

Evaluating Vietnam's higher education modernization in the digital era: an Education 5.0-oriented policy review

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ABSTRACT

In the context of rapid digital transformation, widespread adoption of artificial intelligence (AI), and intensifying global knowledge competition, modernizing higher education has emerged as a strategic priority, particularly for developing countries. This study employs a policy-oriented integrative review combined with a comparative evaluation approach to examine the modernization of Vietnamese higher education in the digital era, emphasizing the interaction among data-driven university governance, responsible autonomy, innovation ecosystems, and human-centered education. Drawing on a selective synthesis of international literature and policy documents published between 2020 and 2026—including reports from the OECD, UNESCO, and World Bank alongside key Vietnamese policy instruments—the study analyzes reform experiences in Japan, South Korea, the United States, and Taiwan. The analysis reveals that higher education modernization involves a systemic institutional and cultural transformation that extends beyond technological adoption, requiring coordinated development of ethical AI governance, science, technology, engineering, arts, and mathematics (STEAM)-oriented education, and smart data-driven governance mechanisms. Based on these insights, the study develops a five-dimensional Education 5.0 evaluation framework tailored to the Vietnamese context, providing policy recommendations and a conceptual basis for evaluating higher education reform in digitally transforming education systems.

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1. INTRODUCTION

In the context of knowledge globalization and the fourth industrial revolution, Vietnamese higher education faces an urgent need for modernization that extends beyond infrastructure to governance, pedagogy, quality assurance, and human resource development [1]–[6]. This modernization is essential for Vietnam's integration into the knowledge-based economy because it supports graduates' creativity, critical thinking, digital competence, and adaptive learning capacity [7]. Drawing on comparative insights from Japan, South Korea, and the United States, as well as OECD and UNESCO recommendations, this article treats modernization as a governance-centered and human-centered transformation rather than a narrow technological upgrade [3], [8]–[10].

Education 5.0 is central to this transformation because it integrates advanced technologies with humanistic values, ethical responsibility, sustainability, and social innovation [11]. Recent scholarship links Education 5.0 with Society 5.0, ethical artificial intelligence (AI) integration, socio-technical coordination,

and sustainable human development [10], [12]. Systematic reviews further show that Education 5.0 prepares future workforces to combine technological innovation with social responsibility, interdisciplinary thinking, and sustainable development goals [13].

Vietnamese higher education still faces structural constraints, including digital divides, regional quality disparities, uneven institutional readiness, and limited digital competencies among lecturers and students [2], [6], [14]. Research on equitable lifelong learning and digital equity shows that unequal access to technology, connectivity, and digital literacy can reinforce educational inequality and affect learning participation [15], [16]. Therefore, modernization must be assessed not only by digital adoption but also by institutional capacity, inclusion, governance quality, and measurable learning conditions [14].

The global educational landscape is also being reshaped by AI, digital platforms, and changing socio-economic demands [17]. Generative AI now influences curriculum design, assessment, feedback, academic integrity, and institutional governance, while also supporting language learning, automated feedback, and personalized instruction [18]–[21]. In Vietnam, digital transformation can improve higher education quality and international alignment, but its benefits depend on accountable governance, ethical AI use, and pedagogically meaningful innovation [3], [7], [22].

At the governance level, AI integration raises ethical and regulatory risks related to transparency, accountability, human oversight, privacy, and algorithmic fairness [23]–[27]. Comparative studies show that national and institutional contexts shape AI ethics and governance models, while university case studies indicate the need for coordinated institutional guidance rather than ad hoc experimentation [28]–[31]. Without clear governance mechanisms, AI-enabled systems may increase bias, data misuse, unequal access, and declining public trust. Digital transformation also requires structured maturity and readiness assessment. Capability maturity frameworks for learning analytics and digital governance provide measurable pathways for institutional benchmarking, while learning analytics research emphasizes justice, equity, diversity, and inclusion in data-driven decision-making [32]–[34]. These approaches show that higher education modernization should be evaluated through structured, comparable, and policy-relevant indicators rather than general reform aspirations.

Despite growing scholarship on digital transformation, AI in education, and university autonomy, three analytical gaps remain. Existing studies often examine digital governance, autonomy reform, AI integration, or innovation ecosystems separately, while Education 5.0 has not been sufficiently translated into measurable governance and policy dimensions in emerging higher education systems [8], [9]. In addition, structured evaluation models linking AI governance, autonomy performance, digital maturity, innovation ecosystems, and inclusive education remain limited [24], [27]–[31].

The novelty of this study lies in operationalizing Education 5.0 into a five-dimensional evaluation framework for assessing higher education modernization in Vietnam. Unlike prior studies that examine digital transformation, university autonomy, AI governance, innovation ecosystems, or human-centered education as separate domains, this study integrates them into a single model covering digital transformation and smart governance, responsible university autonomy, AI application and data ethics, innovation ecosystems and international collaboration, and human-centered science, technology, engineering, arts, and mathematics (STEAM)-oriented education. This framework provides a policy-relevant tool for evaluating reform alignment, implementation readiness, and future benchmarking in emerging higher education systems.

To address these gaps, this study develops a five-dimensional Education 5.0 evaluation framework and applies it to Vietnam as an analytically transferable case. The framework enables assessment of national higher education reform while contributing to broader debates on digital-era modernization. It also shows how emerging systems can translate Education 5.0 principles into measurable governance and policy dimensions. Guided by this objective, the study addresses three research questions:

- How can Education 5.0 principles be operationalized into structured and measurable evaluation dimensions for higher education modernization?
- To what extent do Vietnam’s higher education reform policies align with these dimensions?
- What institutional, governance, and capacity conditions are required for effective and sustainable implementation?

To answer these questions, the study employs a policy-oriented integrative review combined with a comparative evaluation framework. It synthesizes international scholarship and Vietnamese policy documents to assess modernization through the five Education 5.0 dimensions. By integrating governance theory, AI ethics scholarship, and digital maturity measurement frameworks, the study contributes to understanding Education 5.0 as both a normative orientation and an evaluative instrument for higher education reform in developing contexts.

2. LITERATURE REVIEW

Recent scholarship published between 2020 and 2026 conceptualizes higher education modernization as a multidimensional governance transformation rather than a simple process of technological adoption. Across this literature, modernization is associated with digital infrastructure, institutional autonomy, AI governance, innovation ecosystems, and human-centered educational philosophy [3], [6], [35]. This shift is important because universities are no longer evaluated only by teaching delivery or administrative efficiency, but also by their capacity to govern data, support innovation, protect learner rights, and respond to social change. In this sense, the literature increasingly treats higher education reform as a system-level issue that requires alignment between policy design, institutional capacity, ethical governance, and measurable performance.

One major stream concerns institutional and governance transformation. Digital transformation is increasingly understood as institutional restructuring rather than a technical intervention [36]. Gkrimpizi *et al.* [36] conceptualize digital transformation across strategic, organizational, and cultural layers, emphasizing that sustainable change depends on governance alignment and institutional culture. Santos [37] similarly links modernization with international competitiveness and global knowledge networks, suggesting that digital transformation affects how universities position themselves within wider research, labor-market, and innovation systems. Studies on emerging markets further show that fourth industrial revolution learning models often face constraints related to infrastructure, digital literacy, and institutional readiness [38]. These studies converge on the view that governance reform, rather than technological procurement alone, determines whether digital transformation becomes strategic and sustainable.

This governance literature is especially relevant to Vietnam because policy articulation has advanced more quickly than institutional implementation. Vietnamese higher education modernization has been institutionalized through policy milestones related to comprehensive education reform, digital transformation, autonomy, and human resource development [4], [5], [7]. However, empirical scholarship continues to report uneven institutional capacity, fragmented digital governance, and limited integration of AI ethics into higher education reform strategies [2], [39]. These findings suggest that modernization should be assessed not only by the existence of national policies but also by the ability of universities to translate policy directions into internal quality assurance, digital management routines, and accountable decision-making. Thus, the Vietnamese case reflects a broader challenge in emerging higher education systems: strong reform ambition must be matched by operational capacity.

A second stream focuses on AI integration and ethical governance in higher education. Comprehensive reviews emphasize that AI can support adaptive learning, assessment design, administrative efficiency, and personalized feedback [40], [41]. Generative AI has further reshaped academic practices by influencing curriculum design, academic writing, feedback systems, and the role of educators [19]–[21]. Studies on generative AI applications also show its growing potential in language learning and personalized instructional support [18]. At the same time, policy-oriented research argues that universities need explicit AI governance frameworks addressing acceptable use, academic integrity, transparency, accountability, and data protection [22], [23], [25], [26]. Systematic reviews reinforce this point by showing that responsible AI adoption requires integrated policy instruments rather than fragmented or informal guidelines [24], [27], [31].

The ethical dimension of AI governance is particularly significant because AI-enabled education systems may reproduce bias, compromise privacy, or weaken institutional trust if adopted without human oversight. Comparative case studies indicate that effective university AI governance depends on coordinated institutional strategies rather than ad hoc experimentation [29], [30]. Cross-national research also shows that national academic cultures shape how AI ethics is interpreted and regulated, as illustrated by debates within Chinese academia concerning regulatory priorities and governance models [28]. In Vietnam, empirical studies on tools such as ChatGPT suggest that generative AI can influence student engagement, information-seeking, and learning behavior in digital environments. These findings support the need to include AI application and data ethics as a core dimension of any Education 5.0 evaluation framework.

A third stream addresses autonomy and accountability architectures. University autonomy is widely recognized as a driver of innovation and institutional flexibility when accompanied by clear accountability systems [11], [42]. Comparative governance studies emphasize that autonomy reforms depend on bureaucratic capacity, regulatory clarity, academic freedom safeguards, and institutional vision [8], [43]. Recent discourse also links autonomy to internationalization, language policy, and global integration pressures, particularly in European and post-Soviet contexts [9], [44]. For Vietnam, this literature suggests that autonomy should not be evaluated merely as a legal status or administrative delegation. It should be assessed through institutional performance, internal quality assurance, transparency, stakeholder accountability, and the ability of universities to convert discretion into verifiable outcomes [6].

A fourth stream concerns digital maturity and measurement frameworks. Capability maturity models for learning analytics provide tools for assessing governance alignment, technical infrastructure, data use, and

human competencies across staged development pathways [32], [33]. Research on learning analytics dashboards adds that data-driven governance must incorporate justice, equity, diversity, and inclusion if it is to support fair educational decision-making [34]. Studies on digital equity further warn that unequal access to technology, connectivity, and learning resources may reinforce educational disparities when digital transformation is not designed inclusively [15]. Recent pedagogical work also highlights the need to cultivate digital equity awareness in curriculum design and teacher preparation [14]. Together, these studies shift modernization discourse from broad aspiration toward operational benchmarking, readiness assessment, and performance transparency.

Across these streams, the literature converges on one central insight: digital-era higher education modernization requires synchronized progress across governance reform, AI ethics, institutional autonomy, innovation ecosystems, and measurable digital maturity. Yet important fragmentation remains between theoretical discussions and policy evaluation practice. Existing studies often examine digital governance, autonomy, AI adoption, or digital maturity separately, while fewer studies integrate them into a single evaluative model suitable for emerging higher education systems. The Education 5.0 paradigm offers a useful conceptual basis for such integration because it connects technological innovation with human-centered development, ethical responsibility, and sustainable social value [10], [12], [13]. Nevertheless, its operationalization into measurable policy and governance dimensions remains underdeveloped.

This review therefore indicates the need for an integrated Education 5.0 evaluation framework that can translate normative principles into structured dimensions for policy assessment. Such a framework should connect digital transformation and smart governance with responsible autonomy, AI application and data ethics, innovation ecosystems, and human-centered STEAM-oriented education. It should also allow policymakers and university leaders to distinguish between policy intention, implementation readiness, and measurable performance. By synthesizing these strands, the present study addresses the gap between conceptual discourse and evaluative practice and provides a basis for assessing Vietnam's higher education modernization within a broader international reform context.

3. METHOD

This study adopts a policy-oriented integrative review with an evaluation focus to assess how contemporary higher education reform policies align with Education 5.0 principles. This design is appropriate for complex system-level reforms because it synthesizes theory, empirical findings, and policy instruments within a unified analytical framework. It therefore supports evidence-informed policy evaluation beyond narrow outcome aggregation.

3.1. Data sources and selection

The analytical corpus comprises policy documents and peer-reviewed studies published between 2020 and 2026 on higher education modernization, digital transformation, AI governance, university autonomy, and Education 5.0. International sources include reports from the OECD, UNESCO, the World Bank, and the Asian Development Bank, alongside journal articles on digital governance, AI-supported learning, autonomy, accountability, and innovation ecosystems. National sources include Resolution No. 29-NQ/TW [45], Resolution No. 71/NQ-CP [46], Decision No. 131/QĐ-TTg [47], Notice No. 45-TB/TGV [48], and Official Dispatch No. 4324/BGDĐT-CNTT [49], selected through targeted keyword searches and screened for governance relevance, policy utility, and evaluative value.

3.2. Analytical framework and evaluation dimensions

Analysis was guided by an Education 5.0 evaluation framework synthesizing international benchmarks and policy-relevant scholarship. Five dimensions were specified: digital transformation and smart governance; university autonomy and accountability; AI application and data ethics; innovation ecosystems and international collaboration; and human-centered and STEAM-oriented education. These dimensions served as evaluative criteria for assessing international experiences and Vietnamese policies, as summarized in Table 1.

3.3. Thematic and comparative analysis

Thematic content analysis coded the selected materials according to the five evaluation dimensions, using deductive categories and inductive sub-codes to capture recurrent mechanisms and constraints. Cross-source comparison identified convergence, divergence, and policy gaps across international literature and Vietnamese reform documents. Comparative analysis then contrasted Vietnam with Japan, South Korea, the United States, and Taiwan at macro-policy and micro-implementation levels to identify transferable governance instruments.

3.4. Analytical rigor and limitations

Methodological rigor was supported through dimension-based coding, iterative cross-source comparison, and triangulation between policy documents and peer-reviewed scholarship. Because the study relies on secondary materials and does not include primary institutional measurement, its findings should be interpreted as an evaluation of policy alignment and reform readiness rather than causal evidence of outcomes. Future research should operationalize the framework into measurable indicators and test it through surveys, institutional case studies, or readiness-index benchmarking.

Table 1. Education 5.0 evaluation framework for higher education modernization

Evaluation dimension	Evaluation focus	Key indicators/criteria	Primary evidence sources	Evaluation purpose
Digital transformation and smart governance	Institutionalization of digital governance	- Integrated higher education databases - Use of learning analytics and AI in quality assurance - Evidence-based decision-making mechanisms	OECD, UNESCO, MOET policy documents	Readiness for smart and data-driven governance
University autonomy and accountability	Balance between autonomy and public responsibility	- Scope of academic, financial, and organizational autonomy - Internal quality assurance systems - Transparency and performance reporting	OECD Autonomy Framework, Resolution 71-NQ/TW	Capacity for responsible and accountable autonomy
AI application and data ethics	Responsible use of AI in teaching, assessment, governance	- AI ethics guidelines and data protection mechanisms - Human oversight in AI-based assessment - Safeguards against algorithmic bias	OECD, UNESCO, AI-in-education studies	Ethical alignment and risk management
Innovation ecosystems and international collaboration	University integration into national and global innovation	- University–industry–government collaboration (Triple Helix) - International joint programs and research - Support for entrepreneurship and start-ups	World Bank, UNESCO, Notice 45-TB/TGV	Role of universities as innovation hubs
Human-centered and STEAM-oriented education	Alignment with Education 5.0 humanistic philosophy	- Integration of STEAM and humanistic values - Lifelong learning orientation - Equity and inclusion in digital education	OECD Learning Compass 2030, Education 5.0 literature	Human-centered, inclusive, sustainable education

4. RESULTS AND DISCUSSION

4.1. International perspectives on higher education reform: an Education 5.0 evaluation lens

International experience shows that higher education modernization is a system-level governance transition rather than a sequence of technological upgrades [36], [38], [41], [50]. Across the international reform literature, modernization trajectories converge around five Education 5.0 dimensions: smart governance, accountable autonomy, ethical AI integration, innovation collaboration, and holistic human development [51], [52]. These cases are not presented as models to be copied mechanically, but as comparative reference points for identifying transferable governance instruments and performance logics relevant to Vietnam's challenges in digital competence, infrastructure disparity, and ethical governance [2], [3], [37].

Human-centered and STEAM-oriented education models show that technology should function as an enabling medium rather than the objective of reform [50]. Japan, South Korea, the United States, and Taiwan integrate STEAM curricula, humanities modules, ethical AI reflection, project-based learning, and sustainability-oriented problem solving to cultivate interdisciplinary competence and civic reasoning [10], [13], [18], [19], [41], [50]. These cases suggest that modernization should be evaluated by how effectively technological competence is combined with ethical literacy, experiential learning, and inclusive participation [2], [14]–[16], [39].

For Vietnam, this lesson is important because STEAM reform should not be reduced to adding digital tools or technical courses. The more relevant benchmark is whether universities can connect digital competence with ethical reasoning, creativity, social responsibility, and problem-based learning. This perspective supports the Education 5.0 view that modernization must remain learner-centered and socially responsive rather than technology-centered.

International evidence also shows that autonomy improves performance only when embedded in transparent governance and accountability systems [8], [42], [50]. Japan, the United States, South Korea, and Taiwan link autonomy to curriculum flexibility, financial responsibility, industry collaboration, public reporting, and innovation performance [41], [50]. These experiences indicate that autonomy should be evaluated not only as legal delegation but as institutional capacity to convert discretion into measurable public value, including responsible AI regulation [2], [22], [23].

This comparison is especially relevant to Vietnam because autonomy reform is often discussed in legal and administrative terms. International experience suggests that autonomy should also be assessed through institutional capacity, internal quality assurance, stakeholder accountability, and the ability to mobilize resources for innovation. Therefore, autonomy becomes meaningful only when universities can demonstrate that expanded discretion produces transparent and measurable educational outcomes.

Innovation ecosystems and international collaboration evaluate how universities connect research, industry, government, and global knowledge networks [37], [50]. In advanced systems, joint programs, collaborative research, academic mobility, and Triple Helix partnerships function as core indicators of institutional effectiveness rather than peripheral activities [50]. For Vietnam, the relevant lesson is to measure not only the number of partnerships but also their depth, sustainability, spillover effects, and contribution to regional innovation capacity [53].

This dimension also requires attention to the quality of collaboration. Partnerships that remain limited to formal agreements may have little effect on research productivity, graduate employability, or regional development. For an Education 5.0-oriented system, innovation ecosystems should therefore be assessed through practical outputs such as joint research, technology transfer, start-up support, interdisciplinary programs, and community impact.

Digital transformation and smart governance are increasingly framed as structural reforms of university management [36], [50]. International cases demonstrate the value of learning analytics dashboards, AI-based quality assurance, blockchain credentialing, national data hubs, and smart campus systems for improving transparency, early intervention, resource allocation, and policy responsiveness [3], [41], [50]. These tools require data interoperability, predictive analytics, standardized metrics, infrastructure stability, and sustained faculty digital literacy; without these conditions, digital transformation remains administrative rather than strategic [2], [38], [53], [54].

The international cases further show that smart governance is not simply a matter of building databases. Effective data systems must be connected to decision-making routines, quality assurance processes, academic advising, and institutional planning. This distinction is important for Vietnam because the country has made progress in data infrastructure but still needs stronger mechanisms for transforming data availability into evidence-based governance.

AI application and data ethics have become central to the legitimacy of digital higher education. International evidence shows that AI can enhance learning efficiency and governance capacity, but it also creates risks related to privacy, bias, accountability, and unequal access [22], [24], [27], [29], [41]. Advanced systems therefore combine AI deployment with ethical guidelines, transparency requirements, human oversight, and culturally legitimate governance standards that are also internationally interoperable [27], [28], [50].

From an Education 5.0 perspective, AI governance should be treated as both a technical and moral requirement. Universities need clear rules on acceptable use, assessment integrity, data ownership, consent, privacy, and human review of automated decisions. Such rules are necessary to ensure that AI improves learning and governance without weakening fairness, academic trust, or learner protection.

Overall, international experience demonstrates that sustainable modernization depends on systemic coherence across governance, autonomy, innovation ecosystems, digital infrastructure, and ethical philosophy. When mapped onto the five Education 5.0 dimensions, these cases show that isolated reform success is less important than synchronized institutional transformation. This evaluative lens provides Vietnam with a framework for benchmarking reform progress, identifying policy misalignment, and designing evidence-informed interventions [32], [33], [52].

4.2. Resolution No. 71/NQ-CP and higher education reform policies in Vietnam in the context of digital transformation

Vietnamese policy documents identify higher education as a strategic driver of industrialization, modernization, international integration, and high-quality human resource development [7]. Resolution No. 29-NQ/TW provides the foundational orientation for comprehensive education reform, while Resolution No. 71/NQ-CP translates this vision into concrete policy actions [32], [33]. Through the Education 5.0 framework, these policies can be assessed across digital governance, autonomy, AI ethics, innovation ecosystems, and human-centered STEAM education [13], [36].

In digital transformation and smart governance, Ministry of Education and Training (MOET) has been tasked with developing a National Higher Education Database System to support interoperability,

accreditation, management, and evidence-based policymaking [3], [46]. By 2024, more than 85% of higher education institutions had connected academic and admissions data to the centralized system, showing progress toward data-driven governance [3], [55]. However, the system remains mainly descriptive; stronger integration of learning analytics, AI-supported quality assurance, and decision-support tools is needed to achieve Education 5.0-aligned smart governance [32], [33], [36], [52].

This progress indicates that Vietnam has established an important foundation for system-level digital governance. However, the next stage should move beyond data connection toward analytical use, including early-warning systems, program quality monitoring, graduate tracking, and institutional benchmarking. Such development would make the database more directly useful for policy evaluation and university-level improvement. In university autonomy and accountability, Vietnam has expanded institutional discretion under the amended higher education law and related decrees. By 2023, 67 out of 232 public universities had been granted autonomy, enabling greater flexibility in curricula, resources, industry collaboration, and program development [2], [7]. Nevertheless, independent quality assurance, transparent performance reporting, and social accountability remain underdeveloped, requiring stronger autonomy-accountability coupling [6], [8], [42], [43], [55].

The key policy issue is therefore the uneven conversion of formal autonomy into operational capacity. Some leading universities can use autonomy to redesign programs, strengthen partnerships, and diversify resources, while many institutions still depend heavily on administrative approval and limited internal governance capacity. A more balanced reform approach should combine autonomy expansion with transparent performance indicators and support for weaker institutions.

In AI application and data ethics, Vietnamese policy increasingly recognizes AI as an enabler of digital pedagogy, governance, and accreditation [53]. More than 60% of students have participated in at least one blended learning course, and some universities use learning analytics to personalize learning and support at-risk students [41], [50]. However, fragmented implementation, privacy risks, algorithmic bias, and still-developing legal frameworks show that ethical governance and enforceable standards remain critical [6], [22], [24], [25], [27], [28], [48]. This situation creates both opportunity and risk. On the one hand, AI can support personalized learning, academic advising, and administrative efficiency in a rapidly expanding digital education environment. On the other hand, the absence of detailed institutional rules may lead to inconsistent practice across universities, especially in assessment, data protection, and the use of generative AI in teaching and research.

In innovation ecosystems and international collaboration, Resolution No. 71/NQ-CP emphasizes regional linkages, university-industry cooperation, and international programs as modernization drivers [46]. Vietnam has signed more than 500 joint training agreements, while Notice No. 45-TB/TGV promotes research commercialization, entrepreneurship, staff mobility, and innovation centers in Hanoi, Da Nang, and Ho Chi Minh City [6], [39], [48], [50]. These initiatives strengthen universities as innovation hubs, but their effectiveness depends on sustained research capacity, partnership quality, and system-wide diffusion [37].

The main challenge is to ensure that these initiatives produce substantive outcomes rather than formal cooperation indicators. Universities need incentives to convert partnerships into joint laboratories, applied research projects, internship pipelines, entrepreneurship programs, and technology-transfer activities. Stronger evaluation of partnership quality would help align international collaboration with national innovation and regional development needs.

In human-centered and STEAM-oriented education, Vietnam's reforms increasingly emphasize lifelong learning, humanistic values, project-based curricula, postgraduate expansion, and the integration of STEAM with ethical and social responsibility [12], [13], [39]. Notice No. 45-TB/TGV sets 2030 targets such as English-medium STEM programs, practical or project-based courses, and expanded postgraduate enrollment [39], [48]. These policies align with Education 5.0, but implementation must address equity, inclusion, and diversified learner needs to avoid reproducing digital inequality [15], [16].

This dimension is particularly important because technological modernization can become narrow if it is separated from ethical, cultural, and social purposes. Human-centered STEAM education should encourage students to apply scientific and technological knowledge to real social problems while maintaining civic responsibility and cultural awareness. For Vietnam, this approach can help connect international modernization trends with national educational values and development priorities.

4.3. Opportunities, constraints, and policy implications in Vietnam's digital higher education transition

Vietnam's transition toward Education 5.0 combines strong policy ambition with differentiated institutional capacity. Across the five evaluative dimensions, the reform trajectory shows substantial policy alignment but uneven operational depth, especially in the movement from policy design to institutional implementation. The central challenge is therefore to convert structural readiness into measurable

performance through leadership, information and communication technology (ICT) adoption capacity, accountability, ethical governance, and inclusive implementation [38], [52].

Digital transformation creates an opportunity to shift higher education governance from administrative control to evidence-based knowledge governance [39]. The National Higher Education Database System and the digitization of more than 1.2 million learner records provide a foundation for interoperability and coordinated monitoring [47]. However, only about 60% of institutions operate stable digital learning platforms, predictive analytics remains limited, and regional disparities continue to constrain system-wide smart governance [2], [38], [39], [41], [54], [55].

The policy implication is that digital infrastructure should be paired with managerial capacity and institutional routines for using evidence. Data systems will have limited value if universities lack trained staff, interoperable platforms, and procedures for translating analytics into curriculum revision, student support, or resource allocation. Therefore, smart governance should be understood as a combined reform of technology, people, and institutional decision-making.

University autonomy can strengthen innovation capacity, financial sustainability, and global competitiveness when it is paired with accountability [42], [55]. Vietnam has legally expanded autonomy, but implementation remains uneven. By 2024, only 35 out of 237 institutions had fully implemented autonomy mechanisms in finance, personnel, and internal quality assurance [6]. The main bottleneck is not autonomy as a legal status but the limited institutionalization of performance reporting, internal evaluation, and stakeholder-facing accountability [8], [42]. The distinction between being granted autonomy and fully implementing autonomy should be made explicit in policy evaluation. Legal status alone does not guarantee institutional effectiveness if universities lack internal quality assurance, financial planning capacity, or transparent reporting systems. For this reason, autonomy reform should be accompanied by capacity-building programs and a national benchmarking mechanism that compares outcomes across institutions.

AI and big data offer opportunities for personalized learning, institutional efficiency, and equity-oriented early intervention. International evidence shows that learning analytics can reduce dropout and improve on-time graduation, while Vietnam's large-scale blended learning adoption creates conditions for competency-based education [22], [23], [41]. Yet without dedicated AI ethics standards, AI-based assessment and governance may generate bias, compromise privacy, and undermine institutional trust [2], [6], [24], [27].

The risk is that AI may be adopted faster than ethical and professional capacity can develop. Lecturers, administrators, and students need practical guidance on when AI use is appropriate, how AI-supported assessment should be verified, and how learner data should be protected. Building this capacity would allow Vietnam to use AI as a supportive educational tool rather than as an uncontrolled source of inequality or academic risk. International integration and innovation ecosystems can expand Vietnam's knowledge base and strengthen universities' role in national development. Vietnam's joint programs and potential cooperation in green energy, AI, and sustainable education create opportunities for deeper global engagement [37], [50]. Nevertheless, research partnerships remain concentrated in leading institutions, while many universities lack the governance capacity, resources, and human capital needed to sustain system-wide innovation [2].

To avoid concentration effects, innovation policy should support not only national leading universities but also regional and applied institutions. Broader participation can be encouraged through shared research platforms, regional innovation hubs, and funding schemes that reward collaboration across institutional types. This would help internationalization contribute to system-wide modernization rather than widening gaps between well-resourced and less-resourced universities. STEAM-oriented education offers Vietnam a pathway toward holistic human development, creativity, ethical reasoning, and technological responsibility [12], [13], [41], [50]. The growth of STEAM programs indicates progress, but faculty capacity gaps, pedagogical inertia, limited project-based learning capacity, and unequal access to learning devices constrain implementation [2], [39]. Across all five dimensions, Vietnam's modernization is strategically aligned but operationally uneven, requiring stronger accountability, ethical governance, faculty development, and inclusive innovation diffusion [15], [16], [22], [24], [52].

The immediate priority is faculty development because curriculum reform depends on lecturers who can design interdisciplinary, project-based, and digitally supported learning experiences. Investment in devices and platforms is also necessary, but it will not be sufficient without pedagogical support and inclusion policies for disadvantaged learners. A human-centered Education 5.0 strategy should therefore combine STEAM curriculum reform with lecturer training, digital access, and learner support.

Advancing Education 5.0 in Vietnam requires an integrated policy framework that aligns institutional reform, digital capacity, ethical governance, and human-centered educational philosophy. These domains should not be treated as separate reform tracks because sustainable modernization depends on their coordinated implementation. Recent research likewise shows that successful digital transformation requires alignment among infrastructure, leadership, human capital, and governance strategy [36], [52].

First, higher education governance should move further from administrative control toward strategic, evidence-based, and data-driven governance. A responsible autonomy index linked to learning

outcomes, financial performance, educational quality, and stakeholder accountability would help convert autonomy into measurable outcomes [6], [42], [55]. National learning analytics infrastructures and digital maturity benchmarks should also be developed to support accreditation, workforce forecasting, and institutional performance monitoring [17], [33].

Second, digital capacity and innovation ecosystems should be strengthened through a national program for digital faculty development and a higher education innovation fund. Such initiatives should prioritize digital pedagogy, AI-supported teaching, virtual laboratories, project-based learning, university-industry collaboration, and differentiated institutional readiness [2], [4], [32], [33], [38], [50]. Digital internationalization can further expand cross-border research, knowledge exchange, and globally networked learning environments [37].

Third, technological advancement must be accompanied by equity, ethics, and sustainability. Vietnam should accelerate a mandatory AI ethics framework for education covering learner rights, algorithmic transparency, data protection, accountability, assessment, and learning analytics [24]. Targeted support through digital scholarships, learning devices, and infrastructure investment is also necessary to reduce digital divides among disadvantaged students [15], [16], [39]. Finally, Education 5.0 requires a renewed higher education philosophy that balances technological competence with humanistic values, ethical reasoning, and social responsibility. STEAM-oriented and differentiated learning models can foster creativity and learner engagement while sustaining a distinct Vietnamese educational identity [10], [13], [41], [56]. In the long term, modernization will depend not only on technological capability but also on ethical governance, inclusive innovation, and culturally grounded human-centered values [31].

5. CONCLUSION

Vietnamese higher education modernization in the digital era is a systemic institutional transition that extends beyond technological adoption. International experience shows that sustainable modernization requires coherent governance reform, responsible autonomy, ethical oversight, innovation ecosystems, and a human-centered educational philosophy. Vietnam's reform architecture, especially Resolution No. 29-NQ/TW and Resolution No. 71/NQ-CP, demonstrates meaningful progress in these areas while still facing uneven institutional capacity, regional digital readiness, and incomplete mechanisms for turning policy alignment into measurable institutional performance.

This study contributes by operationalizing Education 5.0 into a structured five-dimensional evaluation framework. The framework integrates digital transformation and smart governance, university autonomy and accountability, AI application and data ethics, innovation ecosystems and international collaboration, and human-centered STEAM-oriented education. Applied to Vietnam, it shows that modernization must balance technological efficiency with equity, autonomy with accountability, and innovation with ethical safeguards. Because this study is a policy-oriented integrative review, the proposed framework requires future empirical validation. Future research should develop an Education 5.0 readiness index with measurable indicators for AI-supported learning analytics, faculty digital competencies, autonomy-performance relationships, ethical AI compliance, and innovation income. Pilot testing across autonomous and non-autonomous universities would strengthen benchmarking, identify capacity gaps, and improve policy sequencing. Ultimately, the success of Vietnam's Education 5.0 modernization depends on linking conceptual clarity with institutional commitment and measurable implementation. Ethical governance, inclusive digital access, faculty capacity development, and transparent evaluation are necessary to turn policy alignment into systemic transformation. By connecting normative vision with structured evaluation, this study provides a foundation for more rigorous and internationally relevant assessment of higher education reform in the digital era.

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AUTHOR CONTRIBUTIONS STATEMENT

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Thuy Nhu Thi Nguyen	✓	✓		✓	✓	✓		✓	✓	✓				
Quyet Thi Nguyen	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓

C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest. No personal, financial, institutional, or professional relationship influenced the preparation of this manuscript. The authors are solely responsible for the content and conclusions presented in the study.

INFORMED CONSENT

This study did not involve human participants, animals, personal data, or primary data collection. Therefore, informed consent was not required. All analyzed materials were publicly available policy documents, international reports, or previously published academic literature.

ETHICAL APPROVAL

This study is based exclusively on a policy-oriented integrative review of publicly available documents, international reports, and previously published academic literature. It does not involve human participants, animals, personal data, or primary data collection. Therefore, ethical approval from an institutional review board was not required. All sources were analyzed in accordance with relevant national regulations, institutional research policies, and accepted standards of academic integrity. The study fully complies with ethical norms for secondary research and literature-based policy analysis.

DATA AVAILABILITY

Data availability is not applicable because no new primary dataset was created or analyzed. The study is based on publicly available policy documents, international reports, and previously published academic literature. All information supporting the findings is cited in the manuscript and can be accessed through the original publication channels.

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