

A Systematic Literature Review of Digital Business Transformation Effect on Sustainable Development at Universities

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ABSTRACT

Digital business transformation is currently considered a key component of sustainable development in higher education, yet the strategies and measurable impact used remain sparse in the academic literature. This paper conducts a comprehensive review of 53 peer-reviewed papers, employing the PRISMA method to ensure consistency in the identification, selection, and summarization steps. The timeframe was limited to peer-reviewed journal articles between 2020 and 20225. A systematic search was performed in Scopus, Web of Science, and Google Scholar with a manual search for other papers that were relevant. The initial database search yielded 1,842 records. After applying criteria to exclude some records and include others, a final analysis was conducted on 53 articles. Nineteen DBT-related sustainable development indicators are identified and categorized into three main themes: technological transformation and infrastructure (21.1%); governance, policy, and culture (26.3%); and competencies, collaboration, and ecosystems (52.6%). These reflections highlight the diversity and imbalance of previous studies and point to a lack of knowledge on how to link governance and infrastructure aspects in sustainable transformation models. This review work provides evidence-based information ensuring the impact of digital transformation in business on sustainability in higher education, providing valuable data for researchers and practitioners seeking to link digital strategies to the sustainable development goals.

Key Words: Digital Business Transformation, Sustainable Development, Digital Technology, Digital Infrastructure, and Innovation Ecosystems.

INTRODUCTION

Universities are radically transforming their core activities, driven by the increasing impact of digital technologies on teaching, research, administration, and community engagement (Elbolok, et al., 2025). Digital Business Transformation (DBT) has shifted from a secondary experience to a critical, priority component of higher education institutions, where digital technologies bring about strategic changes that enhance value and reshape structures and processes (Abad-Segura, et al., 2020; Al-Shamsi, 2024; Aleryani, 2024). According to information systems-based studies, digital transformation is a process in which radical changes occur as a result of the application of digital technologies (Giesenbauer & Müller-Christ, 2020). This transformation is addressed through coordinated changes across several "key pillars," such as offerings, value, activities, governance, and culture. From this perspective, the extent of transformation and interconnectedness between technology, strategy, and organizational structures is highlighted (Alojail & Khan, 2023).

At the same time, universities are facing increasing pressure to help achieve sustainable development, as defined in the United Nations 2030 Agenda, which includes 17 Sustainable Development Goals (SDGs) calling for global action to achieve social inclusion, protect the environment, and foster economic growth (Ajani, 2024; Lee & Lee, 2024). Universities are expected not only to deliver sustainable education to students but also to embody sustainability principles and lead research and innovation in this field. The Sustainable Development Goals (SDGs) represent a shared agenda and specific targets that increasingly drive university strategies, performance standards, and external accountability. Research conducted over the past decade reveals diverse university responses to sustainability adoption, pointing to both significant progress and ongoing challenges. (Achkar, 2025; Aldoghiher, et al., 2025; Muthu, et al., 2023) studies demonstrate that many institutions have adopted

policies, practices, and initiatives aligned with sustainability, although the implementation of these policies varies by region and institution type (Mutahar et al., 2022).

Recent research on higher education institutions (Happonen, et al., 2020; Popescu, et al., 2020; Aldogiher, et al., 2025; Zeleza & Okanda, 2021) suggests that digitalization can contribute to sustainability in several ways: reducing resource use and improving processes (such as workflows and digital exams), enabling energy and resource management using real-world data, improving access to education by integrating traditional and e-learning, and fostering collaboration between universities and various sectors to solve sustainability problems. Bibliometric analyses and content reviews indicate increased interest in the concept of "sustainable digital transformation" as a strategy for universities (Farea, 2022). The digital transformation in education have increased post-pandemic, accelerated the use of digital platforms and opened up debate about capabilities and gaps in access to digital skills (Mhlanga, et al., 2022; Filho, et al., 2024). Detailed assessments of digital transformation in education highlight emerging areas of success—such as leadership, skills, data architecture, and stakeholder support—that are equally important for integrating dialectical behavior into strategies related to the Sustainable Development Goals. However, studies are scattered across different fields and tend to treat “digitalization” and “sustainability” as separate agendas, rather than as part of an integrated approach to systematic transformation.

This review aims to bridge the existing gap through addressing emerging research examining how changes in digital business contribute to driving sustainable development in universities. By systematically synthesizing the literature, this review identifies key indicators and strategies linking digitalization to sustainable outcomes, while also considering the technological, organizational, and contextual factors that influence these processes. In this way, it provides a useful basis for understanding recent developments and fostering future research in this emerging field.

METHOD

The procedures for this systematic review followed the PRISMA 2020 guidelines developed by (Page, et al., 2021), as the updated guidance for systematic review reporting by (Takkouche, et al., 2011; Moher, et al., 2009), a well-known set of standards aimed at enhancing the quality and transparency of evidence gathering. This guide provided a structured method for identifying and compiling appropriate studies, making the review comprehensive and less susceptible to bias. To highlight recent developments in digital transformation within universities, the review was limited to research published between 2020 and 2025. This timeframe included years when digital transformation accelerated due to global trends in technology use and the challenges of the COVID-19 pandemic.

The search strategy relied on several well-known databases, such as Scopus, Web of Science, and Google Scholar, as these sources have a strong reputation for covering academic literature across all disciplines. A selection of keywords and clear search criteria were used to ensure that search strings covered the intersection of higher education, sustainability, and digital transformation. Terms used included combinations such as: (“digital transformation” or “digital business transformation”), (“sustainability” or “sustainable development”), and (“universities” or “higher education institutions”). This was done to ensure that the studies found addressed the technological and sustainability aspects of the research question. To further enhance operationalization, the reference lists of prominent studies were manually screened to identify other relevant publications not captured in the search.

After the initial studies were compiled, duplicate records were removed using Zotero reference management software (Lorenzetti & Ghali, 2013); (Ivey & Crum, 2018), and only unique studies were retained for further screening. A list of inclusion and exclusion criteria was then used to select suitable studies. The inclusion criteria were as follows: (a) studies must be articles published in peer-reviewed journals; (b) they must have been published between 2020 and 2025; (c) they must have focused primarily on digital transformation in universities; (d) they must clearly define sustainability or sustainable development for each associated outcome; and (e) the article must be written in English. Research focusing on non-university settings, discussing digitization without addressing sustainability, or research addressing sustainability without addressing digital transformation were

not included. Similarly, non-peer-reviewed texts such as conference papers, chapters, books, reports, and these were not included to ensure methodological integrity.

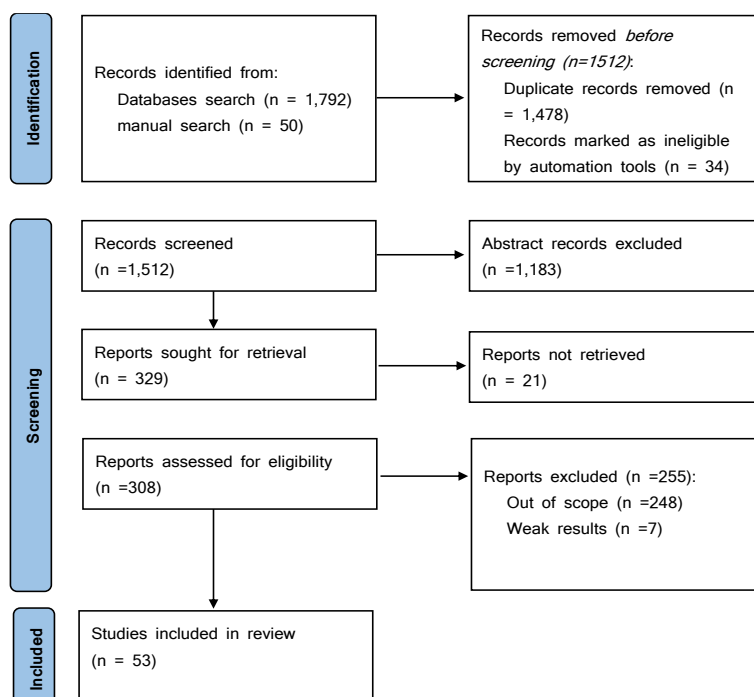
The filtering process was conducted in two stages. In the first stage, all titles and abstracts of retrieved studies were reviewed to exclude those that did not meet the selection criteria. In the second stage, the full texts of studies deemed appropriate were carefully reviewed to ensure their relevance (Page, et al., 2021). This process ensured the inclusion of studies that directly contributed to the objective of this review, which is to study the impact of digital transformation on sustainable development in universities. To minimize any potential bias, the selection and screening process was validated, and discrepancies were resolved through discussion.

Data were extracted in a structured manner using a pre-prepared data sheet. Information extracted from each study included details such as: (authors, year, journal), research method (qualitative, quantitative, or mixed), geographic location, activities related to DVT (e.g., teaching, research, administration, or campus operations), sustainability aspects addressed (e.g., environmental, social, and economic aspects), and main outcomes and effects. Systematically collecting this information allowed for comparisons between studies and helped in synthesizing evidence. The data were then analyzed thematically to search for patterns, differences, and shortcomings in the literature, a method deemed appropriate due to the diversity of research designs in this field.

Through all databases search, 1,842 papers are identified. After removing 330 duplicate articles, 1,512 unique records remained for screening. After reviewing the titles and abstracts, 1,183 articles were excluded for not meeting the inclusion criteria, leaving 329 articles for full evaluation. At this stage, 255 studies were excluded because they did not clearly focus on higher education, did not include sustainability aspects, or were not widely applied in the context of digital transformation. Finally, 53 studies met all the necessary criteria and were included in the final synthesis. These studies formed the empirical and theoretical basis upon which the analysis of the relationship between digital business transformation and sustainable development in academia was based.

To ensure transparency in the study selection, Figure 1 presents a PRISMA flowchart of the process of identifying, screening, excluding, and including studies at each stage. Furthermore, the quality of the selected studies was critically assessed using the CASP checklist (CASP, 2018) to ensure that the final articles were based on a reliable and valid methodology. Through this systematic and formal process, the review established a solid foundation for understanding the impact of digital business transformation on sustainable development outcomes in universities.

Figure 1. PRISMA 2020 flowchart



RESULTS

Overall, 53 articles met the criteria and were analyzed. These papers addressed multiple topics related to digital transformation in universities, such as strategic integration, technology adoption, and sustainability practices. The selected articles were analyzed based on their stated objectives, methods used, analytical focus, and reported findings. This process provided a comprehensive understanding of how digital transformation initiatives relate to sustainable development outcomes in higher education. Table 1 presents the search results, including the number of records identified in each database, the articles extracted, and the final studies that were merged after the screening phase.

Table 1. Search strategy and database results

Database	Search Terms Used	Number of Articles Retrieved	Number of Articles After Screening	Number of Included Articles
Scopus	“Digital Business Transformation” AND “Sustainable Development” AND “Universities”	820	139	28
Web of Science	“Digital Transformation” AND “Higher Education” AND “Sustainability”	540	86	16
Google Scholar	“Digital Business Transformation in Universities” AND “Sustainability”	441	90	6
Manual Search	Reference lists, conference papers, and institutional reports	41	14	3
Total		1,842	329	53

Distribution and Categorization of the Included Papers

Table 2 provides a full summary of how the 53 studies were distributed and categorized, demonstrating the diversity of research approaches in the research subject. The first section focuses on digital business transformation strategies and shows that innovation in technology and infrastructure was the most discussed, appearing in 26.92% of the articles (14 articles). This indicates that digital platforms, smart systems, and environmental technologies remain at the forefront of sustainability priorities in universities. The second most common theme was policies and governance structures (23.08%; 12 articles), which discussed the institutional tools and rules that help achieve sustainable digital transformation. 19.23% of the studies addressed the digital policy and corporate culture (10 articles), exploring the impact of this vision and culture on the institution. Developing digital skills and capabilities accounted for 17.31% of the research (9 articles), highlighting the importance of enhancing sustainable digital skills among faculty and students. Finally, the study of innovation systems and collaboration was less common, representing 13.46% of the research (7 articles), but it emphasized the importance of collaboration with industry partners and external collaborators.

In terms of research design, quantitative methods were the most widely used, with 48.08% (25 articles) using questionnaires and advanced statistical techniques such as SEM and PLS-SEM. Qualitative research represented 28.85% (15 articles), typically using interviews and focus groups to explore organizational practices more deeply. Multi-method research was less prevalent, but not insignificant, accounting for 23.08% (12 articles).

Geographically, research was heavily concentrated in Asia (39.7%; 21 articles), followed by Europe (35.8%; 19 articles), and America (15.1%; 8 articles). The remaining 9.4% (5 articles) were from Africa, Australia, and other regions. This distribution reflects the global importance and sustainability of dialectical behavior therapy in higher education institutions, as well as the underrepresentation of research from the Global South in these sectors.

Table 2. Illustration of the distribution and classification of papers

Category	Number of Studies	Percentage (%)
Digital Business Transformation Strategies		
Technological Innovation & Infrastructure	14	26.92%
Governance & Policy Frameworks	12	23.08%
Digital Policy & Organizational Culture	10	19.23%
Digital Competencies & Skills Development	9	17.31%
Innovation Ecosystems & Partnerships	7	13.46%
Study Design		
Quantitative (Surveys, SEM, PLS-SEM)	26	48.08%
Qualitative (Interviews, Focus Groups)	15	28.85%
Mixed-Methods	12	23.08%
Geographic Distribution		
America	8	15.1%
Europe	19	35.8%
Asia	21	39.7%
Other Regions (Africa, Australia, etc.)	5	9.4%

Bibliographic Information for the included Papers

Table 3 shows the bibliographic information for the selected articles. The table includes the author's name, year of publication, study design, and the digital transformation strategy for the relevant work. One of the most prominent trends identified in the selected articles is the focus on studying the relationship between digital innovation and sustainability in higher education. Previous work (e.g., (Happonen, et al., 2020); (Giesenbauer & Müller-Christ, 2020) have addressed the development of transformation models, such as University 4.0 and collaborative models that combine industry and universities, highlighting how digitalization promotes sustainability. Over time, more recent work (e.g., Neves et al., 2024; Olubosola et al., 2024; Ashkar, 2025) has shown an interest in practical approaches and comparative studies across different regions, demonstrating the link between digital transformation, the UN Sustainable Development Goals, and Industry 5.0.

The diversity of study designs also shows a methodological balance. Concepts and theories still play a key role, especially in the early years, but empirical approaches, including surveys, case studies, and comparative evaluations, are becoming more common in recent work. This diversity reflects the evolving approach in the field, where concepts and practical evidence help enhance understanding of how digital transformation can be leveraged to achieve sustainable development in higher education. In addition, the strategies outlined in the articles discuss many aspects of digital transformation. These plans include developing technology and infrastructure, the administrative system and policy environment, enhancing digital competencies and skills, innovation systems and partnership building, and establishing a sustainable digital culture. These strategies provide a comprehensive picture of digital transformation, not just as a technological step, but as a digital cultural and organizational evolution in universities.

Table 3. Bibliographic Information of Included Papers

Article No.	Author, Year	Study Design	Digital Business Transformation Strategy
1	(Elbolok, et al., 2025)	Quantitative (SEM)	Technological Innovation & Infrastructure.

2	(Filho, et al., 2024)	Mixed-Methods	Governance & Policy Frameworks.
3	(Ashme, et al., 2022)	Conceptual/Qualitative	Innovation Ecosystems & Partnerships.
4	(Mendez-Picazo, et al., 2024)	Quantitative (Econometric Analysis)	Technological Innovation & Infrastructure.
5	(Awady, et al., 2025)	Literature Review/Conceptual	Digital Competencies & Skills Development.
6	(Alojail & Khan, 2023)	Quantitative (Survey-Based)	Technological Innovation & Infrastructure.
7	(Bindeebea, et al., 2025)	Meta-Analytic Review	Innovation Ecosystems & Partnerships.
8	(Shenkoya & Kim, 2023)	Qualitative (Case Study)	Open Knowledge Frameworks.
9	(Strapchuk, et al., 2025)	Mixed-Methods	Innovation Ecosystems & Partnerships.
10	(Dang, et al., 2024)	Qualitative (Interviews, Document Analysis)	Technological Infrastructure
11	(Aleryani, 2024)	Conceptual/Qualitative	; Capacity Development
12	(Alotaibi, 2022)	Conceptual	Digital Competencies & Skills Development
13	(Aldogihier, et al., 2025)	Quantitative (SEM)	Governance & Policy Frameworks
14	(Sayari, et al., 2025)	Quantitative (Survey-Based)	Innovation Ecosystems & Partnerships
15	(Alotaibi, 2021)	Qualitative (Case Study)	Governance & Policy Frameworks
16	(Al-Shamsi, 2024)	Conceptual/Policy Analysis	Strategic Innovation
17	(Tarhini, et al., 2025)	Editorial/Conceptual	Regional Innovation Strategies
18	(Tram, 2025)	Quantitative (Econometric Analysis)	Innovation Ecosystems & Partnerships
19	(Abad-Segura, et al., 2020)	Quantitative (Survey)	Digital Competencies & Skills Development
20	(Lee & Lee, 2024)	Mixed-Methods	Governance & Policy Frameworks
21	(Muthu, et al., 2023)	Quantitative (Survey)	Environmental Sustainability
22	(Prabawati, et al., 2025)	Quantitative (Survey-Based)	Digital Competencies & Skills Development
23	(Laorach & Tuamsuk, 2022)	Qualitative (Interviews/Exploratory Study)	Capacity Building
24	(Kumar & D.Shobana, 2025)	Conceptual/Qualitative	Technological Innovation & Infrastructure; Policy & Governance
25	(Khatib & Al-Sadi, 2023)	Case Study	Innovation Ecosystems
26	(Herman & Georgescu, 2025)	Quantitative (Multivariate Analysis)	Technological Innovation
27	(Irina, et al., 2024)	Comparative Study (Cross-National)	Digital Competencies & Skills
28	(Karadayi-Usta, 2024)	Quantitative (Survey-Based)	Innovation Ecosystems
29	(Veckalne & Tambovceva, 2022)	Quantitative (Survey-Based)	Digital Competencies & Skills Development; Governance Frameworks
30	(Trevisan, et al., 2023)	Quantitative (Survey-Based)	Innovation Ecosystems

31	(Karahan, 2024)	Qualitative (Case Study)	Innovation Ecosystems & Partnerships; Technological Innovation
32	(Nosratabadi, et al., 2023)	Quantitative (Cross-National Empirical Study)	Governance & Policy Frameworks; Social Sustainability
33	(Rof, et al., 2020)	Conceptual/Qualitative	Innovation Ecosystems & Partnerships
34	(Popescu, et al., 2020)	Case Study	Digital Competencies & Skills Development
35	(Cristea, et al., 2023)	Quantitative (Survey/Regression)	Technological Innovation & Infrastructure
36	(Kerras, et al., 2020)	Comparative Quantitative Study	Governance & Policy Frameworks; and Social Inclusion
37	(Mirolyubova & Voronchikhina, 2021)	Case Study/Econometric Analysis	Governance & Policy Frameworks; Regional Innovation Strategies
38	(Oliveira & Gomes, 2024)	Quantitative (Survey-Based)	Quality Management
39	(Tsaples, et al., 2024)	Qualitative (Interviews/Organizational Study)	Digital Competencies & Skills Development
40	(Teixeira, et al., 2021)	Case Study	Governance & Policy Frameworks
41	(Happonen, et al., 2020)	Conceptual and applied model analysis (conference paper).	Business model innovation for sustainability through digital technologies in collaboration frameworks.
42	(Carmo, et al., 2025)	Review paper with case discussion.	Integration of digital transformation into higher education sustainability frameworks.
43	(Olubusola, et al., 2024)	Comparative review study.	Adoption of digital platforms for sustainable business growth and development.
44	(Plecko & Hojnik, 2024)	Cross-regional comparative analysis.	Application of digital tools for sustainable business operations and practices.
45	(Daú, et al., 2023)	Empirical study in higher education sector.	Integration of digital education processes aligned with sustainability goals.
46	(Neves, et al., 2024)	Qualitative case analysis in library and information science.	Use of digital preservation systems to advance sustainability objectives.
47	(Ziadlou, 2021)	Conceptual and strategic framework analysis.	Development of digital strategies to enhance progress toward sustainable development.
48	(Giesenbauer & Müller-Christ, 2020)	Conceptual and theoretical framework.	University 4.0 transformation integrating digitalization with sustainability agendas.
49	(Achkar, 2025)	Theoretical and conceptual analysis (book chapter).	Digital innovation and transformation aligned with Industry 5.0 sustainability.
50	(Genga & Babalola, 2025)	Conceptual and advocacy-based study.	Promotion of sustainable green culture through digital transformation.
51	(Ajani, 2024)	Empirical case-based approach.	Leveraging digital tools for sustainability in rural higher education.
52	(Zezeza & Okanda, 2021)	Analytical review with regional focus.	Strengthening ICT infrastructure and digital education strategies for sustainability.
53	(Mhlanga, et al., 2022)	Empirical and case-based analysis.	Acceleration of digital adoption in higher education to ensure sustainability post-COVID-19.

Digital Business Transformation Indicators for Sustainable Development

After a systematic review of 53 selected articles, nineteen indicators specific to sustainable development in the field of digital business transformation were identified. These indicators were compiled by organizing research topics, where similar findings from studies were grouped into broad points that indicate differences in sustainability in higher education. The results showed that digital business transformation is a key factor for achieving sustainable development through three main areas:

- Technological transformation and infrastructure, which focuses on innovations in digital technology, information systems, and infrastructure adaptability to enhance sustainability in institutions.
- Governance, policy, and culture, which digital governance, culture within institutions, and policy frameworks that influence the adoption of digital initiatives.
- Competencies, collaboration, and ecosystems, which addresses the development of digital skills, collaboration, innovation systems, and collaborative networks that help universities achieve a sustainable path.

Among these points, nineteen indicators were identified, such as the capacity for technological innovation, digital governance models, policy alignment with the Sustainable Development Goals, digital environmental culture, equal access, digital skills, collaborative partnerships, and the ability to adapt to Industry 4.0 and 5.0 models. These indicators provide a comprehensive framework for assessing how the digital transformation of business contributes to achieving the Sustainable Development Goals in the field of higher education.

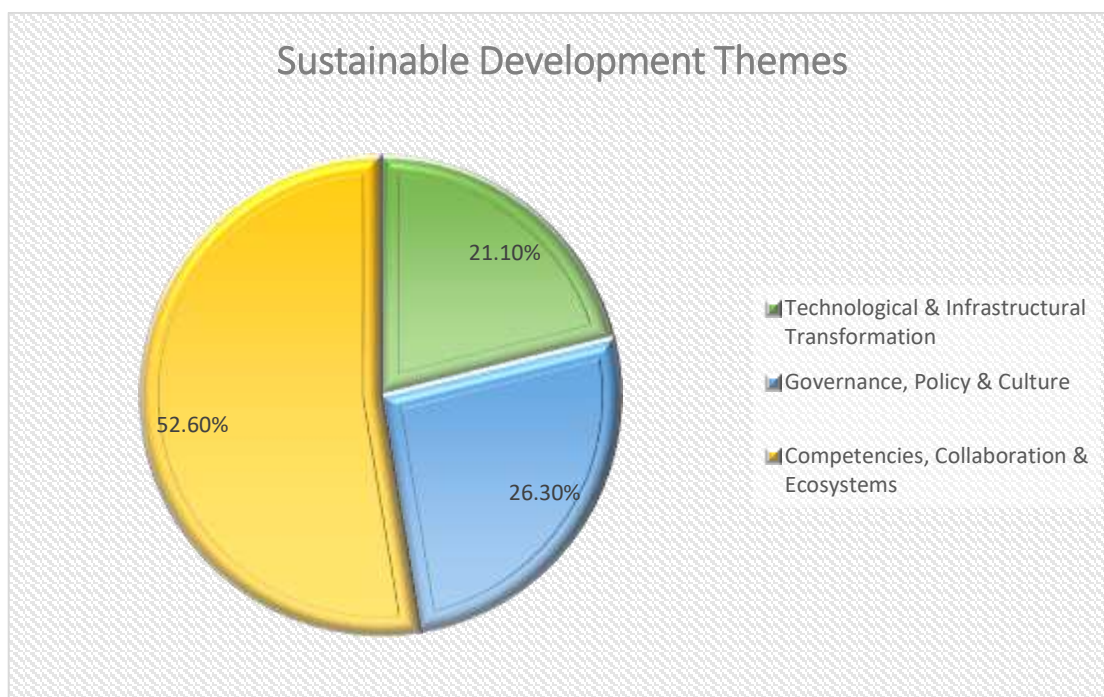
Table 4. Digital Business Transformation Indicators for Sustainable Development

Theme	Category	Indicator	Article No.
Technological & Infrastructural Transformation	Technological Innovation	Advanced digital technologies.	(1, 3, 7, 8, 15, 16,21, 28, 30, 31, 34, 38, 41, 44)
		Smart infrastructures	
	Infrastructure & Reliability	Development of resilient digital systems.	(2, 3, 6, 7, 20, 24, 27, 29, 32, 34, 36, 46, 53)
		Infrastructure supporting sustainability.	
Governance, Policy & Culture	Governance	Digital governance.	(6, 9, 25, 34, 47, 52)
		Integration of SD goals in university strategies	
	Policy Frameworks	National and institutional policy alignment.	(14, 22, 27, 36, 42)
		Digital sustainability agendas	
	Digital policy	Green digital culture.	(11, 18, 29, 35, 50)
Competencies, Collaboration & Ecosystems	Skills Development	Digital skills.	(2, 5, 7, 10, 15, 17, 18, 19, 20, 21, 17, 31, 39, 40, 41, 44, 49, 50, 51)
		Digital competencies.	
		Literacy for sustainability	
	Partnerships	University–industry collaborations.	(8, 15, 19, 22, 30, 41, 49)
		International partnerships for digital sustainability.	

	Innovation Ecosystems	Innovation hubs, incubators.	(2, 5, 8, 12, 13, 14,15, 26, 27, 30, 33, 45)
		Entrepreneurial ecosystems	
	Equity & Inclusion	Access to digital resources.	(13, 23, 36,41,45, 48, 51)
	Sustainable Practices	Digital transformation into environmental.	(4, 6, 7, 8, 12, 14, 16, 24, 26,29, 30, 35, 37, 40, 43,48,49,52)
		Social sustainability practices	

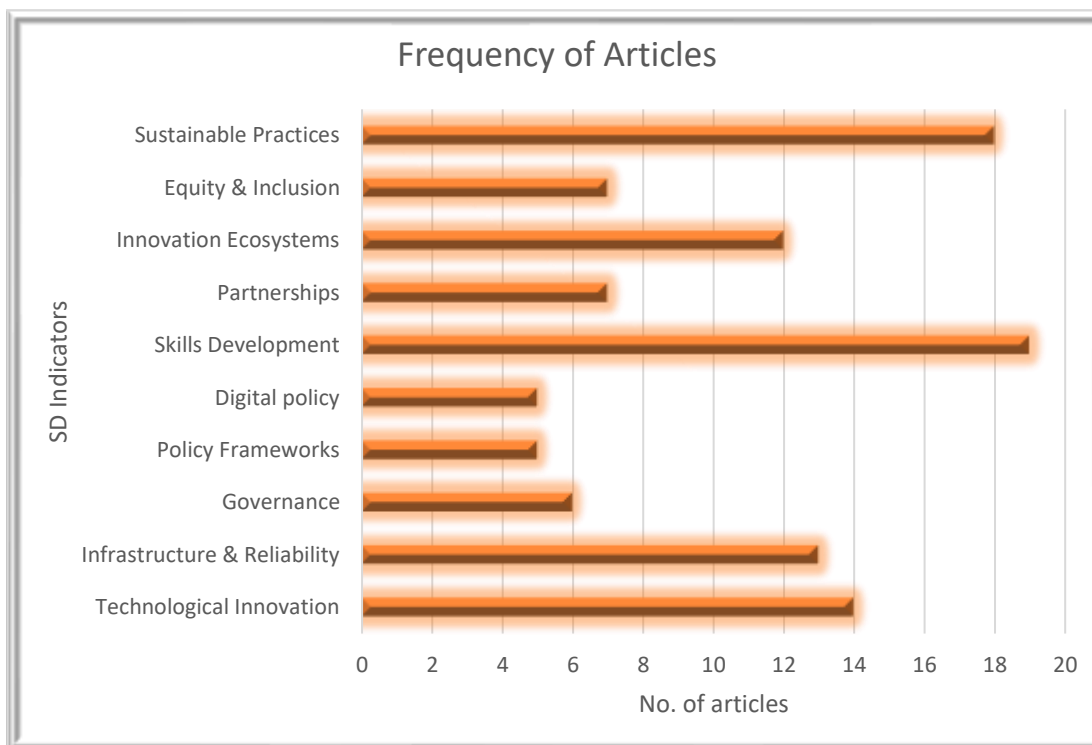
The indicators were distributed across the three themes of SD, depicted in Figure 2. Technology and infrastructure-related indicators accounted for 21.1% (4 out of 19) of the total, highlighting the need for important technological innovation and reliable infrastructure as key drivers of sustainability. Meanwhile, governance, policy, and culture accounted for 26.3% (5 out of 19), showing the importance of digital governance and policy environments that support the creation of a digital culture in universities. While, collaboration competencies and ecosystems accounted for the highest proportion, accounting for 52.6% (10 out of 19) of the indicators, ensuring the importance of human capacity development, cross-sector partnerships, and innovation ecosystems in promoting sustainability in higher education through digital transformation.

Figure 2. Sustainable development themes



The frequency of articles, shown in Figure 3, reflect the SD indicators across the ten categories. Skills development was mentioned most frequently, appearing in 19 studies, followed by sustainable practices (18 studies), highlighting their important role in facilitating digital transformation and future sustainability. Technological innovation (14 studies) and infrastructure and reliability (13 studies) were also emphasized, reflecting the importance of technology and system readiness. Meanwhile, innovation systems (12 articles) and partnership (7 articles) emphasized the importance of intersectoral collaboration. While governance-related aspects were less frequently addressed, they included governance (6 articles), policy frameworks (5 articles), and digital policy (5 articles), and were mentioned in seven articles related to equity and inclusion, a new but important topic towards inclusive digital transformation for sustainable development.

Figure 3. Frequency of Papers Stating Each Category of DBT



Comparison of Indicators' Number of Citations across Digital Business Transformation Strategies

When examining the distribution of citations by DBT themes, the analysis shown in Table 5 indicated a significant statistical variation in the interest of various indicators study in the literature. The statistically significant chi-squared test results ($p < 0.05$) showed that citations across the first categories are unevenly distributed, causing different academic attention to be placed on these elements. More specifically, the indicators of competence, collaboration, and ecosystem reach the highest percentage of citations, with 59.4%, indicating a strong scientific consensus that developing competencies, collaborating toward skill development and sustainable practices are among the most important factors for the success of DBT in universities. Next, technological transformation and infrastructure rank with 25.5% of citations, which further supports the idea that technological innovation and a strong digital infrastructure are crucial but do not serve as the only drivers of this change. Meanwhile, the issues of governance, policy, and culture have the lowest percentage of citations, with 15.1%. However, the p-value for such theme indicated that governance frameworks and policy guidelines continue to maintain a statistically significant role in ongoing debates related to DBT. In other words, the clear evidence provided through the chi-square test points to the differences in academic focus, which has observably shifted toward strategies that put human factors and environments at the center of driving sustainable digital transformation in higher education.

Table 5. Comparison of Indicators' Number of Citations in the Articles Related to DBT Strategy

Theme	Category	DBT No. of Citations	Total (%)	p-value
Technological & Infrastructural Transformation	Technological Innovation	14	27 (25.5%)	.03
	Infrastructure & Reliability	13		
Governance, Policy & Culture	Governance	6	16 (15.1%)	.05
	Policy Frameworks	5		

	Digital Policy	5		
Competencies, Collaboration & Ecosystems	Skills Development	19	63 (59.4%)	.02
	Partnerships	7		
	Innovation Ecosystems	12		
	Equity & Inclusion	7		
	Sustainable Practices	18		

DISCUSSION

The purpose of this comprehensive review was to examine how digital business transformation strategies can be used to promote sustainable development in universities. Through compiling information from 53 included articles, the review provided great reflections into how digitalization interacts with sustainability in higher education. The findings demonstrate that digital business transformation in universities is a complex process influenced by technology, various entities, and people.

The review revealed a significant but wide distribution across categories. Competencies, collaboration, and environments accounted for more than half of the analyzed indicators (52.6%), nearly three times as much as technology transformation and infrastructure (21.1%) or systems, policies, and culture (26.3%). These variations underscore that the lasting success of digital initiatives in higher education increasingly depends on the ability of universities and individuals to learn new skills, share knowledge, and form partnerships. Previous reviews of digital transformation in education (Lee et al., 2022) have shown that focusing on approaches that focus on people and environments is most important, suggesting that technology investments alone are insufficient without accompanying developments in culture and skills.

Besides, the number of citations from articles on specific categories confirms this understanding. Skills development ($n = 19$) and sustainability measures ($n = 18$) were the most discussed, while governance ($n = 6$) and policy frameworks ($n = 5$) received relatively less attention. This difference reveals that research has focused on practical and functional issues of transformation rather than fundamental structural and organizational issues. Previous studies have also shown that policy issues are being neglected in discussions of digital transformation, despite the fact that governance frameworks play an important role in ensuring sustainability, accountability, and long-term success (Nguyen, 2021). Therefore, these findings point to a key gap in research: to achieve sustainability of behavioral computing technology, it is essential to integrate strong governance and policy frameworks that contribute to driving change.

Although a comparison of indicators across behavioral computing strategies did reveal statistically significant differences in citation distribution ($p < 0.05$), it does suggest that some areas are receiving greater research attention. The unspoken bias toward collaboration and environmental strategies reflects a shift in the theoretical paradigm toward viewing universities as interconnected parts of digital knowledge networks rather than as independent entities. This perspective aligns with general trends in innovation studies, which recognize the importance of inter-institutional partnerships and open innovation systems in creating sustainable solutions (Chen & Miller, 2023). In this way, universities operate as institutions that contribute to and benefit from shared digital capabilities and assets.

However, the findings also highlight areas that still need further research. Although digital equity and inclusion have been mentioned in several studies (numbering seven), they have not been considered as universally recognized as key components of sustainable change metrics. This lack of focus is concerning, as the relationship between educational sustainability and equitable access to digital media cannot be ignored. As Gonzalez and Herrera (2020) point out, overlooking digital divides can threaten the achievement of fundamental sustainability goals by reinforcing inequalities in participation between students and institutions. These challenges require research and policy reform that intentionally incorporates inclusiveness in the development and evaluation of gender-based behavioral therapy strategies.

FUTURE RESEARCH PROSPECTS AND KNOWLEDGE GAP

Even though this review shows how digital business transformation strategies contribute to promoting sustainable development in universities, but some gaps remain. Initially, most of the evidence focuses on skills development (19 articles) and sustainable practices (18 articles), while studies addressing important topics such as governance, policy frameworks, and equality are lacking, with each of these topics being addressed in fewer than seven studies. This disparity suggests that future research will need to take an integrated approach to linking technology, policy, and cultural drivers of change. Furthermore, most of the studies used in this research relied on cross-sectional designs, which hinders understanding the long-term impacts of digital transformation efforts on sustainable development outcomes. Adopting mixed-methods study designs could provide more comprehension into how strategies evolve over time and across diverse institutional contexts. Finally, a regional imbalance is observed, with efforts focusing more on North America, Europe, and Asia, while research contributions from Africa and developing regions remain very limited, despite facing unique challenges and opportunities. Addressing these gaps will require further context-sensitive comparative studies, which will help expand the evidence base and develop more comprehensive policies and practices in the field of digital transformation for sustainable development in higher education.

LIMITATION

This review does have some limits. First, 53 studies were analyzed, which, while diverse, may not represent all research related to digital transformation in higher education. Second, relying on published studies reviewed could lead to publication bias, as comparative findings from the grey literature, institutional reports, or current projects were not included. Third, the objectives, designs, and methodologies of the studies were classified based on the data available in the articles, which may introduce interpretation bias. Finally, despite efforts to achieve balance, geographical differences in the distribution of studies limit the applicability of the findings to different contexts around the world.

CONCLUSION

This paper reviewed information from 53 studies assessing how a digital business transformation can help promote sustainable development in universities. The findings highlighted three main themes: technological & infrastructural transformation, governance of digital policy & culture, and competencies, collaboration & ecosystems, with identifying nineteen indicators. Analysis of the distribution of indicators and citations highlighted that competencies and collaboration are highly relevant in recent studies, while technology and governance are equally important for long-term sustainability. Despite differences in research design, locations, and geographic scope, the combined evidence ensures the vital role digital business transformation plays in guiding higher education institutions toward a sustainable and resilient future.

CONFLICT OF INTEREST

The authors confirm there is no conflict of interest to declare in publishing this paper work.

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Appendix 1. PRISMA 2020 Checklist



PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Line 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract written based on this checklist
INTRODUCTION			



Section and Topic	Item #	Checklist item	Location where item is reported
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction (Section 1, Paragraphs 1–5)
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	End of Introduction (final paragraph).
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods (Section 2, Paragraph 3)
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methods (Section 2, Paragraphs 2–3)
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Methods (Section 2, Paragraph 2)
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methods (Section 2, Paragraph 4)
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methods (Section 2, Paragraphs 4-5)
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methods (Section 2, Paragraph 5)
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	N/A
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methods (Section 2, last paragraph, CASP checklist)
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methods (Section 2, Paragraph 7)
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Methods (Section 2, data extraction paragraph)
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Methods (Section 2: PRISMA flowchart + Tables 1–5)

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Methods + Results (narrative synthesis used)
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Methods (CASP quality appraisal paragraph)
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Results (Section 3 + PRISMA Flow Figure 1)
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Methods (selection stages) + PRISMA flow details
Study characteristics	17	Cite each included study and present its characteristics.	Table 3 (Bibliographic information)
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Methods (CASP assessment)
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Results (Tables 2–5, Figures)
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Results Sections 3.1–3.4
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Section 3.4 (Chi-square significance)
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Methods (quality appraisal)
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion (Section 4)
	23b	Discuss any limitations of the evidence included in the review.	Discussion (Section 4)



Section and Topic	Item #	Checklist item	Location where item is reported
	23c	Discuss any limitations of the review processes used.	Limitations (Section 6)
	23d	Discuss implications of the results for practice, policy, and future research.	Future Research & Gaps (Section 5)
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Not registered yet
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	protocol was not prepared.
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	No amendment
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	No financial support
Competing interests	26	Declare any competing interests of review authors.	No any competing interest by review authors
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

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