer is composed of information infrastructure construction and intelligent campus management, which are the cornerstone of the digital transformation of higher education. This level focuses on providing a solid technical and management infrastructure, and ensures technical support and capabilities such as network, hardware, software, and data centres that are required for digital transformation by building an efficient, secure and reliable information infrastructure. At the same time, the introduction of intelligent systems has improved the efficiency and intelligence of campus management, provided intelligent support for teaching, scientific research and management, and laid the foundation for the digital transformation of higher education.

**4.2.3. Basic Support Layer: The Driving Force of Digital Transformation**

The basic support layer, as the driving force of digital transformation, focuses on promoting the efficient use of educational resources and the improvement of innovation capabilities through the improvement of scientific and technological research and development capabilities, the integration and sharing of digital resources, and the construction of collaborative innovation platforms. Through these measures, higher education can continuously introduce and apply cutting-edge technologies and promote the optimal allocation of resources and collaborative innovation.

**4.2.4. Middle Promotion Layer: The Key Link of Digital Transformation**

The middle promotion layer, which is the key link of digital transformation, comprises the modernisation of teaching content, diversification of teaching methods, cross-disciplinary integration mechanisms, and professional development of the teaching staff. This level focuses on the specific links of education and teaching that directly promote the improvement of educational quality and the optimisation of teaching outcomes through the updating of teaching content, enrichment of teaching methods, promotion of cross-disciplinary integration, and improvement of the teaching staff's professional levels.

**4.2.5. Advanced Application Layer: Efficient Implementation of Digital Transformation**

The advanced application layer, crucial for the efficient implementation of digital transformation strategies, focuses on optimising teaching evaluation mechanisms, upgrading education management systems, strengthening data-driven decision support, constructing interdisciplinary research teams, the talent training model of industry-education integration, the innovative entrepreneurship education system, and the international talent training strategy. This level focuses on promoting the overall improvement of education management and teaching quality. At the same time, through the construction of interdisciplinary teams and the integration of industry and education, this framework supports the cultivation of innovative talent with strong international competencies.

#### **4.2.6. *Integrated Transformation Pathways and Implementation Implications***

By synthesising the DEMATEL-ISM results, the causal hierarchy can be interpreted as four interrelated transformation pathways: (a) information infrastructure, (b) collaborative innovation, (c) pedagogical reform, and (d) intelligent management. These pathways are mutually reinforcing rather than sequentially isolated.

Infrastructure construction establishes the enabling environment; collaborative innovation accelerates knowledge diffusion; pedagogical reform transforms learning practices; and intelligent management integrates governance and evaluation processes. Their interactions form a resilient mechanism supporting equitable and high-quality digital transformation in higher education.

The findings also imply that the implementation of digital transformation strategies should follow a phased and adaptive approach, emphasising infrastructure security, pilot experimentation, continuous evaluation, and scalable institutional learning. Aligning evaluation indicators and monitoring mechanisms with the influence intensity revealed by the DEMATEL-ISM analysis helps maintain consistency between empirical evidence and policy development.

#### **4.2.7. *Limitations and Future Research***

This study has certain limitations despite being comprehensive in its regional focus and its use of the mixed method design. Specifically, generalisability is possibly restricted because the Delphi panel consisted primarily of experts only from Yunnan Province. Testing for cross-regional applicability would require future studies to expand expert sampling at national and international levels.

Additionally, the DEMATEL-ISM framework captures relatively static causal relationships. Subsequent research should consider incorporating dynamic modelling approaches or system-dynamics analysis to examine temporal evolution in digital transformation processes. Large-scale quantitative validation or machine-learning-based causal inference could further enhance empirical robustness.

Despite these limitations, this study provides a replicable analytical framework for understanding how NQP promotes the digital transformation of higher education.

## **5. Conclusion**

This study investigated the key drivers of digital transformation in higher education using an integrated Delphi-DEMATEL-ISM approach. A total of 16 influencing factors were identified and structurally analysed to reveal their causal relationships and hierarchical configuration. The findings demonstrate that digital transformation is a multidimensional process in which technological infrastructure and intelligent governance form the basic layer, while collaborative innovation mechanisms and pedagogical reform work as critical transmission mechanisms. The results emphasise the importance of curricular modernisation and varying teaching methodologies in the centre of the digital transformation system. This indicates that digital transformation in regional higher education is not driven solely by technology, but is strongly pedagogically driven. By considering how strategic, structural, and operational factors are inter-related, this study provides a system-level analytical perspective to the existing digital transformation literature and shows the applicability of the DEMATEL-ISM approach in educational research. The proposed framework offers a replicable methodical reference to analyse transformation pathways in

other regional circumstances. Future research may also offer further validation to these findings using large-scale and quantitative surveys or dynamic modelling techniques to explore the long-term evolution of digital transformation in various higher education systems.

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