Management Strategies and Engineering Sciences 2026; 8(6):1-18



Multi-Level Governance and Science and Technology Policy in Steering Digital Transformation in Higher Education A Qualitative Study

Sajad Ghorbani[1*], Mohammad Mojtabazadeh[2] Mahdi Mobini[3] Hossein Rasouli[4]

[1] Assistant Professor, Department of Educational Sciences, Farhangian University, Tehran, Iran
[2] Assistant Professor, Department of Educational Management, Farhangian University, Tehran, Iran,
[3] Assistant Professor, Department of Educational Sciences, Faculty of Literature and Humanities, University of Qom, Qom, Iran
[4] M.A. Graduate in Financial Management, Department of Management, Faculty of Humanities, University of Zanjan, Zanjan, Iran

*** Corresponding author email address**: sajad_ghorbani@cfu.ac.ir

Received: 2026-06-06 **Revised:** 2026-10-27 **Accepted:** 2026-11-02 **Initial Publish:** 2026-11-02 **Final Publish:** 2026-12-01

Abstract

Digital transformation in higher education is often perceived as a technological change; however, in practice it represents a multidimensional and governance-driven process that emerges through the interaction of public policies, institutional arrangements, and the organizational capacities of universities. The purpose of this study is to explain the role of multi-level governance and science and technology policy in guiding and shaping digital transformation in higher education. This study adopted a qualitative approach using an interpretive meta-synthesis method. Research data were collected through the analysis of relevant scholarly documents and examined using thematic analysis. The analytical process included familiarization with the data, open coding, axial coding, and selective coding, which ultimately led to the identification of major conceptual categories and themes. To enhance the trustworthiness of the study, the criteria of credibility, transferability, dependability, and confirmability were applied. The findings indicate that digital transformation in higher education is influenced by a set of governance and institutional factors that can be explained through five main themes: policy steering and multi-level alignment; coherent policy instrument mixes and alignment of science and technology policies; institutional mediation and organizational capacity of universities; tensions between institutional autonomy and accountability mechanisms; and iterative and adaptive implementation logics. The results show that universities are not merely passive recipients of macro-level policies; rather, they act as active mediators that interpret and implement policies within their institutional contexts. Accordingly, the success of digital transformation in higher education requires coordination across different levels of governance, coherence in policy instruments, strengthening institutional capacity within universities, and maintaining a balance between autonomy and accountability. By providing a governance-oriented explanation of digital transformation, this study contributes to a more comprehensive theoretical understanding of this phenomenon in higher education.

Keywords: *Digital Transformation; Higher Education; Multi-Level Governance; Qualitative Meta-synthesis; Science and Technology Policy; Thematic Analysis*

How to cite this article:

Ghorbani, S., Mojtabazadeh, M., Mobini, M., & Rasouli, H. (2026). Multi-Level Governance and Science and Technology Policy in Steering Digital Transformation in Higher Education A Qualitative Study. Management Strategies and Engineering Sciences, 8(6), 1-18.

1. Introduction

Digital transformation has emerged as one of the most significant strategic challenges and opportunities confronting higher education institutions worldwide. Universities are increasingly expected to integrate digital technologies into teaching and learning, research processes, administrative systems, student services, and institutional decision-making structures. However, contemporary evidence indicates that digital transformation cannot be understood merely as the adoption of technological infrastructures, software platforms, or artificial intelligence applications. Rather, it represents a complex institutional transformation process involving changes in governance arrangements, organizational structures, policy priorities,

© 2026 The author(s). Published By: The Research Department of Economics and Management of Tomorrow's Innovators. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

professional practices, and relationships among diverse stakeholders. In this sense, digital transformation in higher education reflects a broader reconfiguration of how universities create value, organize knowledge production, deliver educational services, and respond to societal expectations in an increasingly digital environment. Recent studies emphasize that successful transformation depends not only on technological availability but also on leadership capacity, institutional readiness, organizational culture, and governance mechanisms that enable universities to convert technological possibilities into sustainable institutional change [1-3]. Consequently, digital transformation should be examined as a governance phenomenon in which technological innovation interacts with policy choices, institutional capabilities, and multi-actor coordination processes.

The expansion of digital transformation has also altered traditional assumptions regarding the role and function of higher education governance. Historically, universities have operated within relatively stable governance environments characterized by academic autonomy, professional self-regulation, and nationally defined regulatory frameworks. However, digital transformation has introduced new governance demands associated with data management, artificial intelligence regulation, digital infrastructure investment, cybersecurity, technological standards, and accountability mechanisms. These developments have increased the interdependence between universities, governments, technology providers, and innovation ecosystems. As a result, decision-making regarding digital transformation increasingly extends beyond institutional boundaries and involves multiple governance levels, including international organizations, national governments, regional networks, and individual universities. The concept of multi-level governance provides a valuable analytical perspective for understanding these complex relationships because it explains how authority, resources, responsibilities, and policy decisions are distributed and negotiated among different actors and institutional levels. Recent research demonstrates that digital transformation initiatives in higher education are shaped by interactions between national policy frameworks, institutional strategies, and collaborative governance arrangements rather than by centralized decision-making alone [4-6].

Within this governance-oriented perspective, science and technology (S&T) policy plays a fundamental role in directing the trajectory of digital transformation in higher education. S&T policies establish national priorities concerning innovation capacity, digital infrastructure development, research ecosystems, technological competitiveness, and human capital formation. In higher education systems, these policies influence the allocation of resources, institutional incentives, regulatory expectations, and strategic orientations that determine how universities engage with digital transformation. Therefore, digital transformation is not simply an institutional response to technological change but also a policy-driven process embedded within broader innovation and development strategies. Studies examining digital transformation policies suggest that the effectiveness of digital initiatives depends on policy coherence, alignment between educational and innovation agendas, and the ability of governments to combine regulatory, financial, strategic, and evaluative instruments in a coordinated manner [7, 8]. When science and technology policies remain disconnected from higher education strategies, digital transformation efforts may become fragmented, inefficient, or limited to technological modernization without deeper institutional change. Conversely, integrated policy frameworks can strengthen governance coordination and promote sustainable digital transformation pathways.

The contemporary literature on digital transformation in higher education has expanded rapidly; however, existing research remains theoretically fragmented. A significant body of scholarship approaches digital transformation primarily from a technological or pedagogical perspective, emphasizing innovations such as artificial intelligence, generative technologies, digital credentials, flipped classrooms, and smart learning environments. These studies demonstrate that digital technologies can enhance educational accessibility, personalization, flexibility, and learning outcomes. For example, emerging research on digital micro-credentials and generative artificial intelligence highlights the importance of connecting technological innovation with pedagogical redesign and quality assurance mechanisms [9]. Similarly, studies on flipped classroom models indicate that digital transformation can support sustainable educational practices when technological tools are embedded within appropriate instructional frameworks [10]. Research examining Industry 4.0 and higher education further suggests that digital transformation represents a paradigm shift requiring universities to reconsider knowledge production, curriculum design, and workforce preparation [11]. Although these contributions provide valuable insights into technological and educational dimensions, they often provide limited

explanation of how governance structures and policy systems shape the conditions under which such innovations emerge and become institutionalized.

A second stream of research focuses on organizational transformation, emphasizing leadership, organizational culture, institutional readiness, and resistance to change. From this perspective, universities face significant internal challenges when attempting to implement digital transformation because technological change often requires modifications in administrative processes, professional roles, and organizational routines. Studies indicate that leadership commitment, change management capacity, and organizational learning are among the most important determinants of successful transformation. Digital transformation requires leaders who can develop strategic visions, coordinate institutional actors, and create environments that support innovation and adaptation [12-14]. At the same time, organizational resistance, limited digital competencies, and insufficient institutional resources may prevent universities from moving beyond superficial technology adoption toward comprehensive transformation [15-17]. These studies highlight the importance of internal organizational dynamics; however, they frequently examine universities as individual organizations rather than as actors embedded within wider governance and policy environments.

A third research trajectory addresses governance, policy implementation, and institutional coordination more directly. This literature emphasizes that digital transformation requires effective governance structures capable of aligning technological investments, institutional objectives, stakeholder interests, and public policy priorities. Research on educational administration in the digital era demonstrates that governance challenges involve not only technological management but also regulatory adaptation, accountability structures, and coordination among multiple actors [18]. Similarly, studies on artificial intelligence governance in higher education highlight the importance of policy design, implementation flexibility, ethical considerations, and adaptive governance mechanisms in managing emerging technologies [19, 20]. Other studies emphasize the role of data governance, student rights, inclusion, and institutional legitimacy in shaping digital universities, suggesting that digital transformation involves broader questions of governance, justice, and sustainability rather than technological efficiency alone [21]. This emerging governance literature provides important foundations; however, further theoretical integration is required to explain how multiple governance levels and science and technology policies interact to steer digital transformation processes.

One of the central challenges in current scholarship is the limited understanding of how policy intentions are translated into institutional practices across different governance levels. National governments may develop ambitious digital strategies, establish funding programs, and introduce regulatory frameworks, yet the implementation of these policies occurs within universities that possess different organizational capacities, strategic priorities, and cultural contexts. Consequently, identical policy interventions may generate different outcomes across institutions. Research on national digital transformation models demonstrates that policy implementation depends on the interaction between national strategies, institutional mediation, and local organizational conditions [5]. Similarly, studies on digital transformation and public value creation indicate that institutional readiness, digital competencies, and governance pathways determine whether technological investments produce meaningful educational and societal outcomes [22]. Therefore, understanding digital transformation requires moving beyond policy formulation or technological adoption alone and examining the mechanisms through which governance arrangements enable, constrain, and reshape institutional transformation.

The issue of governance coordination becomes particularly important because higher education systems frequently experience tensions between institutional autonomy and external accountability. Universities traditionally value autonomy as a foundation for academic freedom, innovation, and institutional diversity. However, governments increasingly employ digital performance indicators, monitoring systems, quality assurance frameworks, and outcome-based funding mechanisms to ensure accountability and alignment with national priorities. While these mechanisms can enhance coordination and transparency, excessive reliance on centralized control may reduce institutional flexibility and encourage compliance-oriented behavior rather than genuine innovation. Recent studies suggest that sustainable digital transformation requires balancing external steering with institutional autonomy, allowing universities to adapt policies according to their missions, resources, and contextual conditions [4, 23]. This tension demonstrates why digital transformation should be analyzed through governance perspectives capable of explaining both structural coordination and institutional agency.

Furthermore, digital transformation in higher education increasingly involves questions of inclusion, sustainability, and unequal access. Although digital technologies create new possibilities for expanding educational opportunities, they may also reinforce existing inequalities when institutions lack sufficient infrastructure, financial resources, or digital capabilities. Research on digital transformation in different national contexts shows that disparities in ICT access, policy implementation capacity, and institutional resources significantly influence transformation outcomes [24, 25]. Sustainable digital transformation therefore requires governance approaches that address not only technological advancement but also equity, accessibility, and long-term institutional resilience. Studies on sustainable digital transformation in public administration and university systems further emphasize that digital initiatives must be integrated with broader governance principles, organizational sustainability, and public value creation [22, 26].

Despite the growing body of research on digital transformation, several theoretical and empirical gaps remain. First, much of the existing literature examines either technological innovation, organizational change, or policy development separately, resulting in fragmented explanations of transformation processes. Second, limited attention has been given to the interaction between multi-level governance structures and science and technology policy as interconnected mechanisms shaping higher education digital transformation. Third, although universities are frequently identified as important actors, insufficient emphasis has been placed on their role as institutional mediators that interpret, adapt, and reconstruct policy intentions within specific organizational contexts. Finally, existing studies often focus on individual countries, institutions, or technological interventions, leaving a need for broader conceptual syntheses capable of identifying common governance mechanisms across diverse contexts.

Addressing these gaps is important because digital transformation has become a strategic priority for higher education systems seeking to improve educational quality, research capacity, administrative efficiency, and societal responsiveness. A governance-centered understanding can provide policymakers and university leaders with deeper insights into why some digital transformation initiatives achieve sustainable institutional change while others remain fragmented or symbolic. Recent conceptual and empirical studies increasingly call for integrated frameworks that connect policy models, governance arrangements, institutional readiness, and implementation processes [8, 27, 28]. Such frameworks are necessary for explaining how digital transformation emerges through interactions among policy instruments, governance structures, organizational capabilities, and stakeholder networks.

Accordingly, this study seeks to contribute to the literature by conceptualizing digital transformation in higher education as a multi-level governance process shaped by science and technology policy, institutional mediation, and adaptive implementation mechanisms, and the aim of this study is to explain how multi-level governance and science and technology policy steer digital transformation in higher education through the identification and synthesis of governance mechanisms, policy instruments, and institutional dynamics.

2. Methodology

2.1. Research Design and Paradigm

This study adopts a qualitative research design grounded in an interpretivist paradigm in order to develop an in-depth and context-sensitive understanding of how multi-level governance (MLG) and science and technology (S&T) policy shape and steer digital transformation in higher education (HE). An interpretivist stance is particularly appropriate for this inquiry because the core phenomena under investigation—governance coordination across levels, policy rationales, institutional responses, and implementation dynamics—are socially constructed, discursively mediated, and strongly conditioned by organizational and policy contexts rather than reducible to measurable variables alone (Creswell & Poth, 2018; Denzin & Lincoln, 2018). Within this framework, the study is empirically designed as an interpretive analysis and synthesis of scholarly literature and policy-oriented studies, including academic works that analyze, evaluate, or theorize policy processes, governance arrangements, and institutional transformations in higher education. Accordingly, the methodological aim is not to measure effectiveness in a narrowly causal or positivist sense, but rather to identify, interpret, and synthesize recurring governance logics, coordination mechanisms, institutional tensions, and policy narratives through which digital transformation is framed, justified, and operationalized across multiple governance levels.

2.2. *Data Sources and Search Strategy*

The data corpus for this study consists of peer-reviewed journal articles, review papers, and policy-oriented scholarly studies focusing on digital transformation, governance, and policy processes in higher education. Relevant sources were identified through structured and purposive searches conducted in major academic databases and publisher platforms, namely Scopus, Web of Science, Google Scholar, and Taylor & Francis Online. To ensure both conceptual breadth and thematic precision, the search strategy was developed around a set of interrelated keywords associated with the three central dimensions of the study: governance, policy, and digital transformation in higher education. These keywords included "multi-level governance," "science and technology policy," "digital transformation," "higher education," "policy implementation," "institutional coordination," "digital governance in universities," and "innovation policy in higher education." These terms were combined using Boolean operators such as AND and OR in order to expand or refine the search results according to conceptual relevance. Illustrative query combinations included expressions such as ("multi-level governance" OR "multilevel governance") AND ("higher education" OR university) AND ("digital transformation" OR digitalization), as well as ("science and technology policy" OR "innovation policy") AND "higher education" AND ("policy implementation" OR governance). Additional combinations such as ("institutional coordination" OR "intergovernmental relations") AND "digital governance" AND university were also employed to capture studies addressing coordination mechanisms across institutional and policy levels. Although the review prioritized recent scholarship published between 2024 and 2026 in order to reflect the latest governance and policy developments in the field of digital transformation, earlier foundational studies were also retained when they offered indispensable conceptual or methodological insights.

2.3. *Eligibility Criteria and Source Selection*

To enhance methodological transparency and reproducibility, explicit inclusion and exclusion criteria were applied throughout the source selection process. Studies were included if they were published in English, underwent peer review, and focused directly on higher education systems and/or universities. In addition, selected sources had to demonstrate substantive relevance to at least one of the following analytical domains: multi-level governance, science and technology policy or innovation policy, digital transformation, policy implementation, or institutional coordination within the context of higher education. Particular priority was given to studies published between 2024 and 2026 in order to ensure contemporary relevance, although earlier seminal works were included where conceptually indispensable. By contrast, non-scholarly outputs such as blogs, opinion pieces, and non-peer-reviewed reports were excluded from the dataset. Studies focusing primarily on primary or secondary education were also excluded, as were purely technical or engineering-oriented articles dealing with digital systems in the absence of a clear governance or policy dimension. Duplicate records and studies with only marginal relevance to the research problem were removed as well. The screening and selection process proceeded in three sequential stages. First, titles were reviewed to remove clearly irrelevant publications. Second, abstracts were assessed to determine whether the studies aligned with the intersection of governance, policy, and digital transformation in higher education. Third, full texts were examined to confirm conceptual fit, analytical richness, and direct relevance to the research objectives. Final inclusion decisions were therefore based not merely on topical proximity, but on the degree to which each source contributed meaningful analytical insight into governance arrangements, policy steering mechanisms, and institutional dynamics associated with digital transformation in higher education.

2.4. *Data Analysis Procedure*

The selected sources were analyzed using Qualitative Thematic Analysis as a flexible yet methodologically rigorous approach for identifying, interpreting, and synthesizing patterned meanings across textual materials (Braun & Clarke, 2006, 2021). Given the synthetic orientation of the study, the analysis also incorporated a meta-synthesis logic, through which interpretive insights from multiple studies were integrated in order to generate higher-order themes and a coherent explanatory account rather than a purely descriptive summary of findings. The analytical process was iterative and unfolded through three interrelated phases of coding. In the first phase, open coding was conducted through close reading of the full texts in order to identify salient units of meaning related to governance interactions across levels, including supranational, national, regional, and institutional dimensions; S&T policy instruments; rationales for digital transformation;

implementation challenges; and institutional or inter-organizational coordination arrangements. At this stage, codes were generated inductively while remaining conceptually sensitized by the central research problem (Tracy, 2020). In the second phase, axial coding was employed to cluster the initial codes into more coherent conceptual categories by examining the relationships among structural conditions, organizational actions and interactions, and observed consequences. This process facilitated the identification of mid-level analytical themes related to issues such as regulatory mandates, funding mechanisms, stakeholder engagement, implementation asymmetries, and institutional capability gaps, thereby revealing recurring governance and policy dynamics across different empirical settings. In the third phase, selective coding enabled the integration of these categories into broader explanatory themes that clarified how MLG and S&T policy steer digital transformation in higher education. These integrative themes included cross-level steering and alignment between different policy tiers, instrument mixes and policy coherence involving regulation, funding, standards, and capacity-building, institutional mediation and capability dynamics related to organizational readiness and leadership, tensions and trade-offs between autonomy and accountability or innovation and compliance, and the implementation logics through which policy objectives are translated into infrastructures, routines, and governance practices within higher education institutions. Throughout the analytical process, constant comparison was applied across sources in order to refine thematic boundaries, identify convergent and divergent patterns, and strengthen the interpretive consistency of the synthesis.

2.5. Trustworthiness and Research Rigor

The methodological rigor of the study was established through the trustworthiness criteria proposed by Lincoln and Guba, namely credibility, transferability, dependability, and confirmability, adapted here to the context of document-based qualitative synthesis (Lincoln & Guba, 1985; Nowell et al., 2017). Credibility was strengthened through repeated and careful reading of the selected sources, systematic coding, and iterative comparison across studies so that the emerging themes were grounded in recurring textual evidence rather than isolated interpretations. In addition, peer debriefing was used during the analytical process by discussing the evolving coding structure and thematic organization with an informed colleague, thereby challenging assumptions and improving the plausibility and coherence of the interpretations (Nowell et al., 2017; Tracy, 2020). Transferability was supported through the provision of a conceptually rich and contextually detailed account of the themes and their conditions of emergence, including governance levels, policy instruments, and institutional capacities, enabling readers to judge the relevance of the findings for other higher education systems and policy settings (Lincoln & Guba, 1985). Dependability was addressed through the maintenance of an audit trail documenting the main procedural steps of the study, including database selection, search strings, screening decisions, exclusion rationales, coding iterations, and the analytic logic through which themes were refined, merged, or differentiated. This documentation increased procedural transparency and allowed the analytical path of the study to remain open to scrutiny. Finally, confirmability was enhanced by sustained reflexive attention to interpretive choices throughout the analysis and by preserving analytic memos that connected each major theme to representative evidence from multiple sources. The use of peer debriefing further contributed to confirmability by reducing the risk of unchecked interpretive bias and reinforcing analytical discipline in the synthesis process.

3. Findings and Results

This study employed an interpretivist qualitative meta-synthesis to examine how multi-level governance (MLG) and science and technology (S&T) policy shape and steer digital transformation in higher education. Following a thematic analysis framework used in recent qualitative policy synthesis research [8], the analytical process proceeded through three iterative stages: (1) open coding to extract key concepts and policy-governance mechanisms from the selected studies; (2) axial coding to cluster conceptually related codes into higher-order analytical categories; and (3) selective coding to integrate these categories into overarching explanatory themes.

In the first stage, recurring constructs across the reviewed literature—such as national digital strategies, regulatory frameworks, funding mechanisms, institutional leadership, organizational capabilities, autonomy tensions, and implementation models—were systematically identified and coded. Through constant comparison, these codes were grouped into coherent analytical categories capturing structural, policy, and institutional dimensions of digital transformation governance. In the final stage, these

categories were synthesized into five higher-order themes that collectively explain how governance architectures and policy instruments interact to steer digital transformation processes in universities.

The synthesis indicates that digital transformation in higher education is not merely a technological shift but a structurally embedded governance phenomenon. It emerges from dynamic interactions among national and supranational policy frameworks, institutional mediation mechanisms, and organizational capabilities [4, 5]. Across diverse contexts—including emerging and advanced higher education systems—the effectiveness of digital transformation initiatives appears contingent upon policy alignment across governance levels, coherence of policy instrument mixes, and the adaptive capacities of universities [8, 22, 29].

Overall, the analysis resulted in the identification of five explanatory themes:

1. Policy steering and multi-level alignment;
2. Policy instrument mixes and S&T policy coherence;
3. Institutional mediation and organizational capacity dynamics;
4. Governance tensions between autonomy and accountability;
5. Implementation logics of digital transformation in universities.

These themes structure the Findings section and provide the analytical backbone for understanding how multi-level governance arrangements shape the trajectory of digital transformation in higher education systems.

Table 1. Summary of the Thematic Extraction Process

Extracted Open Codes	Axial Categories	Final Themes
National digital transformation strategies in higher education	Policy alignment mechanisms	Policy steering and multi-level alignment
Digitalization policies for teaching and research	Alignment between education and innovation policy	Policy steering and multi-level alignment
Regulatory frameworks for educational technologies	Regulatory policy instruments	Policy instrument mixes and S&T policy coherence
Innovation funding schemes for digital infrastructure	Economic policy instruments	Policy instrument mixes and S&T policy coherence
Digital leadership within universities	Leadership and change management capacity	Institutional mediation and organizational capacity dynamics
Faculty digital skills and training programs	Human capital and organizational capability	Institutional mediation and organizational capacity dynamics
Institutional autonomy of universities	University autonomy	Governance tensions between autonomy and accountability
Performance evaluation and accountability systems	Policy-driven accountability mechanisms	Governance tensions between autonomy and accountability
Development of digital learning platforms	Organizational innovation practices	Implementation logics of digital transformation
Data governance and IT management structures	Digital infrastructure governance	Implementation logics of digital transformation

As shown in Table 1, the analytical progression from open codes to axial categories and ultimately to five higher-order themes reflects a structured and transparent synthesis process consistent with qualitative rigor criteria. The table demonstrates how dispersed empirical findings across the reviewed studies were consolidated into a coherent governance-oriented explanatory framework for understanding digital transformation in higher education.

The interpretive analysis of the selected studies indicates that one of the central patterns in the literature on digital transformation in higher education is the role of policy steering through alignment across multiple levels of governance. Within this framework, digital transformation is understood not merely as a technological shift, but as a policy-driven process embedded in a multi-level governance architecture. The reviewed studies show that policies related to the digitalization of higher education are typically designed at supranational and national levels, while their practical realization occurs at the institutional level of universities [4, 5]. Consequently, the degree of alignment between policies formulated at different governance levels and the implementation capacities of universities plays a decisive role in shaping the direction and effectiveness of digital transformation initiatives.

At the supranational level, policy frameworks and initiatives related to innovation and the digitalization of higher education often function as normative and strategic reference points for national governments. Through policy networks and international collaborations, these frameworks influence the overall orientation of digital reforms in higher

education systems [5]. At the national level, governments define the overarching goals and implementation pathways of transformation by formulating digital transformation strategies, science and technology policies, and investment programs in information technology infrastructure [4]. However, a key insight emerging from many studies is the role of universities as institutional mediators in translating these policies into concrete actions. Universities reinterpret and contextualize macro-level policies and implement them through operational plans, organizational reforms, and digital educational innovations [22].

The analysis further demonstrates that steering digital transformation does not occur solely through hierarchical relationships between governments and universities. Rather, it is also significantly dependent on horizontal coordination mechanisms among universities and regional networks. Such networks facilitate the exchange of experiences, policy learning, and the development of technological collaborations, thereby supporting digital transformation processes within higher education systems [29]. Overall, the findings suggest that the realization of digital transformation in higher education requires policy coherence across multiple governance levels, ensuring that macro-level policies at the supranational and national levels are aligned with institutional capacities and inter-organizational collaboration mechanisms.

Based on this analysis, a set of conceptual codes extracted from the selected studies was organized into axial categories that form the analytical structure of the theme "Policy steering and multi-level alignment." This analytical structure is presented in Table 2.

Table 2. Analytical Structure of the Theme "Policy Steering and Multi-Level Alignment"

Extracted Open Codes	Axial Category	Dominant Governance Level	Supporting Studies	Analytical Implication
National strategies for digital transformation in higher education	Alignment of national and institutional policies	National	[4]	Governments define the strategic direction of digital transformation
Integration of higher education and science and technology policies	Policy coherence	National/supranational	[7, 8]	Reducing fragmentation between education and innovation policy domains
Supranational digitalization frameworks	Multi-level policy alignment	Supranational	[5]	Providing normative reference points for national reforms
Regional university collaboration networks	Horizontal coordination	Regional	[29]	Facilitating policy learning and diffusion of digital practices
Translation of national policies into university strategies	Institutional mediation	Institutional	[22]	Operationalizing macro-level policies within universities
Government–university coordination mechanisms	Inter-level governance arrangements	National/institutional	[6]	Bridging policy formulation and institutional implementation

As shown in Table 2, the extracted codes converge into a set of analytical categories that collectively explain the mechanism of policy alignment in governing digital transformation. The data indicate that national digital transformation policies play a critical role in defining the overarching direction of reform in higher education. However, the realization of these policies depends substantially on the capacity of universities to translate and operationalize them. In other words, universities act as key institutional actors that reinterpret macro-level policies and embed them into organizational strategies and digital innovation practices.

At the same time, the evidence suggests that policy alignment is not confined to vertical relationships between governments and universities. Collaborative networks among universities and regional actors also play a significant role in fostering policy learning and disseminating digital transformation practices. These mechanisms point to a networked and polycentric governance structure in which actors at different levels actively participate in shaping the trajectory of digital transformation.

Taken together, the evidence presented in Table 2 demonstrates that steering digital transformation in higher education requires coordination mechanisms across governance levels, coherence among policy domains, and robust institutional capacities within universities. These findings suggest that multi-level governance functions as a policy architecture that shapes the trajectory of digital transformation through vertical alignment and horizontal coordination.

The interpretive analysis indicates that digital transformation in higher education is shaped not by isolated policy tools but by coordinated mixes of policy instruments embedded within broader science and technology (S&T) policy frameworks. The effectiveness of digital transformation depends on how regulatory, financial,

strategic, and evaluative instruments are combined and aligned across policy domains.

The reviewed studies show that governments typically employ a combination of regulatory instruments, such as digital accreditation standards and quality assurance requirements; financial instruments, including competitive grants and performance-based funding schemes; strategic instruments, such as national digital transformation roadmaps; and evaluative mechanisms, including monitoring systems and performance indicators.

A key finding of the literature is that fragmentation between higher education policy and S&T policy often leads to incoherent reform trajectories. When digitalization strategies are developed independently from broader innovation policies, misaligned incentives and duplicated investments may emerge. In contrast, integrating higher education digitalization into national innovation systems improves policy coherence, optimizes resource allocation, and strengthens systemic learning [7, 8]. Moreover, the evidence suggests that policy instruments are most effective when they operate in complementary combinations. For example, financial incentives for digital infrastructure require supportive regulatory frameworks and monitoring mechanisms in order to produce sustainable institutional change [4].

Table 3. Analytical Structure of the Theme "Policy Instrument Mixes and S&T Policy Coherence"

Extracted Open Codes	Axial Category	Instrument Type	Supporting Studies	Analytical Implication
Competitive digital infrastructure grants	Financial incentives	Economic	[4]	Directing institutional investment toward digital priorities
Digital accreditation and quality assurance standards	Regulatory steering	Regulatory	[9]	Embedding digital requirements into formal governance mechanisms
National digital transformation roadmaps	Strategic coordination	Strategic	[5]	Providing long-term direction and policy signaling
Integration of higher education digitalization within national innovation systems	Cross-domain coherence	Strategic/systemic	[7, 8]	Reducing policy fragmentation across sectors
Performance-based funding linked to digital indicators	Incentive alignment	Economic/evaluative	[7]	Aligning institutional behavior with national digital goals
Monitoring and evaluation frameworks	Policy feedback mechanisms	Evaluative	[28]	Enabling adaptive governance and policy learning
Institutional capacity-building programs	Enabling instruments	Supportive	[22]	Strengthening implementation capacity

As shown in Table 3, digital transformation governance relies on coordinated combinations of policy instruments rather than single interventions. Financial incentives encourage investment in digital infrastructure, while regulatory standards embed digital requirements within governance systems. Strategic roadmaps provide long-term policy direction, and monitoring frameworks generate feedback mechanisms that enable adaptive governance and policy learning.

Furthermore, the integration of higher education digitalization within national innovation systems contributes to cross-sectoral policy coherence and reduces fragmentation between education and innovation policy domains. Overall, the evidence suggests that digital transformation in higher education is governed through interconnected constellations of instruments, where coherence between S&T policy and higher education policy strengthens institutional implementation and long-term transformation processes.

The interpretive synthesis identifies institutional mediation and capability dynamics as a central mechanism through which digital transformation policies are translated into organizational practice. While supranational and national frameworks define strategic orientations, universities act as active mediators that reinterpret, adapt, and operationalize these policies within their specific institutional contexts. Digital transformation therefore unfolds not as a linear implementation process but as a context-sensitive organizational reconfiguration shaped by institutional capacity, leadership, and internal governance arrangements.

The reviewed studies consistently highlight the importance of organizational capabilities in determining the depth and sustainability of digital transformation. These capabilities include digital infrastructure readiness, leadership commitment, managerial coordination, staff digital competencies, and internal learning mechanisms. In many cases, variation in transformation outcomes across

institutions can be explained less by differences in national policy design and more by disparities in institutional capacity [22].

Leadership emerges as a particularly critical factor. Digital transformation requires strategic vision, cross-departmental coordination, and the alignment of academic and administrative units. Universities that establish dedicated digital governance structures—such as digital transformation committees or chief digital officer roles—tend to demonstrate stronger internal coherence and more effective implementation trajectories [1, 3, 13]. Conversely, fragmented internal governance often results in isolated technological adoption without systemic organizational change.

Another key dimension concerns institutional learning. The literature suggests that successful digital transformation depends on iterative experimentation, feedback mechanisms, and knowledge-sharing practices within universities. Institutions that foster collaborative cultures and professional development programs are better positioned to integrate digital tools into teaching, research, and administrative processes. In this sense, digital transformation is closely linked to organizational learning dynamics rather than mere technological acquisition [17].

The analysis also indicates that universities do not passively comply with policy directives. Instead, they selectively interpret national digital agendas according to their missions, resource bases, and strategic priorities. This process of institutional translation may generate variation in implementation patterns, even within the same national policy environment.

Table 4. Analytical Structure of the Theme "Institutional Mediation and Capability Dynamics"

Extracted Open Codes	Axial Category	Institutional Dimension	Supporting Studies	Analytical Implication
Establishment of digital governance units	Organizational restructuring	Governance structure	[13, 28]	Enhancing coordination and strategic oversight
Leadership commitment to digital strategy	Strategic leadership	Leadership	[1, 22]	Driving institutional alignment and vision
Staff digital skills development programs	Capacity building	Human capital	[22]	Strengthening implementation capability
Investment in digital infrastructure	Resource mobilization	Technological capacity	[4]	Providing the material basis for transformation
Internal monitoring and evaluation systems	Organizational learning	Learning mechanisms	[28]	Facilitating adaptive implementation
Contextual adaptation of national policies	Institutional translation	Strategic mediation	[22]	Producing differentiated implementation outcomes

As shown in Table 4, digital transformation outcomes are strongly mediated by internal governance structures, leadership capacity, human capital development, and organizational learning mechanisms. The table illustrates that policy implementation is not automatic; rather, it depends on the institutional ability to mobilize resources, coordinate actors, and adapt strategies to local conditions.

Overall, the findings suggest that institutional mediation constitutes a decisive layer within multi-level governance. Even when policy alignment and instrument coherence are achieved at higher governance levels, transformation remains contingent upon institutional capabilities. Digital transformation in higher education should therefore be conceptualized as a dynamic interaction between external policy steering and internal organizational capacity, where universities function as strategic actors shaping the trajectory of reform rather than merely executing externally defined agendas.

The interpretive analysis identifies governance tensions between institutional autonomy and external accountability as a recurring and structuring dimension of digital transformation in higher education. Across the reviewed studies, digital transformation policies are shown to reconfigure traditional governance relationships by introducing new forms of performance monitoring, data-driven oversight, and strategic steering. These developments often intensify tensions between universities' desire for organizational autonomy and governments' expectations for accountability and measurable outcomes.

Digital transformation initiatives frequently rely on accountability instruments such as performance indicators, benchmarking systems, digital reporting requirements, and outcome-based funding models. While these instruments are designed to enhance transparency and efficiency, the literature suggests that they may simultaneously constrain institutional discretion. Universities are increasingly

required to align their digital strategies with externally defined metrics, which can limit their ability to pursue context-specific or mission-driven digital innovations [18, 23].

At the same time, several studies emphasize that autonomy remains a critical enabling condition for meaningful digital transformation. Institutional autonomy allows universities to experiment with digital pedagogies, reorganize internal structures, and allocate resources flexibly. Where digital policies are overly prescriptive or tightly coupled to standardized indicators, institutions tend to adopt compliance-oriented behaviors rather than transformative practices. This can result in superficial digitalization focused on meeting reporting requirements rather than achieving deep organizational change [30].

The analysis also reveals that governance tensions are not uniform across systems but are mediated by national governance traditions and institutional histories. In more centralized systems, digital transformation is often steered through hierarchical control mechanisms, whereas in systems with stronger traditions of university autonomy, governments rely more on soft coordination, incentives, and negotiated accountability frameworks. These variations shape how digital transformation is interpreted and enacted at the institutional level [5].

Table 5. Analytical Structure of the Theme "Governance Tensions: Autonomy Versus Accountability"

Extracted Open Codes	Axial Category	Governance Mechanism	Dominant Level	Supporting Studies	Analytical Implication
Digital performance indicators	Performance-based accountability	Evaluative control	National	[7]	Steering institutional behavior through metrics
Outcome-based digital funding schemes	Financial accountability	Economic control	National	[7]	Linking resources to measurable digital outputs
Mandatory digital reporting requirements	Administrative oversight	Regulatory control	National	[18]	Increasing transparency while constraining discretion
Institutional freedom in digital strategy design	Organizational autonomy	Self-governance	Institutional	[5]	Enabling context-sensitive innovation
Negotiated accountability frameworks	Hybrid governance	Coordinated control	National/institutional	[6]	Balancing autonomy and oversight
Compliance-oriented digital practices	Symbolic adoption	Institutional response	Institutional	[30]	Risk of superficial transformation

As shown in Table 5, digital transformation governance is characterized by a persistent tension between mechanisms that enhance accountability and those that protect institutional autonomy. The table illustrates how evaluative, financial, and regulatory controls strengthen governmental oversight, while institutional self-governance enables experimentation and localized adaptation.

Overall, the findings suggest that effective digital transformation requires a calibrated balance between autonomy and accountability. Excessive external control may undermine innovation and institutional learning, whereas insufficient accountability can weaken strategic coordination and public legitimacy. From a multi-level governance perspective, managing this tension is central to steering digital transformation in higher education, as it shapes how universities engage with policy objectives while retaining the capacity to pursue meaningful and context-responsive digital change.

The interpretive synthesis indicates that the success of digital transformation policies ultimately depends on the implementation logics through which strategic objectives are translated into operational practices within higher education systems. While earlier themes highlighted policy alignment, instrument mixes, and institutional capabilities, the literature shows that transformation outcomes are strongly shaped by how policies are implemented, coordinated, and adapted over time.

The reviewed studies suggest that digital transformation in higher education is implemented through a combination of top-down strategic steering and bottom-up institutional experimentation. Governments typically establish broad policy frameworks, funding programs, and national roadmaps that define the direction of digital reforms. However, universities play a decisive role in interpreting these strategies and embedding them within teaching practices, research infrastructures, and administrative processes [4].

A recurring pattern in the literature is the importance of incremental and adaptive implementation. Rather than occurring through abrupt systemic change, digital transformation often progresses through gradual experimentation, pilot projects, and iterative policy

adjustments. Such processes allow institutions and policymakers to respond to technological uncertainty, organizational resistance, and evolving educational needs. Adaptive implementation mechanisms—such as feedback loops, evaluation frameworks, and policy learning platforms—enable governments and universities to refine strategies over time [13, 28].

Another key dimension concerns coordination across actors and sectors. Effective implementation frequently depends on collaboration among universities, technology providers, government agencies, and regional innovation ecosystems. These multi-actor arrangements facilitate knowledge exchange, resource mobilization, and the scaling of successful digital practices across institutions [6].

The literature also highlights potential implementation gaps. Even when policies are well designed, institutional constraints such as limited technical expertise, fragmented governance structures, or insufficient funding may slow down or distort implementation processes. As a result, digital transformation policies may produce uneven outcomes across institutions and national systems [24, 25, 27].

Table 6. Analytical Structure of the Theme "Implementation Logics in Digital Transformation"

Extracted Open Codes	Axial Category	Implementation Mechanism	Governance Level	Supporting Studies	Analytical Implication
National digital transformation programs	Strategic steering	Top-down coordination	National	[4]	Providing direction and policy guidance
Institutional pilot projects for digital learning	Experimental implementation	Bottom-up innovation	Institutional	[22]	Testing and refining digital practices
Policy monitoring and evaluation cycles	Adaptive governance	Feedback mechanisms	National/institutional	[13, 28]	Enabling iterative policy adjustment
Collaboration with technology providers	Multi-actor coordination	Public–private partnerships	National/regional	[6]	Facilitating access to expertise and innovation
Knowledge-sharing platforms among universities	Policy learning networks	Horizontal diffusion	Regional/institutional	[29]	Spreading successful digital practices
Institutional capacity constraints	Implementation barriers	Organizational limitation	Institutional	[24, 27]	Producing uneven transformation outcomes

As shown in Table 6, digital transformation in higher education is implemented through a combination of strategic steering, institutional experimentation, and adaptive policy learning. National frameworks provide direction, while universities experiment with new digital practices through pilot initiatives and organizational reforms. Monitoring systems and feedback mechanisms allow policymakers to adjust strategies and refine policy instruments over time.

Furthermore, collaborative arrangements involving universities, technology firms, and innovation networks support the diffusion of digital practices and strengthen implementation capacity. However, the table also highlights that institutional constraints may generate uneven implementation patterns across institutions.

Overall, the findings suggest that digital transformation should be understood as an iterative and multi-actor implementation process rather than a linear policy rollout. Within the architecture of multi-level governance, effective implementation emerges from the interaction between strategic policy steering, institutional experimentation, and continuous policy learning.

The thematic synthesis reveals that digital transformation in higher education is not driven by a single policy instrument or institutional initiative but emerges from a complex governance architecture in which multiple policy domains, governance levels, and organizational actors interact. When the five themes are examined together, they form an integrated explanatory structure that clarifies how multi-level governance and science and technology (S&T) policy steer digital transformation processes across higher education systems.

First, the analysis demonstrates that policy steering begins with multi-level alignment mechanisms. Supranational agendas, national strategies, and institutional policies interact to shape the strategic orientation of digital transformation. Rather than operating independently, these levels form a layered governance structure in which policy priorities, regulatory frameworks, and funding programs circulate vertically across governance levels and horizontally across institutional networks [4, 5]. Effective transformation therefore depends on the degree of coherence between these levels and the capacity of institutions to translate policy objectives into organizational strategies.

Second, the findings show that steering mechanisms are operationalized through coordinated mixes of policy instruments embedded within broader S&T policy

frameworks. Regulatory instruments, financial incentives, strategic roadmaps, and evaluation systems together create a policy environment that shapes institutional incentives and behavior. The literature consistently suggests that isolated policy tools rarely produce transformative change; instead, coherent instrument combinations generate stronger and more stable policy effects by aligning resources, regulatory expectations, and strategic direction [7, 8].

Third, the synthesis highlights the decisive role of institutional mediation. Universities are not passive recipients of policy directives; they act as strategic organizations that interpret, adapt, and implement digital transformation policies within their own institutional contexts. Organizational leadership, internal governance structures, digital competencies, and infrastructure investments strongly influence how policies are translated into practice. Consequently, similar national policies may lead to different outcomes depending on institutional capabilities and strategic priorities [22].

Fourth, the analysis identifies governance tensions between autonomy and accountability as a central structural feature of digital transformation governance. Governments increasingly employ performance indicators, benchmarking systems, and digital reporting mechanisms to ensure transparency and policy effectiveness. However, meaningful transformation also requires institutional autonomy to experiment with new pedagogical models, technological infrastructures, and organizational forms. The interaction between these two governance principles shapes how universities engage with digital reforms and whether they adopt transformative or merely compliance-oriented strategies [18, 23, 30].

Finally, digital transformation unfolds through iterative implementation processes characterized by experimentation, policy learning, and multi-actor collaboration. Rather than occurring as a linear policy rollout, transformation typically progresses through pilot initiatives, feedback mechanisms, and adaptive policy adjustments. Collaboration among universities, technology providers, government agencies, and regional innovation ecosystems further supports the diffusion and scaling of successful digital practices [6, 29].

Taken together, these findings suggest that digital transformation in higher education should be conceptualized as a multi-level policy–institution interaction process. Multi-level governance structures provide strategic direction and coordination, S&T policy instruments shape incentives and resources, universities mediate policy implementation through their organizational capacities, and iterative implementation processes translate strategic goals into operational change.

Table 7. Integrative Conceptual Synthesis of the Findings

Analytical Dimension	Core Governance Mechanism	Institutional Process	Transformation Implication
Multi-level policy alignment	Vertical and horizontal coordination among governance levels	Translation of national and supranational priorities into institutional strategies	Strategic direction for digital transformation
Policy instrument mixes	Combination of regulatory, financial, strategic, and evaluative tools	Alignment of incentives and resources	Policy coherence and system-wide coordination
Institutional mediation	Organizational leadership, governance structures, and digital capabilities	Adaptation and implementation of policy objectives	Variation in institutional transformation outcomes
Autonomy–accountability balance	Performance monitoring and institutional discretion	Negotiation between control and innovation	Governance stability and legitimacy
Implementation logics	Adaptive governance, experimentation, and policy learning	Pilot initiatives and collaborative networks	Gradual scaling of digital transformation practices

As illustrated in Table 7, digital transformation in higher education emerges from the interaction between policy structures and institutional processes across multiple governance levels. The integrative model demonstrates that transformation is shaped simultaneously by strategic policy alignment, coherent policy instruments, institutional mediation capacities, governance tensions, and adaptive implementation dynamics.

Overall, the findings highlight that steering digital transformation in higher education requires coordinated governance across policy domains and institutional levels. Policies that successfully combine multi-level alignment, coherent instrument mixes, institutional capacity development, balanced governance arrangements, and adaptive implementation mechanisms are more likely to produce sustainable and meaningful digital transformation within higher education systems.

4. Discussion and Conclusion

The findings of this qualitative meta-synthesis demonstrate that digital transformation in higher education should be understood as a governance-driven and policy-

mediated process rather than a purely technological transition. The synthesis of the reviewed literature revealed five interconnected dimensions shaping digital transformation trajectories: policy steering and multi-level alignment, coherence of science and technology policy instruments, institutional mediation and organizational capacity, tensions between autonomy and accountability, and adaptive implementation logics. Collectively, these findings indicate that the success or failure of digital transformation depends on the interaction between external governance arrangements and internal institutional capabilities. This interpretation challenges technology-centered approaches that view digital transformation primarily as the acquisition of digital infrastructure or the adoption of emerging technologies. Instead, the results suggest that technology becomes transformative only when embedded within coherent policy frameworks, supportive governance structures, and organizational environments capable of translating policy intentions into meaningful institutional change.

The first major finding concerns the central role of multi-level governance and policy alignment in steering digital transformation in higher education. The results showed that transformation processes emerge through interactions among supranational orientations, national strategies, regional networks, and institutional initiatives. Universities were identified not as passive recipients of government directives but as active institutional mediators that interpret, adapt, and operationalize broader policy objectives according to their organizational contexts. This finding is consistent with research emphasizing that digital transformation in higher education requires coordination among different governance levels rather than isolated institutional interventions. Studies examining multi-level governance frameworks indicate that digital transformation outcomes are shaped by the relationship between national policy direction and institutional implementation capacity, demonstrating that policy effectiveness depends on the alignment between strategic priorities and organizational realities [4]. Similarly, national policy analyses of digital transformation demonstrate that successful implementation requires interconnected layers of policy design, institutional action, and stakeholder coordination rather than a simple top-down policy transfer process [5]. The present findings extend these arguments by showing that governance alignment operates as an interpretive mechanism through which universities negotiate and reconstruct digital transformation policies within their institutional environments.

The importance of multi-level alignment identified in this study also corresponds with evidence that digital transformation requires collaboration among diverse stakeholders, including governments, universities, technology actors, and professional communities. The results indicate that horizontal coordination networks among universities contribute to policy learning, knowledge exchange, and the diffusion of effective digital practices. This finding aligns with stakeholder-driven governance perspectives suggesting that digital transformation becomes more sustainable when institutions participate in collaborative governance arrangements rather than relying exclusively on centralized policy control [6]. Furthermore, research on higher education governance models highlights that integration between business processes, human resources, and technological systems requires coordinated governance mechanisms capable of connecting strategic goals with operational practices [29]. Therefore, the findings reinforce the argument that digital transformation should be approached as a networked governance process characterized by continuous negotiation among actors operating at different levels.

The second important finding relates to the role of coherent policy instrument mixes within science and technology policy frameworks. The results demonstrated that digital transformation is rarely achieved through individual policy interventions; rather, it depends on the combination of regulatory, financial, strategic, and evaluative instruments. This finding indicates that governments need to design integrated policy ecosystems in which funding mechanisms, regulatory requirements, strategic plans, and monitoring systems mutually reinforce each other. Previous studies similarly suggest that policy combinations generate stronger governance effects than isolated instruments because they align institutional incentives, resource allocation, and accountability expectations [7]. In addition, research on policy frameworks for digital transformation in higher education emphasizes that coherent policy models are necessary for connecting technological investment with institutional development and organizational transformation [8]. The current study contributes to this discussion by highlighting that science and technology policy coherence is not merely a matter of policy consistency but also a mechanism through which universities receive clear signals regarding priorities, expectations, and available resources.

The findings regarding policy coherence are also supported by research emphasizing the relationship between digital transformation and governance performance. When digital initiatives are disconnected from broader innovation systems, institutions may experience fragmented investments, overlapping responsibilities, and limited transformation outcomes. Conversely, integrated policy approaches strengthen strategic coordination and improve institutional responsiveness. Evidence from national digital transformation policy studies shows that carefully designed policy combinations can enhance governance performance by aligning technological development with administrative capacity and institutional objectives [7]. Similarly, studies examining public policy challenges in digital transformation highlight that access, utilization, and implementation barriers are often associated with fragmented policy environments rather than technological limitations alone [24]. Thus, the present findings suggest that science and technology policies should be designed as comprehensive governance frameworks rather than as separate technology-oriented programs.

The third finding emphasizes the decisive role of institutional mediation and organizational capacity in determining digital transformation outcomes. Although external policies establish strategic direction, universities ultimately determine how transformation is interpreted and implemented. The results indicate that leadership capacity, digital competencies, organizational structures, infrastructure readiness, and learning mechanisms represent essential conditions for successful transformation. This finding corresponds with studies demonstrating that digital leadership and system-level institutional change are closely connected, as leaders influence strategic orientation, resource mobilization, and organizational adaptation processes [1]. Similarly, research on digital leadership in higher education identifies leadership capability as a central driver of transformation because leaders must coordinate technological, pedagogical, and administrative changes simultaneously [3]. Therefore, the present study confirms that digital transformation is fundamentally an organizational capability challenge rather than simply a technological implementation challenge.

The results further indicate that institutional culture and organizational learning influence whether universities achieve deep transformation or merely adopt digital tools superficially. Universities with stronger internal coordination mechanisms, professional development systems, and change-oriented cultures are better positioned to integrate digital technologies into teaching, research, and administration. This interpretation is supported by studies showing that organizational change processes and cultural conditions mediate the relationship between digital technologies and institutional outcomes [14]. Furthermore, research examining barriers and drivers of digital transformation in public higher education institutions demonstrates that organizational readiness, leadership support, and institutional resources determine whether digital initiatives generate sustainable improvements [16]. Accordingly, the findings highlight the necessity of viewing universities as strategic actors with unique capacities and constraints rather than as uniform implementation sites.

The fourth finding concerns the tension between institutional autonomy and accountability mechanisms in digital transformation governance. The results revealed that governments increasingly use digital indicators, performance assessments, reporting systems, and funding mechanisms to guide institutional behavior. While these mechanisms can improve transparency and coordination, excessive external control may limit institutional experimentation and encourage compliance-oriented practices. This finding reflects broader debates regarding the governance of higher education, where institutions must balance autonomy with increasing expectations for measurable outcomes and public accountability. Research on university governance and institutional management demonstrates that policy implementation requires negotiation between external expectations and internal professional practices [23]. Similarly, studies on artificial intelligence governance in higher education emphasize the need for adaptable policy arrangements that combine oversight with flexibility because rapidly evolving technologies cannot be effectively managed through rigid regulatory approaches alone [19]. The present findings therefore suggest that effective digital transformation governance requires balanced arrangements that preserve institutional creativity while maintaining strategic accountability.

The fifth finding highlights adaptive implementation as a fundamental characteristic of digital transformation processes. The results demonstrate that transformation does not occur through linear policy execution but through experimentation, feedback, learning, and gradual adjustment. Universities often implement pilot projects, evaluate outcomes, modify strategies, and expand successful practices over time. This finding aligns with research showing that organizational resilience and learning

processes are critical for navigating digital transformation, particularly under conditions of uncertainty and rapid technological change [17]. In addition, studies on sustainable digital transformation emphasize the importance of agile governance approaches that combine strategic planning with flexibility and continuous adaptation [13]. Therefore, the findings indicate that policymakers should avoid assuming that digital transformation can be achieved through predefined technological solutions; instead, transformation requires ongoing learning processes involving institutional experimentation and policy adaptation.

The findings also reinforce concerns regarding the gap between technology adoption and governance capacity. Although universities increasingly invest in artificial intelligence, digital platforms, and advanced educational technologies, implementation gaps may emerge when policy awareness, institutional governance, and organizational preparedness are insufficient. This issue has been identified in research examining the disconnect between technological adoption and institutional governance in higher education, where digital initiatives often fail to achieve transformative outcomes because governance structures do not evolve alongside technological capabilities [30]. Similarly, studies on AI-driven transformation indicate that governance, stakeholder engagement, and institutional readiness are necessary conditions for ensuring that emerging technologies contribute to improved educational performance and public value [31]. The present study extends this argument by demonstrating that such gaps are not merely technological problems but manifestations of broader governance misalignment.

Overall, this study contributes to the theoretical understanding of digital transformation in higher education by integrating multi-level governance and science and technology policy perspectives into a unified analytical framework. The findings demonstrate that transformation emerges from the interaction between policy structures, institutional agency, organizational capacity, and adaptive implementation processes. This perspective complements previous research that has examined digital transformation from technological, pedagogical, or organizational viewpoints by emphasizing the governance mechanisms that connect these dimensions. The study therefore argues that sustainable digital transformation requires coordinated policy architectures, coherent instrument combinations, empowered institutions, balanced accountability systems, and continuous learning mechanisms.

This study has several limitations that should be acknowledged. First, because the research employed qualitative meta-synthesis of existing literature, the findings are dependent on the availability, quality, and conceptual orientation of previous studies. Although systematic procedures were applied to identify and analyze relevant sources, the synthesis cannot fully capture contextual variations that may exist across different higher education systems. Second, the study relied primarily on published scholarly documents and therefore may not fully represent the perspectives of practitioners, policymakers, administrators, faculty members, and students directly involved in digital transformation processes. Third, differences in national governance structures, technological development levels, and institutional cultures may influence the applicability of the findings across contexts. Finally, the interpretive nature of qualitative synthesis means that thematic development necessarily involves analytical judgment, despite efforts to enhance rigor and transparency.

Future research should expand this conceptual framework through comparative empirical studies examining how different governance configurations influence digital transformation outcomes across countries and higher education systems. Quantitative studies could test the relationships among governance alignment, policy coherence, institutional capacity, and digital transformation performance. Longitudinal research would also be valuable for examining how digital transformation evolves over time and how institutions adapt their strategies in response to technological and policy changes. In addition, future studies could investigate the experiences of specific stakeholder groups, including faculty members, students, administrators, and policymakers, to provide deeper insight into the social and organizational dimensions of transformation. Research focusing on artificial intelligence governance, data ethics, digital inclusion, and sustainability could further enrich understanding of emerging challenges within digitally transforming universities.

For practical implementation, policymakers should develop integrated digital transformation strategies that connect higher education policies with science and technology priorities and ensure coordination among governance levels. Universities should strengthen internal digital governance structures, invest in leadership development, enhance digital competencies among faculty and staff, and create organizational cultures that support innovation and learning. Accountability mechanisms should be designed to encourage meaningful transformation rather

than symbolic compliance, allowing institutions sufficient flexibility to adapt policies according to their missions and circumstances. Furthermore, universities and policymakers should prioritize inclusive approaches that address digital inequalities and ensure that technological advancement contributes to educational quality, accessibility, and long-term institutional sustainability.

Authors' Contributions

Authors equally contributed to this article.

Acknowledgments

Authors thank all participants who participate in this study.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

References

[1] N. Aedi, B. A. Luxfiati, N. Amaliyah, and L. B. Wei, "Digital Leadership and System-Level Transformation in Indonesian Higher Education: A Mixed-Methods Study of Institutional Change and Governance," ed, 2026.

[2] H. Al-Dmour, R. Al-Dmour, Y. Al-Dmour, and A. Al-Dmour, "Redefining Job Satisfaction in the Digital Era: Herzberg's Two-Factor Theory and the Mediating Role of Digital Transformation in Higher Education," *Education and Information Technologies*, pp. 1-28, 2026, doi: 10.1007/s10639-025-13884-z.

[3] R. Kalra, K. Vazirani, R. Anuradha, and P. V. Ahuja, "Navigating Digital Transformation in HEIs: The Role of Leadership and Key Drivers Using DEMATEL," in *Digital Leadership*: Productivity Press, 2026, pp. 80-100.

[4] W. Lei, M. H. Alharbi, Z. Yu, M. M. Ariffin, and M. Shutaywi, "Governing Laboratory Education in the Post-Pandemic Era: A Multi-Level Governance Framework," *European Journal of Education*, vol. 61, no. 1, p. e70430, 2026, doi: 10.1111/ejed.70430.

[5] H. L. Nguyen and Y. Hong, "National Policy Analysis of Digital Transformation in Vietnamese Higher Education: Conceptualising a Three-Layer Model for Implementation," *Policy Futures in Education*, vol. 24, no. 1, pp. 35-58, 2026, doi: 10.1177/14782103251348089.

[6] I. O. Ukeje *et al.*, "From Policies to Strategic Actions: Digitally Transforming Higher Education in Nigeria Through a Stakeholder-Driven Co-Governance Model," *Innovative Higher Education*, vol. 51, no. 1, pp. 121-151, 2026, doi: 10.1007/s10755-025-09861-6.

[7] J. Li and J. Zhang, "Digital Transformation Policy Combination and Government Governance Performance Improvement: Evidence from China," *International Journal of Public Administration*, vol. 49, no. 7, pp. 472-490, 2026, doi: 10.1080/01900692.2025.2499693.

[8] S. Rajabi Bazl, A. Khorasani, H. Yazdani, and F. Alami, "Designing a Policy Framework for Digital Transformation in Higher Education: A Meta-Ethnographic Synthesis of Public Policy Models," *Iranian Journal of Public Policy*, vol. 12, no. 1, pp. 209-224, 2026.

[9] D. Padma and N. Sumathi, "Digital Micro-Credentials and Generative AI in Higher Education: Global Policy, Pedagogical Innovation, and Quality Assurance Frameworks," *Academic Research Journal of Science and Technology*, vol. 5, no. 01, pp. 14-25, 2026.

[10] J. Yang and M. Valcke, "Flipped Classroom Design as a Driver of Digital Transformation and Sustainable Education in Higher Education: A Systematic Review of Reviews," *Sustainability*, vol. 18, no. 7, p. 3582, 2026, doi: 10.3390/su18073582.

[11] B. N. Pasi and P. Dhamak, "Review of Industry 4.0 and Higher Education: A Paradigm Shift Toward Digital Transformation," *Asian Education and Development Studies*, pp. 1-36, 2025, doi: 10.1108/AEDS-01-2025-0018.

[12] M. A. Al-Qawasmi, "The Role of Agile Administrative Leadership in Enhancing the Effectiveness of Digital Transformation in Palestinian Higher Education Institutions," *Arado Business Journal*, pp. 71-96, 2026, doi: 10.64190/abj.1.1.2026.2.

[13] J. R. Batmetan, "Sustainable Digital Transformation in Indonesian Higher Education: The Role of Service Planning and Architecture Strategy Within an Agile IT Governance Approach," *Tadbir: Jurnal Studi Manajemen Pendidikan*, vol. 10, no. 1, pp. 29-66, 2026, doi: 10.29240/jsmp.v10i1.16289.

[14] N. J. Kamel and S. Abdelrahman Ali, "The Impact of Organizational Change on Supporting Digital Transformation in Egyptian Tourism and Hotel Faculties and Institutes: The Mediating Role of Organizational Culture," *Journal of Association of Arab Universities for Tourism and Hospitality*, vol. 30, no. 1, pp. 47-63, 2026, doi: 10.21608/jaauth.2026.448680.1736.

[15] S. Karimi, "Digital Transformation in the Higher Education: Challenges and Opportunities for Faculty Unions," *International Journal of Higher Education*, vol. 15, no. 3, 2026, doi: 10.5430/ijhe.v15n3p28.

[16] L. L. Klein, F. Naranjo, and D. P. Ribeiro, "Analyzing Drivers, Barriers and Lean Outcomes of Digital Transformation in Public Higher Education Institutions," *International Journal of Productivity and Performance Management*, pp. 1-23, 2026, doi: 10.1108/IJPPM-07-2025-0671.

[17] C. Vaz, S. Joaquim, B. Rute, P. Emanuel, and R. M. Jcs, "From Resistance to Resilience: Organizational Learning and Digital Transformation in Higher Education Under Crisis," *Education Sciences*, vol. 16, no. 5, p. 735, 2026, doi: 10.3390/educsci16050735.

[18] A. A. M. Al-Momani *et al.*, "Educational Administration in the Digital Era: Governance and Policy Challenges in Higher Education Institutions," *EDPACS*, pp. 1-19, 2026, doi: 10.1080/07366981.2026.2645145.

[19] R. Eissa, "Exploring Artificial Intelligence Governance in Higher Education: Policy Design, Implementation and Adaptability in Egypt," ed, 2026.
[20] P. Jha, E. J. A. Palau, and S. Bag, "Governance and Innovation Through Generative AI: A Systematic Literature Review of Policy-Driven Practices in Higher Education Supply Chains," *Advances in Consumer Research*, vol. 3, no. 1, 2026.
[21] O. Gran, "Data Governance, Student Rights, and Inclusive Digital Universities: A Comparative Legal-Institutional Analysis of Higher Education Reform in France and South Korea," *Allogio: Journal of Law, Education and Economic Development*, vol. 1, no. 1, 2026.
[22] H. C. Nwaigwe *et al.*, "Digital Transformation and Public Value Creation in Higher Education: A PRISMA-ScR Review and Evidence-Synthesized Framework of Digital Competencies, Institutional Readiness, and Governance Pathways," *Sustainability*, 2026, doi: 10.3390/su18105125.
[23] J. Castro-Gomez, N. Marulanda-Grisales, C. Zapata-Molina, and J. A. Sanchez-Torres, "University Governance and Institutional Management for Sustainability: Teachers' Perspectives on Policy Implementation in Higher Education," *Frontiers in Education*, vol. 11, p. 1731067, 2026, doi: 10.3389/feduc.2026.1731067.
[24] F. Aposika, "Digital Transformation in Higher Education in Ghana with Focus on ICT Access Utilization and Policy Challenges," *Discover Education*, 2026, doi: 10.1007/s44217-026-01306-2.
[25] S. Rindawati, D. G. Saputra, and S. Supriadi, "Education Policy Recommendations in Addressing Digital Transformation and Access Inequality in Indonesia: A Public Administration Perspective," *IJOSPOL-International Journal of Social, Policy and Law*, vol. 7, no. 3, pp. 213-217, 2026.
[26] B. Eisinger Balassa and L. Buics, "Sustainable Digital Transformation in Public Administration: A Framework for University Enrollment," *Journal of Sustainable Development of Energy, Water and Environment Systems*, vol. 14, no. 1, pp. 1-22, 2026, doi: 10.13044/j.sdewes.d13.0639.
[27] D. E. Saputra, "Digital Transformation in Higher Education Management: Analysis of Readiness and Implementation," *Zabags International Journal of Education*, vol. 4, no. 1, pp. 34-45, 2026, doi: 10.61233/zijed.v4i1.36.
[28] H. N. D. Saputra and W. Wasilah, "Evaluation of Information Technology Governance Maturity Level Using COBIT 2019 in the Academic Information System at Nahdlatul Ulama University of Lampung," *Sistemasi: Jurnal Sistem Informasi*, vol. 15, no. 2, pp. 455-462, 2026, doi: 10.32520/stmsi.v15i2.5817.
[29] A. Mujahidin, Z. Zuhad, and B. Irawanto, "Digital Transformation Model for Higher Education Governance: An Integration of Business Processes, Human Resources, and Technology," *Priviet Social Sciences Journal*, vol. 6, no. 4, pp. 151-163, 2026, doi: 10.55942/pssj.v6i4.1129.
[30] J. H. Westover, "The AI Implementation Gap in Higher Education: Navigating the Disconnect Between Technology Adoption, Policy Awareness, and Institutional Governance," ed, 2026.
[31] I. L. Nnaji *et al.*, "Enhancing Governance and Performance in Nigerian Higher Education Through AI-Driven Digital Transformation: Insights from Stakeholder Perspectives," *Social Sciences & Humanities Open*, vol. 13, p. 102348, 2026, doi: 10.1016/j.ssaho.2025.102348.