Digital Transformation and Sustainable Development in Nigerian Higher Education Institutions: The Moderating Role of Organizational Culture

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Abstract

This study explores the impact of digital transformation on sustainable development in Nigerian higher education institutions (HEIs), with a focus on the moderating role of organizational culture. While digital transformation enhances operational efficiency, resource optimization, and educational accessibility, its implementation faces challenges such as inadequate infrastructure, low digital literacy, and resistance to change. Grounded in dynamic capability theory, the study examines how digital transformation enables organizations to adapt and thrive. A quantitative approach was employed, surveying 360 faculty, students, and administrative staff, with 348 valid responses analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings confirm a significant positive relationship between digital transformation and sustainability, with organizational culture playing a crucial role in reinforcing sustainability outcomes. Additionally, organizational culture moderates this relationship, underscoring the need for a supportive digital environment to maximize the benefits of transformation initiatives. The study contributes to literature by demonstrating that digital transformation, when aligned with an adaptive organizational culture, enhances sustainability in HEIs. Practical implications highlight the need for policies promoting a digital-friendly culture while addressing barriers to technology adoption. Future research should explore leadership, government policies, and financial constraints to further understand how Nigerian HEIs can leverage digital transformation for long-term sustainability and educational advancement.

Keywords: *Digital transformation, Sustainability, Organizational culture, Higher education, Nigeria*

Introduction

The integration of digital technologies into organizational structures is reshaping industries, fundamentally altering operations and redefining value creation for stakeholders (Fitzgerald et al., 2013). The rapid advancement of technologies such as artificial intelligence, big data analytics, cloud computing, blockchain, and the industrial internet is driving the shift from traditional economic models to highly interconnected digital ecosystems (Abdullahi et al., 2024). Organizations aiming for innovation and long-term success must embrace digital transformation to maintain a competitive edge in an increasingly complex global landscape (Majchrzak et al., 2016; Vial, 2019). Reports such as the "IDC FutureScape: Global Digital Transformation Forecast in 2021" (http://www.idc.com) projected that investments in digital transformation would exceed USD 6.8 trillion between 2020 and 2023. Digitalization plays a crucial role in fostering sustainability across various sectors, including higher education. In this context, digital transformation entails the adoption of advanced technological tools to enhance teaching, research, and administrative functions. A prominent example of this shift is the widespread implementation of online learning platforms, which gained significant momentum during the COVID-19 pandemic (Iivari et al., 2020). However, the transition to digital education has not been uniform worldwide, as many developing nations continue to face challenges associated with the digital divide.

The United Nations defines sustainable development as fulfilling present needs without undermining future generations' ability to meet their own (UN, 1987). By aligning digital transformation with sustainability goals, higher education institutions are leveraging technology to support the United Nations' Sustainable Development Goals (SDGs), particularly SDG 4, which focuses on ensuring quality education for all. The adoption of digital solutions in higher education institutions (HEIs) has become an essential driver of educational reform and institutional sustainability. This transformation enhances access to education, fosters innovation in pedagogical approaches, and embeds sustainability within the operational framework of academic institutions (Fisk, 2023; Martin et al., 2022).

In Nigeria, digital transformation holds particular importance given the country's demographic trends and the growing demand for higher education. Nigerian higher education institutions (HEIs) grapple with challenges such as insufficient infrastructure, limited access to educational resources, and the need for more effective and inclusive teaching approaches (Adamu & Addamu, 2022). The COVID-19 pandemic has catalyzed a global shift towards digital education, underscoring the imperative for Nigerian Higher Education Institutions (HEIs) to embark on digital transformation as a strategic pathway to achieving the Sustainable Development Goals (SDGs) and enhancing educational outcomes (Obi, 2023). However, the higher education sector faces persistent obstacles, including inadequate infrastructure, funding shortfalls, and outdated curricula, which impede efforts to attain sustainable development (Ogunleye, 2018). The integration of digital technologies offers a promising avenue to overcome these barriers by expanding access to education, enhancing learning quality, and fostering research and innovation. Nevertheless, the practical implementation of digital transformation in Nigerian HEIs is fraught with challenges that require systematic investigation and resolution to realize its full potential.

Although digital transformation offers numerous benefits, its implementation in Nigerian higher education institutions (HEIs) is hindered by substantial challenges. While existing research identifies various obstacles, a holistic understanding of these barriers and their implications for sustainable development remains elusive. Adewale et al. (2019) reported severe infrastructure deficiencies, such as unreliable internet, inadequate power supply, and lack of modern devices. Salihu (2020) emphasized funding issues, noting that financial constraints limit investment in digital technologies. Eze et al. (2018) identified significant skill gaps in digital literacy among staff and students, hindering effective digital tool integration. Oye et al. (2014) discussed

organizational resistance to change, with faculty and staff often reluctant to adopt new technologies. Nwosu et al. (2021) pointed out policy and regulatory challenges, noting the absence of clear frameworks to guide digital transformation. These challenges are often examined in isolation, lacking a holistic view of their collective impact on digital transformation and sustainable development in Nigerian higher education. Similarly, notwithstanding the recognized benefits of digital transformation, many HEIs in Nigeria struggle with its implementation. Empirical studies have highlighted several barriers, including insufficient digital infrastructure, a lack of skilled personnel, and resistance to technological change. Studies have identified significant hurdles to digital transformation in Nigerian universities. For example, Adeoye et al. (2022) revealed that many institutions lack essential digital infrastructure, including adequate internet connectivity, to support effective online learning. Moreover, research by Oke and Fernandes (2023) highlighted the pervasive issue of low digital literacy among staff and students, hindering the successful adoption of digital technologies. Despite these findings, empirical evidence on the specific consequences of these challenges on the educational ecosystem remains scarce. Given the vital role of higher education in driving sustainable development and the increasing importance of digital technologies, a comprehensive study is needed to address these interconnected challenges and provide a holistic understanding of their impact.

The digital economy presents new opportunities, but it also challenges how people and organizations will adapt and grow (Kane et al., 2015). Organizational culture significantly impacts the effectiveness of digital technology implementation, with flexible cultures more likely to succeed (McDermott & Stock, 1999). This influence occurs through shaping member behavior (Zheng et al., 2010). Digital transformations often fail due to cultural clashes, despite potential benefits (Wokurka et al., 2017). Thus, a supportive digital culture is essential for successful digital transformation and sustainable development (Haffke et al., 2017). Examining the moderating influence of digital culture on the relationship between digital transformation and sustainable development is essential, yet a significant research gap remains (Duerr et al., 2018; Wokurka et al., 2017). Research is needed to analyze how digital organizational culture can facilitate successful digital transformations and contribute to sustainable development. From a practical standpoint, Nigerian HEIs are under considerable pressure to align their operations with sustainable development principles. However, the integration of digital technologies is often hindered by financial constraints, inadequate policy support, and limited stakeholder engagement (Ololube, 2022). The practical challenges of implementing digital transformation in Nigerian HEIs necessitate a thorough understanding of the barriers and enablers to inform effective strategies and interventions. Addressing these challenges is critical for policymakers and educational leaders to foster a more sustainable and digitally-enabled higher education sector in Nigeria (Ekundayo & Ekundayo, 2021).

This research seeks to address the existing knowledge gap by investigating the current state of digital transformation in Nigerian Higher Education Institutions (HEIs), pinpointing key challenges, and assessing their impact on sustainable development. The study aims to provide actionable recommendations to overcome these challenges, ultimately enhancing digital transformation and promoting sustainable development in Nigerian higher education. Therefore, the following objectives are developed:

1. To assess the impact of digital transformation on sustainable development in Nigerian higher education institutions.

2. To examine the moderating role of organizational culture in this relationship.

3. To offer recommendations for enhancing sustainable practices through digital transformation.

Literature Review and Hypotheses Development

Digital Transformation in Higher Education

DT in higher education institutions (HEIs) involves integrating digital technologies to enhance educational processes, administrative operations, and overall institutional performance. It promises numerous benefits, such as improved educational quality, increased accessibility, and the promotion of sustainable practices (Martin et al., 2022; Fisk, 2023). Sustainable development in this context refers to aligning institutional operations with sustainable development goals (SDGs), which include providing quality education, promoting lifelong learning, and ensuring inclusive and equitable access to education (UNESCO, 2017). The higher education sector is undergoing a significant shift, driven by students' demands for digital convenience, personalization, and exceptional customer service, akin to their experiences in other industries. To meet these expectations and respond to external pressures, institutions must embark on digital transformation, leveraging technologies to streamline operations, reduce costs, and enhance the student experience, while also bolstering their brand reputation. This transformation involves harnessing digital platforms and tools, such as websites, social media, chatbots, and email marketing, to effectively engage, attract, and retain students. Institutions are also leveraging data integration across campuses to inform decision-making. Additionally, self-service capabilities empower students to independently manage tasks like class registration, transcript requests, and financial aid, while automation enhances cross-departmental efficiency by speeding up processes and improving task execution. While digital transformation offers significant benefits, its success rate is surprisingly low, with approximately 30% of organizations successfully meeting their goals and sustaining meaningful change (Fahey, 2021). For colleges and universities to successfully adopt digital transformation, they must identify and address the key barriers to implementation. Fahey (2021) highlights four common challenges: outdated, siloed technology ecosystems, weak technology governance, insufficient skills, and resistance to change. The ongoing digital transformation in higher education is further accelerated by current technology trends. Advances in cloud computing (Olaloye et al., 2019), artificial intelligence (Alotaibi & Alshehri, 2023; Al-Rasheedi & Khan, 2021), the Internet of Things (Al-Qozani & Aleryani, 2018), and social media optimization (Davidovitch & Belichenko, 2018; Alamri et al., 2020) are revolutionizing the educational landscape. By enhancing communication, interaction, and the overall learning experience, these technological innovations make digital transformation a crucial strategy for shaping the future of higher education.

Moreover, digital transformation (DT) has proven to greatly enhance teaching and learning outcomes by supporting innovative teaching methods and enabling tailored learning experiences. Blended learning approaches, which integrate online and in-person instruction, have been shown to boost student engagement and improve learning outcomes (Garrison & Kanuka, 2004). The integration of digital technologies also allows for more efficient use of resources and supports the monitoring and reporting of sustainability metrics, aligning operations with SDGs (Fisk, 2023). Conversely, in Nigerian HEIs, DT is seen as a crucial strategy for addressing challenges such as inadequate infrastructure, limited access to educational resources, and the need for more effective teaching methods (Adamu & Addamu, 2022). However, the successful implementation of digital transformation initiatives faces several barriers, including insufficient digital infrastructure, lack of skilled personnel, and resistance to change (Adeoye et al., 2022).

Digital Transformation and Sustainable Development

The increasing integration of digital technologies into products, services, and operational processes has intensified interest in digital transformation, encompassing both digitization and digitalization (Nasiri et al., 2020; Ritter & Pedersen, 2020). Theoretically, this shift is expected to enhance operational efficiency and optimize resource utilization, ultimately contributing to sustainable economic and environmental benefits (Pagani & Pardo, 2017; ElMassah & Mohieldin, 2020). However, opinions on its overall impact remain divided. For example, McKinsey (2018) reports that

nearly 70% of digital transformation initiatives fail, often leading to significant financial setbacks. Similarly, Cohen (2018) highlights environmental concerns, pointing out that increased reliance on data management systems can escalate energy consumption and carbon emissions. While some studies associate digital transformation with improved sustainable performance (Di Vaio & Varriale, 2020; Dubey et al., 2019; Kamble et al., 2020; Wamba et al., 2017), others warn that it may introduce challenges such as cybersecurity threats and electronic waste (Ahmadova et al., 2021; Kohtamäki et al., 2020). These differing viewpoints emphasize the need for further investigation into the precise relationship between digital transformation and sustainability outcomes.

From a strategic perspective, digital transformation (DT) enables organizations to respond to evolving environmental conditions by leveraging technological innovations to enhance engagement and service delivery (Ylinen, 2021; Agostino et al., 2021). However, higher education institutions (HEIs) exhibit varying levels of digital adoption due to challenges such as misaligned strategic objectives, inadequate structural reforms, and financial constraints (Connolly et al., 2018; Mergel et al., 2019; Ruud, 2017; Scupola & Mergel, 2022). Public sector organizations, in particular, encounter significant obstacles in utilizing information and communication technologies (ICTs) to improve service delivery for citizens (Tangi et al., 2020). Although existing research frequently examines the direct link between digital transformation and organizational performance (Dubey et al., 2020; Li et al., 2020), this perspective may oversimplify the complexities involved. In practice, the benefits of digital transformation are often contingent on the development of key organizational capabilities, such as dynamic capabilities, which facilitate adaptation and innovation (Mikalef et al., 2018). Moreover, the relationship between these capabilities and performance may not always be linear (Chatterjee et al., 2021). Additionally, organizational culture plays a crucial role in determining the success of digital transformation initiatives. A culture that promotes innovation, collaboration, and continuous learning enhances the effectiveness of digital adoption efforts (Schein, 2010). Institutions that cultivate an adaptive and flexible culture are better positioned to implement digital solutions successfully and achieve long-term sustainable outcomes (McDermot & Stock, 1999).

Gómez-Trujillo and Gonzalez-Perez argue that digital transformation, facilitated by advancements in information technology, leads to organizational changes that align with sustainability goals (Gómez-Trujillo & Gonzalez-Perez, 2021). This is echoed by Oliveira, who notes that while digital transformation enhances sustainable consumption and production practices within organizations, it may also introduce disruptive effects (Oliveira, 2024). Furthermore, Zhang and Jin highlight those enterprises leveraging digital transformation can achieve competitive advantages that foster sustainable development (Zhang & Jin, 2023). The synergy between digital technologies and sustainable practices is further emphasized by Zhao et al., who discuss how digital transformation reshapes business models to support sustainability initiatives (Zhao et al., 2021). Collectively, these studies affirm the positive relationship between digital transformation and sustainable development, suggesting that organizations embracing digital technologies are better positioned to achieve sustainability objectives. Consequently, this study postulates that:

H1. The relationship between digital transformation and sustainable development is positive and significant

The Role of Digital Organizational Culture in Sustainable Development

A strong digital culture not only supports the integration of digital technologies but also advances sustainable development by optimizing resource utilization, minimizing environmental impact, and fostering innovation in research and sustainability (Fisk, 2023; Martin et al., 2022). In the context of Nigerian higher education institutions (HEIs), cultivating a digitally adaptive organizational culture can influence the relationship between digital transformation and sustainable development,

enhancing the benefits of digital initiatives (Rai et al., 2021). Studies highlight that digital culture is a key factor in successfully implementing both digital transformation and sustainability strategies. Haffke et al. (2017) emphasize that reshaping organizational culture is essential to achieving digital transformation objectives. However, there remains a notable research gap concerning how digital organizational culture shapes the intersection of digital transformation and sustainable development in Nigerian HEIs (Duerr et al., 2018).

The role of organizational culture in sustainability is particularly significant. Suaidy (2023) underscores that a supportive culture within institutions can drive sustainability initiatives, shaping organizational behavior and environmental commitments. Similarly, research by Kiesnere and Baumgartner (2019) indicates that organizations with open and adaptable cultures are more effective in embedding sustainability into their operations. Bauer et al. (2020) further highlight how organizational culture influences sustainability governance and practices in higher education institutions. Collectively, these findings emphasize the critical role of fostering a sustainability-driven culture within organizations, pointing to the need for deeper exploration, especially in the Nigerian HEI context. Consequently, this study proposes that:

H2. The relationship between organizational culture and sustainable development is positive and significant

Organizational Culture as a Moderator

Organizational culture is a key determinant of the success of digital transformation efforts. A culture that embraces digital innovation, fosters collaboration, and encourages continuous development can significantly improve the effectiveness of such initiatives (Schein, 2010). Research suggests that institutions with adaptable and flexible cultures are more capable of successfully integrating digital technologies and achieving long-term sustainable outcomes (McDermott & Stock, 1999). The link between organizational culture and digital transformation is well-documented. For example, Zheng et al. (2010) found that organizational culture influences individual behaviors, directly affecting the adoption and success of digital technologies. Likewise, Wokurka et al. (2017) pointed out that misalignment between organizational culture and digital initiatives frequently leads to failure, emphasizing the need for a culture that actively supports digital transformation.

The role of organizational culture in moderating the relationship between digital transformation and sustainable development is an area of increasing academic interest. Research indicates that organizational culture significantly shapes how digital transformation is perceived and implemented, ultimately influencing sustainability outcomes. Bican and Brem (2020) argue that digital-driven organizational change must be accompanied by cultural shifts that align with sustainability principles. Similarly, He and Su (2022) highlight that both regulatory pressures and an organization's cultural orientation are key factors in determining the success of digital transformation in fostering green innovation. This suggests that a strong and sustainability-focused organizational culture can enhance the positive effects of digital transformation, ensuring that technological advancements contribute meaningfully to sustainable development. By cultivating an environment that prioritizes innovation, cooperation, and sustainability, organizations can maximize the benefits of digital transformation and drive impactful sustainability outcomes. Accordingly, this study proposes that:

H3. Organizational culture moderates the relationship between digital transformation and sustainable development such that the relationship is stronger when the organizational culture is high.

Theoretical Framework

The dynamic capability theory serves as a fundamental framework for explaining the beneficial effects of digital transformation (Kokshagina, 2021; Papadopoulos et al., 2022). Dynamic capability refers to an organization's ability to recognize market shifts,

capitalize on emerging opportunities, and adjust both internal and external resources to sustain competitiveness (Teece et al., 1997). Digital transformation strengthens this capability by utilizing digital platforms and network services to gather insights on employee behavior and market trends, thereby enhancing an organization's ability to identify and respond to new opportunities (Nylén & Holmström, 2015). Additionally, it supports agility by refining processes and optimizing resources, facilitating efficient resource reallocation (Warner & Wäger, 2019). While digital transformation alone does not inherently lead to higher returns, integrating it with strategies that enhance dynamic capabilities can generate substantial growth and added value (Mikalef et al., 2018). This highlights the intrinsic link between digital transformation and an organization's dynamic capabilities (Coreynen et al., 2020; Gupta et al., 2020; Soluk & Kammerlander, 2021; Torres et al., 2018).

In emerging economies such as Nigeria, digital transformation holds significant promise for fostering sustainable development within higher education institutions (HEIs). However, the effectiveness of these initiatives largely depends on the prevailing organizational culture. Establishing a supportive digital culture is essential for ensuring the seamless adoption and integration of digital technologies, ultimately enhancing sustainability outcomes. Given the importance of this aspect, further research is needed to examine the critical role of digital culture in Nigerian HEIs and its influence on the success of digital transformation efforts.

Methodology

Participants and procedures

This study adopted a convenience sampling approach to collect data from faculty members, students, and administrative staff across multiple higher education institutions in Nigeria. Given the absence of a predefined sampling frame, G-Power software was employed to estimate the minimum required sample size, ensuring a statistical power level of 80%. The calculation indicated a minimum sample size of 123 (Ringle et al., 2020). Data collection was conducted over six months using Google Forms, yielding a total of 360 responses. After removing 12 incomplete submissions, an outlier analysis was performed utilizing the Mahalanobis distance method (Mahalanobis, 1948), resulting in 348 valid responses for further analysis. Importantly, the final sample size surpassed the recommended minimum of 160 for conducting Partial Least Squares Structural Equation Modeling (PLS-SEM) (Kock, 2018). Ethical approval for the study was secured through Nigeria's institutional review process, ensuring data confidentiality and adherence to privacy and ethical guidelines, with participant information used strictly for academic purposes.

Instruments

The study variables were derived from established theoretical frameworks and prior research. The survey instrument was structured into multiple sections, with the first section focusing on the primary constructs: digital transformation, measured using a validated 4-item scale with robust psychometric properties (Dumont et al., 2017); sustainability, assessed through a 5-item scale adapted from Rafiq et al. (2020); and organizational culture, evaluated using a 6-item scale adapted from Wang (2019). Participants rated their responses on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Analysis and Findings

The study utilized SPSS for data entry, coding, screening, and conducting descriptive analyses to ensure data accuracy and assess the reliability of the survey instrument using Cronbach's alpha. To examine the relationships between variables, Partial Least Squares Structural Equation Modeling (PLS-SEM) was conducted using SmartPLS version 4 (Becker et al., 2023). SmartPLS is widely applied in social sciences and management research due to its ability to analyze complex interactions between observed and latent constructs while overcoming the constraints of traditional statistical methods. The study adopted a variance-based PLS approach, which focuses on maximizing the explained variance of dependent variables (Hair et al., 2014), a methodology that has gained widespread acceptance across disciplines (Guenther et al., 2023). PLS-SEM was

chosen for its capacity to handle intricate models, small sample sizes, non-normal distributions, and formative constructs, making it suitable for diverse research contexts (Benitez et al., 2020). To address potential Common Method Bias, the study adhered to the recommendations of Kock & Lynn (2012) and Kock (2015), employing full collinearity assessments (Table 1). The findings confirmed that single-source bias was not a significant concern.

Table 1 Full collinearity

Variables	EMPC	ENVP	GHRM	ORGC
VIF	2.556	1.610	1.412	2.400

Measurement Model

When assessing reflective constructs, it is essential to evaluate the outer model to confirm validity and reliability (Hair Jr et al., 2022). This process includes analyzing indicator loadings, composite reliability (CR), and average variance extracted (AVE) to ensure convergent validity. Adopting the two-step approach proposed by Anderson and Gerbing (1988), this study first examined the measurement model to establish instrument validity and reliability (Ramayah et al., 2018) before proceeding with the structural model to test the proposed hypotheses. The measurement model assessment relied on key indicators such as loadings, AVE, and CR, adhering to established benchmarks: loadings of at least 0.708, AVE values above 0.5, and CR values exceeding 0.7. As presented in Table 3, all AVE values were greater than 0.5, CR values surpassed 0.7, and indicator loadings met the 0.708 criterion, confirming the model's robustness in terms of validity and reliability (see Table 2 and Figure 1).

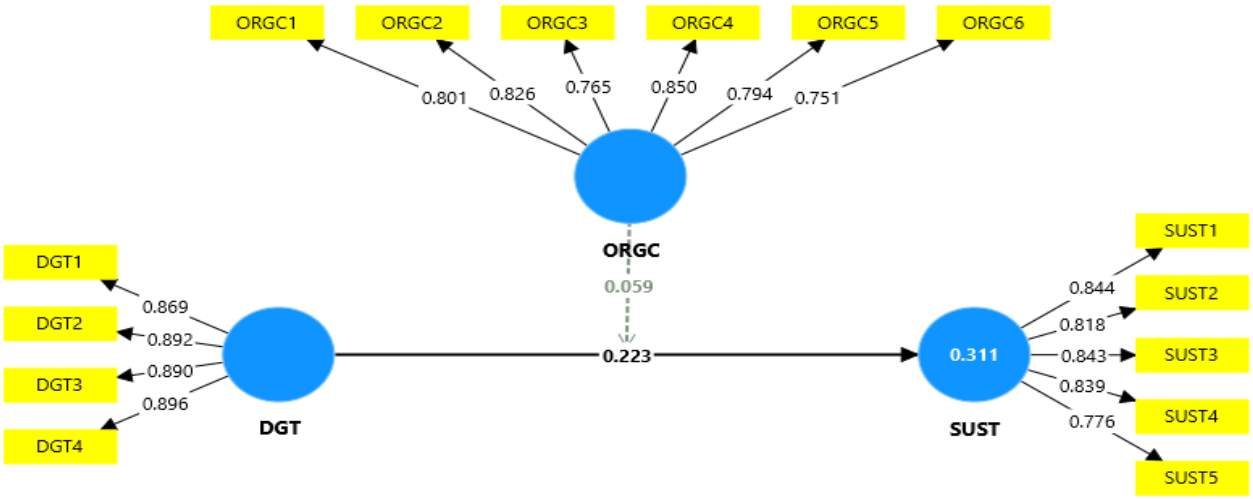

Figure 1 Measurement Model

Table 2. Convergent Validity

Variables	Items	Loadings	Cronbach's Alpha	CR-RhoA	CR-RhoC	AVE

Digital Transformation	DGT1	0.869	0.910	0.912	0.936	0.787
	DGT2	0.892				
	DGT3	0.890				
	DGT4	0.896				
	ORGC1	0.801	0.887	0.894	0.913	0.638
Organizational Culture	ORGC2	0.826				
	ORGC3	0.765				
	ORGC4	0.850				
	ORGC5	0.794				
	ORGC6	0.751				
Sustainable Development	SUST1	0.844	0.883	0.896	0.914	0.680
	SUST2	0.818				
	SUST3	0.843				
	SUST4	0.839				
	SUST5	0.776				

The study also employed the Heterotrait-Monotrait Ratio (HTMT) to evaluate discriminant validity, adhering to the recommended thresholds of ≤ 0.85 or ≤ 0.90. As indicated in Table 3, all HTMT ratios complied with the stricter threshold of ≤ 0.85 (Franke & Sarstedt, 2019; Henseler et al., 2015; Ringle et al., 2023). Thus, the analysis successfully met all required validity and reliability criteria.

Table 3. Discriminant Validity (HTMT)

Constructs	1	2	3
DGT			
ORGC	0.532		
SUST	0.470	0.557	

Structural Model

The structural model focuses on the critical linkages between the constructs in the hypothetical model, illustrating the relationships among various concepts (Hair et al., 2014). This approach provides valuable insights into how endogenous and exogenous latent variables interact within the proposed framework. To examine the relationships between the study variables, the inner model was utilized. Following Cain et al. (2017) and Hair et al. (2022), multivariate skewness and kurtosis were assessed. Mardia's (1970) test revealed significant multivariate skewness ($\beta = 6.445$, $p < 0.01$) and kurtosis ($\beta = 61.065$, $p < 0.01$), indicating non-adherence to a multivariate normal distribution. To address this, a bootstrapping procedure with 10,000 resamples was employed, providing path coefficients, standard errors, t-values, and p-values for the structural model analysis (Becker et al., 2023; Ramayah et al., 2018). Furthermore, to complement p-value evaluations and address concerns raised by Hahn and Ang (2017), the study incorporated additional criteria, including confidence intervals and effect sizes, to ensure a robust and comprehensive analysis.

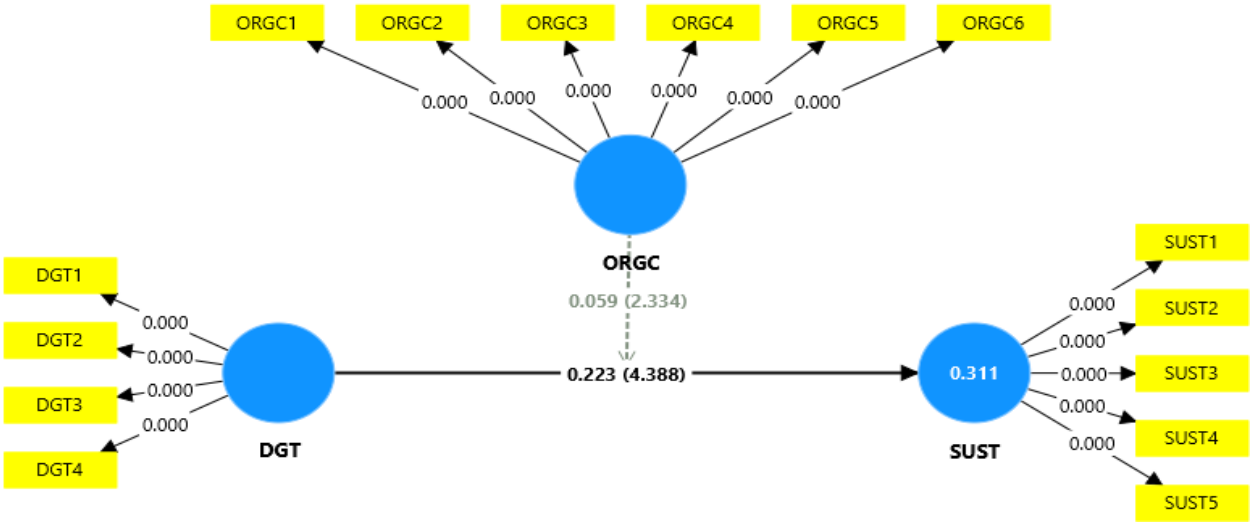

Figure 2 Structural model

This study investigated the direct impact of digital transformation and organizational culture on sustainability. The findings revealed that digital transformation significantly enhances sustainability, demonstrating that technological advancements contribute to sustainable outcomes, thereby confirming hypothesis 1. Similarly, organizational culture exhibited a strong positive relationship with sustainability, suggesting that a well-established organizational culture promotes sustainable development, thus supporting hypothesis 2. Moreover, the moderating role of organizational culture in the link between digital transformation and sustainability was both positive and significant, validating hypothesis 3.

Table 4. Hypotheses testing results

Hypotheses	Relationship	Std-Beta	Std-Error	t-values	p-values	LLCI	ULCI	f^2	Decision
H1	DGT -> SUST	0.223	0.051	4.388	0.000	0.141	0.309	0.054	Supported
H2	ORGC -> SUST	0.412	0.052	7.897	0.000	0.320	0.491	0.186	Supported
H3	ORGC x DGT -> SUST	0.059	0.025	2.334	0.010	0.017	0.099	0.010	Supported

Note: LLCI=Lower Limit confidence interval, ULCI =Upper limit confidence interval

PLS-Predict Evaluation

The model's predictive accuracy was assessed using PLS-Predict, a technique proposed by Shmueli et al. (2019) that evaluates predictive relevance at both the item and construct levels through a holdout sample. Utilizing 10-fold cross-validation, the analysis revealed that the PLS model's errors were generally higher than those of the linear model (LM), indicating moderate predictive accuracy (Table 5). This implies that while the model demonstrates a reasonable capacity for prediction, certain limitations remain.

Table 5 PLS-Predict (PLS-LM)

Items	Q^2predict	PLS-SEM_RMSE	LM_RMSE	PLS-LM
SUST1	0.298	0.907	0.907	0.000
SUST2	0.184	1.036	1.014	0.022
SUST3	0.192	1.034	1.059	-0.025
SUST4	0.170	1.059	1.058	0.001
SUST5	0.141	1.118	1.131	-0.013

Discussions and Implications

The examination of digital transformation and sustainable development in Nigerian higher education institutions provides valuable insights into the relationship between digital initiatives and organizational culture. The empirical results from hypothesis testing reveal that digital transformation has a significant positive impact on sustainability (Std-Beta = 0.223, $p < 0.001$) (Tungpantong et al., 2022). Additionally, organizational culture plays a crucial role in fostering sustainability (Std-Beta = 0.412, $p < 0.001$) (Adeoye, 2023). Notably, the interaction between digital transformation and organizational culture further enhances sustainability outcomes (Std-Beta = 0.059, $p = 0.010$) (Shenkoya & Kim, 2023). These findings highlight the necessity of cultivating a supportive organizational culture to maximize the benefits of digital transformation initiatives. The implications of these results are significant. Empirically, the findings reinforce the idea that digital transformation extends beyond technological adoption, requiring a cultural shift within institutions to ensure its success. This aligns with Adeoye's assertion that customized digital educational content can effectively address the distinct needs of Nigerian students, ultimately enhancing educational quality (Adeoye, 2023). Furthermore, the results support the connectivist perspective, which suggests that digitalization reshapes educational practices and promotes sustainability (Shenkoya & Kim, 2023).

Higher education institutions in Nigeria must prioritize fostering an organizational culture that embraces change and innovation to address barriers to digital transformation. Previous studies have underscored the challenges institutions encounter in adopting new technologies (Aditya et al., 2021). Cultivating a

culture centered on collaboration, respect, and adaptability can enhance institutions' ability to implement digital initiatives effectively, leading to improved educational outcomes and sustainability (Nwajiuba et al., 2020). From a policy perspective, these findings emphasize the importance of integrating organizational culture evaluations into the strategic planning of digital transformation efforts. Policymakers should acknowledge that successful digital transformation requires not only technological investments but also a strong commitment to nurturing a culture of continuous learning and adaptation (Irele, 2021). This is particularly critical in the post-COVID-19 era, where the transition to digital education has become essential (Alenezi et al., 2023). The interplay between digital transformation and organizational culture is crucial for fostering sustainable development in Nigerian higher education. Empirical findings highlight the need for an integrated approach that merges technological advancements with cultural adaptation. Future studies should explore these dynamics further, considering diverse institutional contexts and the specific challenges confronting Nigerian higher education institutions.

Conclusions, Limitations, and Scope for Future Research

This study examined the interplay between digital transformation (DGT), organizational culture (ORGC), and sustainable development (SUST) in Nigerian higher education institutions. The results confirmed significant relationships among these variables, with digital transformation positively influencing sustainable development (H1: $\beta = 0.223$, $p < 0.001$) and organizational culture exerting an even stronger effect (H2: $\beta = 0.412$, $p < 0.001$). Moreover, organizational culture moderated the DGT-SUST relationship (H3: $\beta = 0.059$, $p = 0.010$), reinforcing its critical role in enhancing sustainability outcomes. These findings align with prior research emphasizing the moderating influence of organizational culture on strategic initiatives. For instance, Lee and Kim (2017) demonstrated its role in strengthening the link between corporate social responsibility and firm performance, while Erkutlu (2011) highlighted its impact on the relationship between organizational justice and citizenship behaviors. This study underscores the necessity of cultivating a sustainability-oriented culture in Nigerian higher education institutions to maximize the benefits of digital transformation efforts.

Despite its contributions, this study has several limitations. First, its cross-sectional design restricts the ability to infer causality. Second, the exclusive focus on Nigerian higher education institutions limits the generalizability of findings to other contexts or industries. Third, while organizational culture was examined as a moderator, other contextual factors, such as leadership styles, resource availability, and government policies, were not considered. Future research should address these limitations by employing longitudinal designs to establish causal relationships, expanding the scope to diverse sectors and regions, and exploring additional moderating or mediating variables. Examining factors like leadership behaviors, institutional policies, and resource endowments could provide deeper insights into the interplay between digital transformation, organizational culture, and sustainability. Additionally, comparative studies across different cultural and national contexts could offer a broader perspective on how variations in organizational culture influence digital transformation outcomes.

Notwithstanding these promising findings, this study has several limitations. First, its focus on Nigerian higher education institutions limits the generalizability of the results to other sectors or regions. Second, the reliance on self-reported data introduces the possibility of response bias, which may affect the validity of the findings. Future research should consider longitudinal designs to assess the long-term effects of digital transformation and organizational culture on sustainability. Additionally, incorporating

objective performance indicators and exploring diverse institutional settings could provide a more comprehensive understanding of these relationships. Additionally, comparative studies across various countries or regions could offer broader insights into the interplay between these constructs. Future research should also delve into specific dimensions of organizational culture that most effectively facilitate digital transformation. For example, exploring the influence of leadership styles, employee engagement, and communication practices could provide actionable insights. Moreover, investigating the role of external stakeholders, such as government policies and industry partnerships, in shaping the organizational culture of higher education institutions could yield a more holistic understanding of the ecosystem driving sustainable development. In conclusion, the interconnection between digital transformation, organizational culture, and sustainable development within Nigerian higher education institutions represents a complex but fruitful avenue for further study. The findings highlight the critical importance of cultivating a supportive organizational culture to maximize the effectiveness of digital transformation efforts in achieving sustainability goals.

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