Strategic Management and Digital Transformation in Higher Education Institutions for Sustainable Growth and Competitive Advantage in Modern Academic Environment

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ABSTRACT

While digital transformation in higher education is frequently referred to as a technology-acquisition programme, the success of digital change relies on the strategic direction, institutional support, human capability and readiness to change. This paper examines the link between these enablers and academic and administrative digital transformation and implications for sustainable growth and competitive advantage. The authors have chosen a cross sectional survey study of students, academic staff and administrative staff of Algerian Higher Education Institutions (HEIs). A simple random sampling method was used for a structured questionnaire and 320 valid responses were obtained. The following 5 composites on 6 variables were analysed: Strategic management support, Digital infrastructure, Digital skills, Change readiness, Academic digital transformation and Administrative digital transformation. Descriptive statistics, Pearson correlations, ordinary least-squares regression with HC3 robust standard errors, and nonparametric bootstrap mediation (with 5,000 resamples) were all performed. The average (M) and standard deviation (SD) for each dimension were: Change readiness (M = 3.60, SD = 0.90); Strategic management support (M = 2.73, SD = 0.80); Digital infrastructure (M = 2.73, SD = 0.76). Overall digital

transformation (standardised beta = .585, p < .001; R-squared = .342) was positively related with strategic management support. The infrastructure and skills were found to account for 37.7% of the variance, with skills being a weaker predictor (beta = .119, p = .006) and infrastructure being a stronger predictor (beta = .565, p < .001). There was an indirect relationship between management-support and readiness, with change going through this mediator (indirect effect = .052, 95% bootstrap CI [.026, .081]). The results indicate that institutional support or infrastructure is not even and therefore the degree of transformation is limited less by the willingness of stakeholders to transform, than by the level of institutional support or infrastructure. Portfolios that align to leadership commitment, include resilient infrastructure, identify capability development, and have routines of adoption, are most likely to create a pathway for sustainable growth and competitive positioning. In this paper, these strategic outcomes which are not measured directly are taken to be implications of good evidence.

Keywords: strategic management, digital transformation, higher education institutions, digital readiness, change readiness, sustainable growth, competitive advantage

Introduction

HEIs are operating in a hybrid learning environment, data-informed policymaking, changing student expectations, new ways to compete for students, and access and cost reduction. Digital transformation has thus gone beyond the realm of the IT expert to become a topic of the entire institution. It will affect the programmes, teaching support, record keeping, allocation of resources, communication and learning experiences in universities. Differentiate between digitisation and transformation. While digitisation is the process of making information or a single process digital, digitisation of a process or decision right or capability or value proposition will impact and change in an interconnected way. The latter, therefore, needs organisational change not the installation of platforms just by themselves (Hanelt et al., 2021; Verhoef et al., 2021). This is the big picture, and it's featured in the higher education scholarship that was just awarded. Institutional transformation was the subject of a systematic review by researchers from Van Castro Benavides et al. (2020) which included strategy, people, process, technology and organisational structure. Rof et al. (2020) showed that traditional academic models with their new value propositions, resulting from digital initiatives, have the potential to clash, where coherence in governance and business model is the core issue. The digital agenda should also be well integrated into the institutional agenda and not be built from various projects in a university setting, Mohamed Hashim et al. (2022) also noted. Bygstad et al. (2022) showed that it is not just a change of infrastructure but a change of academic practice that comes with a transformation from parallel administration and education digitisation to an integrated digital learning space. The research reinforces a single takeaway message: Digital capability has little value if the head cannot blend together technology, academics, administration, and change to make it work.

The sustainability aspect is addressed on the top. Enrolments and buildings are only part of the equation for sustainability in a higher education institution. The potential of an institution to grow its academic power, increase the quality of

services, increase its operational resilience, increase its productivity and responsiveness over the long-term while not creating financially, socially and environmentally unsustainable pressures on the institution. Digital systems contribute to this goal in several ways: they enable the scaling of learning, they simplify transaction costs, they enable efficient use of facilities and information and they ensure continuity in case of disruptions. But these are the benefits that are contingent. In recent years, digitalism and sustainability in university management have come into full swing in research, as revealed by Abad-Segura et al. (2020), where research is fragmented in scope; and Trevisan et al. (2024) who found that research is largely disconnected in three strands: smart campus, sustainable competence, and digitally supported institutional practice. If you don't manage your digital growth, you will face consequences like adding redundant systems, continuous licence costs, cyber risk, workload and exclusion. The importance of competitive advantage in higher education is not the same as the commercial definition of competitive advantage - beating the competition. It can be implemented in terms of programme relevance, student experience, research links, administrative responsiveness, reputation, graduate outcomes, access, and in adapting to pace in comparison to other similar institutions. Academic offerings and services can be flexible and reliable with Digital Transformation. But, it is not a good thing, if all universities are having access to a platform. It all boils down to the ability to differentiate, to create that school that combines the leadership, the infrastructure, the competency of staff, the data, the pedagogical design and the change of routines. Both Alenezi (2021) and Akour and Alenezi (2022) identified this multi-dimensional character and it is related to governance, learning, human resources and organizational culture.

Nigeria is not the only country which should take access and implementation into account, rather adoption. This has been found to be true in India. Mishra et al. (2020) shared their experiences about the fast transformation of higher education institutions to online teaching and necessary institutional supports, redesigns, and modifications. The flexibility of online learning was favored by the Indian students with issues raised as connectivity with internet, interactions and practical learning (Muthuprasad et al., 2021). These were confirmed by Bordoloi et al. (2021) who showed that blended provision is preferred and by Kapasia et al. (2020) who showed that the learners' home-study conditions are poor and connectivity is poor in West Bengal. On the other hand, Khan et al (2021) suggested that the variables that affected the perceptions of e-learning were "learning environment", "usefulness" and "access". Considered as a whole, these research findings, however, suggest that there is a risk of assuming that technology is equal to transformation, particularly when it comes to equity.Overall, the studies tend to be about the lack of digital transformation and, of course, the lack of digital transformation in the realm of equity.

1.1 Problem statement

There is not yet any uniformity in user experience or connection between the Learning Management System, Enterprise Application, Electronic Library and Communication tools in most of the Higher Education Institutions. One contributor to this implementation gap is a focus on inputs as indicators of the "digital progress" of the institution – for example, the number of software bought, number of devices installed, number of courses available online, etc. There are two ways: One is to differentiate between strategic management and operational take-up. Digitalisation priorities, budget, standards, training and accountability are not clear, and senior leaders have agreed that digitalisation should take place. Staff and students might wish to change, and have the capacity and support to do so.

There is also a lot of variability in the empirical literature. The evidence base which arose in the context of adoption during disruption (Bond et al., 2021; Turnbull et al., 2021) can also be of benefit for emergency remote teaching but is

also distinct to transformative adoption. There are some strategy and sustainability reviews that do not always involve stakeholders as they are about general mechanisms. Readiness studies, however, evaluate the infrastructure, skills and management support and supportive attitudes rather than academic and administrative change. The question of what causes the difference in the digital outcomes of institutions and what difference this makes to preparedness to change downstream of strategic management support is practical.

The present study attempts to answer this question by gathering the primary survey data and analysing it in the field of higher education. It measures the strategic management support, informational infrastructure, digital competences and change readiness of academic and administrative digital transformation. The survey instrument does not include a measure of financial sustainability and other elements are considered relevant for strategic interpretation, such as: Sustainable growth and competitiveness. For this reason, the analyses are not intended to assess those outcomes. It recognises the developing ability/abilities that can be mobilised to deliver these outcomes and it also identifies the difference between a relationship representing a measurement and a relationship representing a managerial implication.

1.2 Research objectives

The study aims to have three objectives:

- To assess the level of strategic management, academic and administrative digital transformation, change readiness and digital infrastructure of higher education stakeholders.
- To establish a connection between strategic management support, digital infrastructure and digital skills with digital transformation overall and the positive connection.
- To analyse and understand how the change readiness as a mediating variable has shaped the relationship between strategic management support and overall digital transformation and to understand implications of the results for sustainable growth and competitive positioning.

2. Literature Review and Hypothesis Development

2.1 Strategic management and institutional digital transformation

The "how" and "why" of an institution's activities in setting priorities, committing limited resources, assigning responsibility and evaluating results is the result of strategic management. This is not a job that involves approving a budget for information technology in the digital transformation. Leaders will have to decide which academic and administrative issues they aim to address; how different systems will be linked up; what expertise they will develop within the school; and how risk and benefit will be managed. Mohamed Hashim et al. (2022) have identified alignment of leadership, culture, resources, skills and implementation as being related to digital strategy in higher education. The strategic and organizational structure was also identified in the literature (Castro Benavides et al., 2020), as the digital transformation is a socio-technical change. It's a strategic perspective and it is one explanation as to why individual digital projects don't work. The learning-management system may be functioning, and assessment policies, course design, faculty workload, and learner support and data standards may remain constant. Even an unconfirmed management system could start an ineffective process without eliminating duplication. Hanelt et al. (2021) defined the Digital Transformation as organization's restructure and its strategic reactions to perpetual change. Transformation was also associated with resources, organisational design, performance measures and value creation, in the same way, by Verhoef et al. (2021). University

management support can take the form of a clear priority, which facilitates policies, resources across units and monitored outputs (Benneth, et al., 2026).

This is the reason why the symbolic and operational support are not the same. Symbols are support in speech or strategy document, operational support is decision rights, funding, standards, training time, technical assistance and problem escalation. In addition to technology, Alenezi (2021) noted leadership and organizational aspects and Akour and Alenezi (2022) pointed to the need for infrastructure, governance, people and educational redesign for the future of higher education. If coordinated, these can complement and reinforce one another, leading to academic and administrative transformation. If they are not, innovations at the local level could only be pilots and at the central level not well adopted. Competitive position also matters because it also determines the extent to which digital investments result in unique institutional capability. Rof et al. (2020) found that the traditional and digitally enabled arrangements are in tension in business-model innovation in higher education. Academic quality, access, revenue, partnerships, and identity are all elements that need to be balanced in the institutions. A fast follower will be able to get the same technology, but they will not get trusted data, redesigned processes, people's expertise or learning culture in one shot. These complementary assets are the result of a strategic decision making process that has taken place over time. We would therefore expect that there would be a correlation between the level of support and the level of DT in terms of academic and administrative activities.

H1: Strategic management support is positively associated with overall digital transformation in higher education institutions.

2.2 Digital infrastructure, skills, and transformation capability

The backbone of digital transformation is infrastructure. This includes reliable connectivity, devices, platforms, identity and access management, integration, data availability, security, maintenance and user support. It isn't only about the presence of hardware, it's about its strategic value. The reliability and interoperability will help determine whether or not users will be able to complete academic and administrative tasks without having to redo manual workarounds. Bygstad et al. (2022) showed that the introduction of integrated digital learning spaces is an outcome of the transformation of technical arrangements and of education. Employees will not be able to standardise digitally enabled processes without a stable or integrated infrastructure and users will revert to the informal. This dependency is becoming evident during the COVID-19 disruption. Turnbull et al. (2021) did a review of institutional efforts in e-learning and found different technological, pedagogical and support responses from universities. Bond et al. (2021) followed up and described the experiences of emergency remote instruction in the higher education sector, reporting on its variability. These studies cannot be interpreted as evidence of the success of emergency continuity as a complete transformation. Instead, they show how infrastructure, supports and preparedness influence continuity in the event of a sudden surge in demand (Babu, et al., 2026).

Infrastructure is a specialty instructive from the Indian evidence. The impact of poor connectivity, and limited ability to learn at home, was felt by students in West Bengal, and remote and marginalised contexts more difficult for students, found Kapasia et al. (2020). Muthuprasad et al (2021) found that the Indian agricultural students were interested in features of flexibility but faced connectivity and interaction issues. Mishra et al. (2020) highlighted the need for a pedagogical shift and adaptation of institutional support for online teaching in lockdown. It demonstrates that a lack of adequate infrastructure has a cost attached, such as to a student or staff member, in terms of time, cost of data, stress and lost participation. Digital skills is the second competence. These are not just limited to simple

functioning of devices. Digital Pedagogy, Content Design, Feedback, Assessment, Accessibility, Academic Integrity are all abilities that should be held by faculty. Administrative personnel should have a solid understanding of workflow, data quality, and privacy and service redesign. Students should be information literate, know how to navigate platforms, communicate with information, be self-regulated and be responsible towards data use. Khan et al. (2021) and Bordoloi et al. (2021) reported that experience and e-learning/blended learning adoption conditions had an impact on users' perceptions of e-learning/blended learning in India. A system can also be in place and not be utilized when they cannot make the functionality into academic or administrative activities (Arshi, et al., 2021).

The infrastructure and skills should be considered together as one can constrain the other. The training will not help if there are repeated outages and strong platforms won't bring any value if users are not confident and don't have the expertise to accomplish the task. The capability of digital transformation is therefore complementary: the extra value of one type of resource is a function of the other resources. Zine et al. (2023) emphasized organizational and capability factors, rather than just a technological factor, for e-learning readiness through machine-learning techniques. A diagnostic approach can be complemented by the development and validation of a digital-maturity instrument for higher education, designed and validated by Valdivia-Salazar et al. (2025) and having multiple dimensions of stakeholders and institutions. From a strategic perspective, a strong direct link should be established between infrastructure and transformation, since all the digital services for academics and administrative staff depend on infrastructure. The Digital skills should have an explanatory value as it requires the human capability to use it. The second one is the hypothesis that proposes the expected relationship between the variables, the joint relationship.

H2: Digital infrastructure and digital skills are positive joint predictors of overall digital transformation in higher education institutions.

2.3 Change readiness as an organisational mechanism

Change readiness is the collective and personal attitude, confidence and perceived ability to embrace a proposed change. It doesn't have to be the same as being satisfied with one specific system. Stakeholders may agree that change is needed, but feel existing infrastructure or management is not satisfactory.Stakeholders may think that infrastructure or management system is weak, but there is a need to change. At the same time, users might have everything they need, but not have any desire to adopt two things that will take away their voice and choice, or make them more responsible, or have a clear academic value. The organisation then instigates readiness as a mechanism to connect leadership action and adoption. Management can positively impact readiness by effective communication, engagement, resources, training, local support, and taking action to overcome obstacles. Leaders who clearly communicate the need for a change, take time to spend learning about the change, involve users in design and resolve operational concerns during the implementation process have a greater chance of securing stakeholder belief that a change is desirable and possible. Hanelt et al. (2021) made a connection to it with organizational change for digital transformation, and Mohamed Hashim et al. (2022) emphasized culture and people for institutional strategy. There are two pathways, according to their arguments, if management support has a direct contribution to transformation via resources and governance, and an indirect contribution via readiness.Management support could directly influence transformation through resources, and indirectly, through readiness; hence, there are two ways.

Readiness also helps to connect with the transition from emergency adoption to transformation which extends beyond the

emergency. In a crisis, stakeholders may be compliance even though it is not a commitment for the long term. The extent and variability of this transition have been reported by Bond et al. (2021) and Turnbull et al. (2021). To be sustainable, a change in roles is required, standards of teaching and service need to be altered, good practices must be continued and poor practices and workarounds that don't work need to be removed. Change readiness should ease this move from temporary to institutional use. It is unlikely that the relationship is fully mediated, as attitudes are not the only factors that impact digital outcomes, with the support of management offering infrastructure, policies, staffing, and authority to influence outcomes. Strategic support should be directly linked to increased transformation and the association should be a smaller portion, but linked by increased readiness.

H3: Change readiness mediates the positive relationship between strategic management support and overall digital transformation in higher education institutions.

2.4 Sustainable growth and competitive advantage

Sustainability and competitive advantage provide the strategic purpose of the capabilities tested above. As observed by Abad-Segura et al. (2020), sustainable management and digital transformation are an emerging area of research convergence; and based on Trevisan et al. (2024), the key topics in research are digital enabled sustainability competencies, smart campuses and theoretical integration. These mindsets imply that the impact should not be assessed according to only one of the adoption rates, but through a portfolio of academic, operational, social and environmental outcomes. Digital enabling of academic reach may be a way to decrease the need to repeat the same activities physically in order to achieve sustainable growth, while learning quality and inclusion are safeguarded. By reducing cycle time, paper transactions, duplicated data entry and unnecessary travel, administrative integration can significantly reduce these costs. Analytics can be used to optimise scheduling and resource utilisation. However, technology consumes energy, produces e-waste, makes the users to rely on vendors and requires the periodic expenditure. Strategic management should therefore take into account the total cost, resilience, accessibility and impact on the lifecycle. Adding more users, excluding users, taking on too many employees, adding technical debt, would not be viewed as sustainable growth.

The advantage exists when these capabilities enhance outcomes which stakeholders value and which are also not easily replicable by similar institutions. Some of these are faster response for students' service, reliable academic programmes, flexible programmes, access to credible digital libraries, responsive academic advising, and programme improvement based on evidence. This study's survey data do not reflect actual performance, but rather readiness and perceived transformation. Analytical position, therefore, becomes conditional: When strategic support, infrastructure, skills and readiness are all working towards academic and administrative transformation, they can become a potential foundation for sustainable growth and differentiation. They could be real cost savings, reputation, retention or environmental benefits; it's up to direct longitudinal measurement.

3. Methodology

3.1 Research design and data source

The study employed the quantitative, cross sectional and explanatory survey design. Information was gathered by using a structured questionnaire, which was distributed to students, academics and administration staff at Algerian higher education institutions. The questionnaire was adapted from some already validated instruments from previous literature related to digital transformation in Higher Education (HE) (Hanelt et al., 2021; Mohamed Hashim et al., 2022; Zine et al., 2023). Seven dimensions of the

instrument were the digital infrastructure, digital skills, top-management support, readiness for change, e-learning, e-library and e-administration which were measured with 5 Likert scale items. The questionnaire was pre-tested with a small number of respondents to clarify and understand before the full administration. The content validity of the instrument was evaluated by three academics who are experts in higher education management and digital transformation. A final questionnaire was completed online and face-to-face, at various institutions, to get 350 full questionnaires (Wallis, et al, 2023).

A cross-sectional survey design was employed as it allows for data to be gathered from a large number of stakeholders from a number of institutions and also allows for perceptions to be captured at a single point in time. The design is of an observational nature. Note that regression coefficients are association parameters and not causal parameters. The scale of analysis is the individual respondent and the scale of context is higher education, specifically in Algeria. Implications can be used for similar institutions, but not assumed for generalisation beyond the sample respondents.

3.2 Population, sample, and sampling procedure

The accessible population comprised students, academic staff and administrative staff within the participating Algerian higher education institutions. A total of 350 responses were received with 320 responses including complete data meeting inclusion criteria. The sample size from the random sample is 320. The sample size of 185 is greater than the finite population minimum of approximately 185 observations for a frame of 350 observations, with a 95% confidence level, 5% margin of error, and assuming the maximum variance ($p = .50$). In addition, a good audit trail is maintained while retaining the 320 observations necessary for the two-predictor regression and mediation models. The respondents' IDs were chosen and documented on the analysis output to enable the recreation of the sample.

Three groups of stakeholders were included in the sample, namely: students, academic staff, and administrative staff. This was not weighted since the proportion of the participating institutions was not available. The sample thus represents a random sample, which is not necessarily representative of the national composition of Algerian higher education, but rather of the sample of responses gathered.

3.3 Variables and operationalization

Each construct was assessed using a composite score based on a premise of a 5-point Likert scale with higher scores representing greater agreement or readiness. The Administration Support scale measures top management support for digital initiatives, which was operationalised to serve as strategic management support. The three validated scales for digital infrastructure, digital skills and change readiness were used to measure the three components. Since both e-learning and e-library are related to the academic learning and knowledge-service domain, the academic transformation of digital was calculated as the mean value of both. In the context of this paper e-management/e-administration was a symbol of administrative digital transformation. The mean of the e-learning, e-library, and e-management was used as the overall digital transformation. The scores on the validated constructs were not used for differential weights because there is no theoretical basis for differential weights.

Overall digital transformation was the dependent variable for all hypotheses. The independent variable was used by H1 for strategic management support. H2 utilised digital infrastructure and digital skills as co-predictors. H3 set change readiness as the mediator and strategic management support as the predictor and overall digital transformation as the outcome. Sustainable growth and competitive advantage were not measured variables as they were not directly measured in

the survey instrument. They are only referred to in the interpretation.

This was done for descriptive frequency tables, and composite scores were assigned to five equal-width interpretation bands: very low/strongly disagree (1.00–1.80); low/disagree (1.81–2.60); moderate/neutral (2.61–3.40); high/agree (3.41–4.20); and very high/strongly agree (4.21–5.00). These categories are a summarization of the composite scores at the respondent level that were made from the answers to the questionnaire.

3.4 Data collection and data quality procedures

Data were gathered with a structured questionnaire for students and academic and administrative staffs in selected Algerian Higher Education Institutions. The data was collected with the ethical approval of the relevant institutional review boards. All participants gave informed consent and anonymous and confidential responses were assured. The questionnaire was sent out in person and via online channels to ensure maximum penetration within institutions. The types of the variables, number of rows, missing data and range of scores were confirmed at data entry. All seven variables for analysis were numeric and within the range of one to five. There were no missing values in the 350 responses collected or in the 320 records sampled of the variables analysed.

The questionnaire was designed to collect data on respondent-status, gender and age band. Status was noted as students, academic staff, and administrative staff; and gender was noted as male and female. To ensure the confidentiality of respondents, the survey instrument was presented in five age categories instead of actual ages. Therefore, the analysis reports Age-band codes 1 - 5. This is a way of retaining anonymity at the cost of less substantive interpretation of age.

3.5 Data analysis

Python with the libraries pandas, NumPy, and SciPy were used for analysis. Demographics and five-band composite distributions were described in terms of frequencies and percentages. The six focal constructs were compared using means, standard deviations, medians, ranges, ranks, and 95% confidence intervals. Bivariate relationships were explored using Pearson correlations.

A single-predictor ordinary least-squares regression was used to test H1. Multiple regression with simultaneous entry of the variables digital infrastructure and digital skills was used in H2. Effect magnitudes were compared by standardising the coefficients. Residual skewness and excess kurtosis were examined, variance inflation factors were used to check for multicollinearity, and the Breusch–Pagan test was used to check for heteroskedasticity. The Breusch–Pagan test for H2 model was significant, so the coefficient inference is reported using HC3 heteroskedasticity-consistent standard errors in all regression and mediation paths. Overall fit measures (model F and R-squared values) are retained. The simple mediation model was tested with H3. Path estimated the association between strategic management support and change readiness. In Path b, overall digital transformation was estimated to be associated with change readiness, after controlling for management support. The total effect (c), the direct effect (c-prime) and the indirect effect (ab) were determined. The indirect effect was tested with 5,000 nonparametric bootstrap resamples, using a fixed seed, with a 95% percentile confidence interval. The lack of zero in the 95% confidence interval of the difference between two groups was considered evidence of mediation. Two-tailed alpha was .05.

4. Data Analysis and Results

4.1 Demographic profile

Table 1: *Demographic Profile of Respondents (n = 320)*

Variable	Category	n	%
Respondent status	Students	200	62.5
	Academic staff	78	24.4
	Administrative staff	42	13.1
Gender	Male	170	53.1
	Female	150	46.9
Age-band code	Code 1	140	43.8
	Code 2	89	27.8
	Code 3	39	12.2
	Code 4	37	11.6
	Code 5	15	4.7

The sample consisted of 62.5% students, 24.4% academic staff and 13.1% administrative staff. The distribution provides a good learner perspective to the analysis and includes 120 of the relevant staff respondents who have experience in implementation and administrative processes. This was in contrast to gender representation which was relatively balanced with 53.1% male and 46.9% female respondents. 71.6% of observations were in the two lowest age-band codes. Due to the fact that the source provided no substantive label for these codes (such as "under 25" or "25–34"), the codes are not provided with such labels (Tahseen Arshi, et al., 2021).

4.2 Descriptive analysis of five-point scale variables

Table 2: *Strategic Management Support: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	36	11.2
Disagree / low	103	32.2
Neutral / moderate	113	35.3
Agree / high	64	20.0
Strongly agree / very high	4	1.2

Note. Bands: 1.00–1.80 = very low; 1.81–2.60 = low; 2.61–3.40 = moderate; 3.41–4.20 = high; 4.21–5.00 = very high. Frequencies summarise composite scores, not individual items.

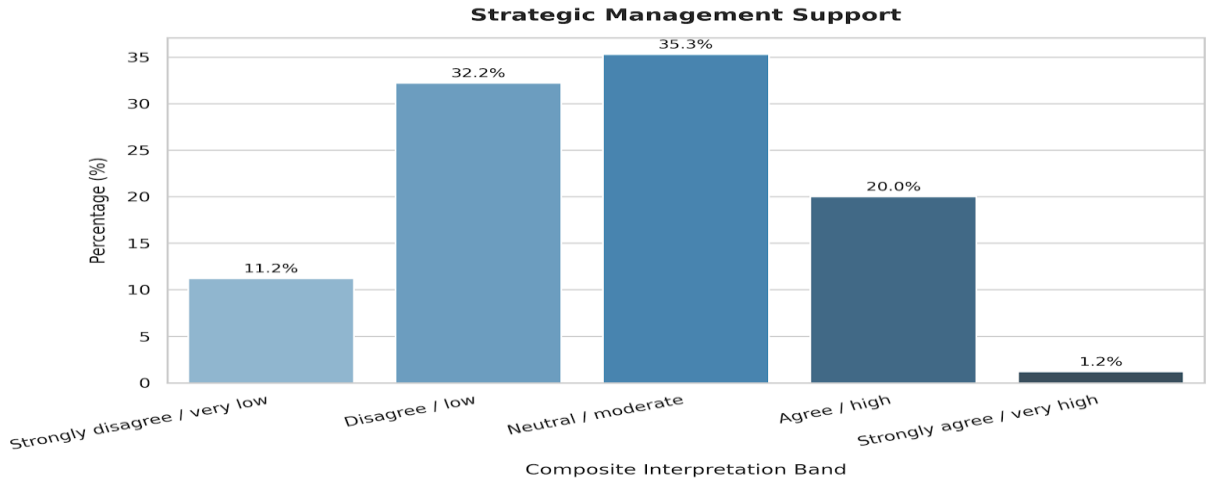

Figure 1: *Strategic Management Support: Composite Response Profile*

The focus of strategic management support is on the low end of the range as seen in Table 2 and Figure 1. Forty-three and four percent of the respondents were classified as low and very-low levels, while 35.3 percent were classified as moderate, and only 21.3 percent were classified as high and very-high levels. The mean of 2.73 is indicative that the perception of management support was slightly below the neutral middle point. The pattern indicates that there was not a uniform operationalization of strategic endorsement across respondents (Begum, et al., 2024).

Table 3: *Digital Infrastructure: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	33	10.3
Disagree / low	103	32.2
Neutral / moderate	131	40.9
Agree / high	46	14.4
Strongly agree / very high	7	2.2

Note. Bands: 1.00–1.80 = very low; 1.81–2.60 = low; 2.61–3.40 = moderate; 3.41–4.20 = high; 4.21–5.00 = very high. Frequencies summarise composite scores, not individual items.

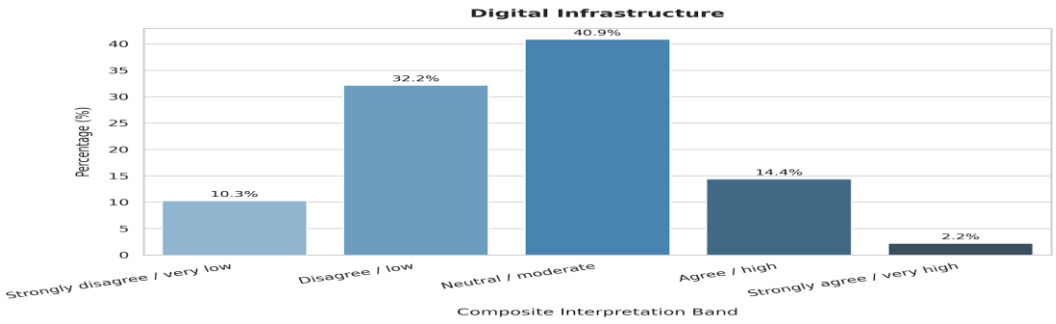

Figure 2: *Digital Infrastructure: Composite Response Profile*

The constraint for digital infrastructure is similar, as illustrated in Table 3 and Figure 2. There were 42.5% low and very-low, while 16.6% were in high and very-high bands. Moderate was the largest group (40.9%). The result does not refer to failure of all infrastructure; it refers to reliability or adequacy which are not equal; there were relatively few who reported a very strong foundation (Ortencia, et al., 2025).

Table 4: *Digital Skills: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	12	3.8
Disagree / low	81	25.3
Neutral / moderate	124	38.8
Agree / high	100	31.2
Strongly agree / very high	3	0.9

Note. Bands: 1.00–1.80 = very low; 1.81–2.60 = low; 2.61–3.40 = moderate; 3.41–4.20 = high; 4.21–5.00 = very high. Frequencies summarise composite scores, not individual items.

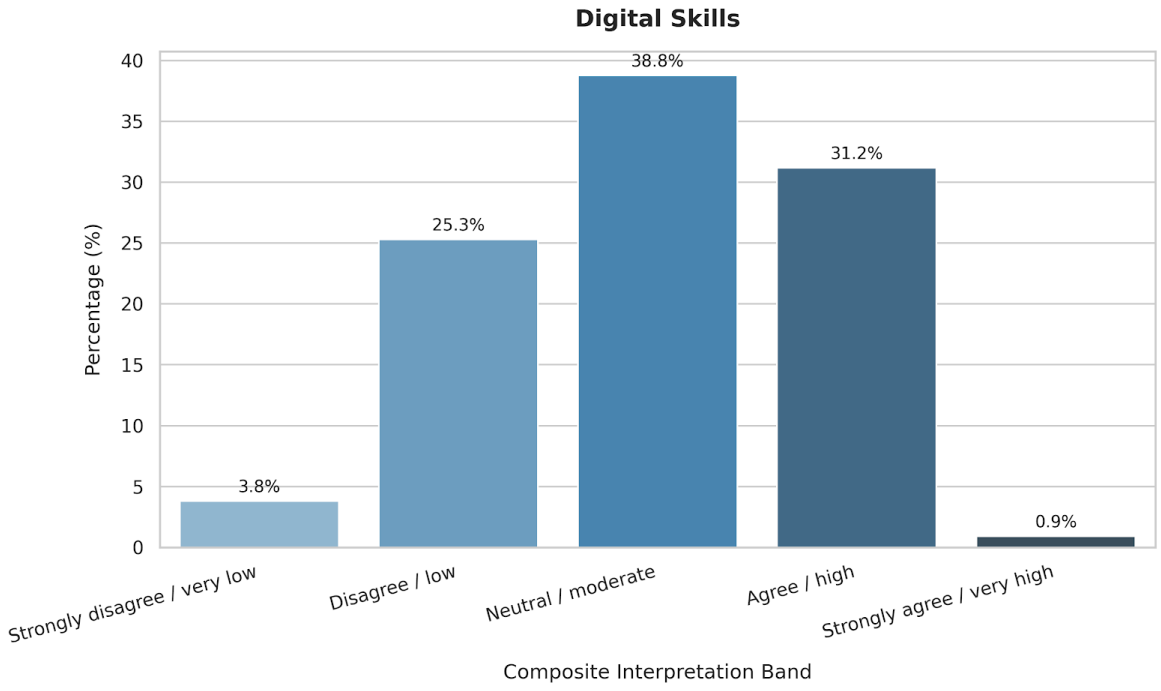

Figure 3: *Digital Skills: Composite Response Profile*

As Table 4 and Figure 3 demonstrate, digital skills were more positive than infrastructure and management support. There were 32.2% in the high and very-high bands, 38.8% in the moderate band, and 29.1% in the low and very-low bands. The mean of 3.05 is near neutral. Stakeholder capability was therefore found to exist but not widely enough to be considered a developed institutional ability.

Table 5: *Change Readiness: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	14	4.4
Disagree / low	34	10.6
Neutral / moderate	67	20.9
Agree / high	124	38.8
Strongly agree / very high	81	25.3

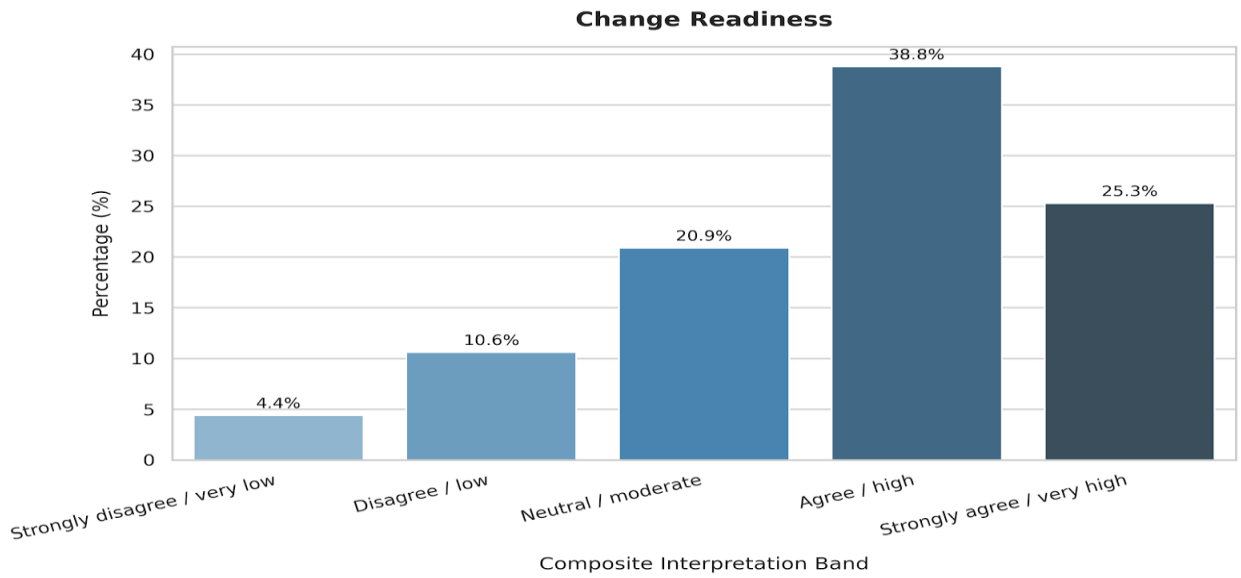

Figure 4: *Change Readiness: Composite Response Profile*

Table 5 and Figure 4 identify change readiness as the strongest construct. Almost two-thirds of respondents (64.1%) were in the high or very-high bands, and only 15.0% were low or very low. The only construct which was clearly outside the neutral range was the mean of 3.60. The difference between readiness and enabling conditions is key: respondents were more inclined to change than they were certain of the surrounding conditions and management support.

Table 6: *Academic Digital Transformation: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	26	8.1
Disagree / low	87	27.2
Neutral / moderate	126	39.4
Agree / high	74	23.1
Strongly agree / very high	7	2.2

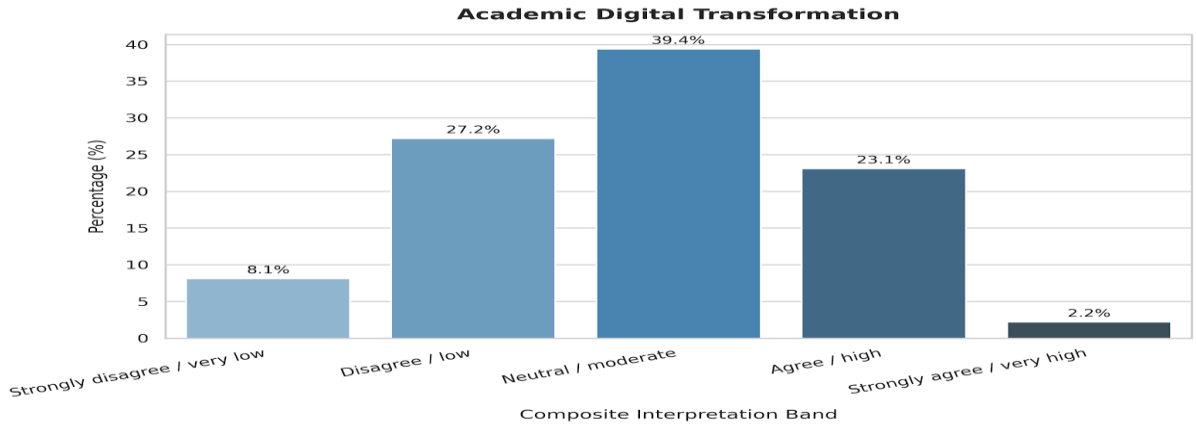

Figure 5: *Academic Digital Transformation: Composite Response Profile*

The academic digital transformation was primarily moderate, as indicated in Table 6 and Figure 5. The high and very-high evaluations accounted for 25.3% of the total, and the low and very-low evaluations accounted for 35.3% of the total. The mean of 2.95 was very close to the middle of the scale. Academic transformation thus had moved beyond a generally low performance to a not yet high implementation for e-learning and e-library services.

Table 7: *Administrative Digital Transformation: Composite-Score Distribution*

Composite interpretation band	n	%
Strongly disagree / very low	24	7.5
Disagree / low	81	25.3
Neutral / moderate	93	29.1
Agree / high	108	33.8
Strongly agree / very high	14	4.4

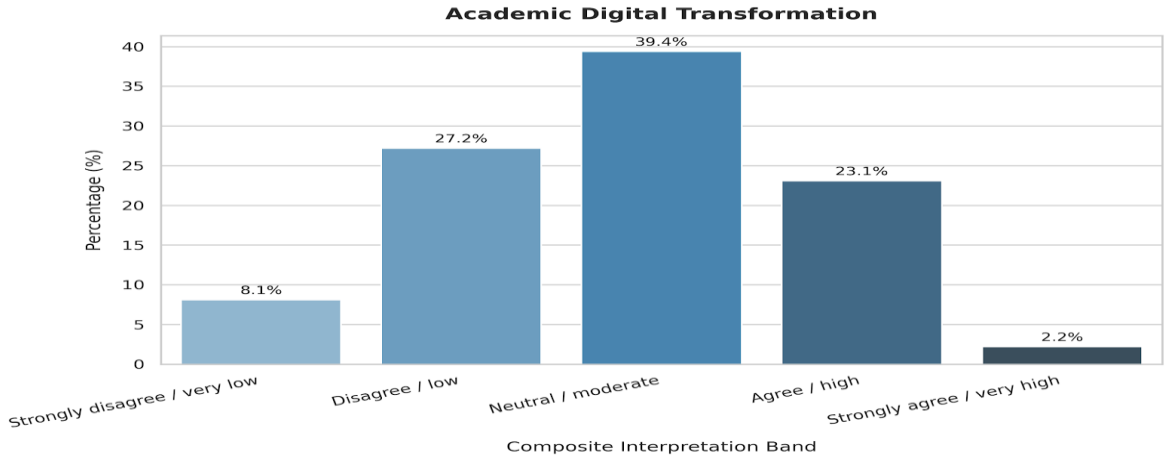

Figure 6: *Administrative Digital Transformation: Composite Response Profile*

Administrative digital transformation was a little more advanced as revealed in Tables 7 & 6. There were 38.1% of children with high and very-high scores, while 32.8% of children had low and very-low scores. The mean of 3.07 was higher than the academic transformation mean. It appears that e-administration or e-management processes were not quite so difficult to standardise as performing pedagogical and library processes.

Table 8: *Overall Comparison of Study Constructs*

Construct	M	SD	Median	95% CI for M	Rank
Change readiness	3.60	0.90	3.86	[3.50, 3.70]	1
Administrative digital transformation	3.07	0.82	3.00	[2.98, 3.16]	2
Digital skills	3.05	0.66	3.00	[2.98, 3.12]	3
Academic digital transformation	2.95	0.78	3.00	[2.86, 3.03]	4
Digital infrastructure	2.73	0.76	2.75	[2.65, 2.81]	5
Strategic management support	2.73	0.80	2.80	[2.64, 2.81]	6
Overall digital transformation	2.99	0.73	—	—	—

The whole comparison provides a clear sequence. The top of the list was change readiness (M = 3.60), administrative transformation (M = 3.07), digital skills (M = 3.05), academic transformation (M = 2.95), infrastructure (M = 2.73), and strategic management support (M = 2.73). The overall mean of digital transformation was 2.99 (SD = 0.73) for e-learning, e-library, and e-management. The overlap between the two weak enabling conditions (strategic support and infrastructure) were very similar, with the confidence intervals for both conditions being very close to each other.

Table 9: *Pearson Correlations Among Study Constructs*

Variable	SMS	DI	DS	CR	ADT	MDT	ODT
SMS	—	.801	.416	.298	.579	.473	.585
DI	.801	—	.323	.249	.619	.446	.603
DS	.416	.323	—	.442	.261	.313	.301
CR	.298	.249	.442	—	.338	.294	.348
ADT	.579	.619	.261	.338	—	.690	.963
MDT	.473	.446	.313	.294	.690	—	.859
ODT	.585	.603	.301	.348	.963	.859	—

Note. SMS = strategic management support; DI = digital infrastructure; DS = digital skills; CR = change readiness; ADT = academic digital transformation; MDT = administrative digital transformation; ODT = overall digital transformation. All reported non-diagonal correlations are positive and significant at $p < .001$.

The correlations between all foci were all positive. The strongest correlation with overall digital transformation was with infrastructure (r = .603) and management support (r = .585), with change readiness (r = .348) and digital skills (r = .301) coming next. There was a strong correlation between management support and the infrastructure (r = .801), suggesting that those who felt more positively about management support also tended to feel more positively about infrastructure. The bivariate relationship did not pose a problem in the H2 model, as the availability of management support was not included with infrastructure in that regression. Infrastructure and digital skills showed an only moderate correlation, r = .323 and their variance inflation factors were 1.12.

4.3 Hypothesis testing

Table 10: *Hypothesis 1: Strategic Management Support Predicting Overall Digital Transformation*

Predictor	B	HC3 SE	β	t	p	95% CI for β	Decision
Strategic management support	0.537	0.045	0.585	12.03	< .001	[0.489, 0.680]	H1 supported

Note. n = 320. R^2 = 0.342; adjusted R^2 = 0.340; F(1, 318) = 165.12, p < .001. Coefficient inference uses HC3 robust standard errors.

H1 saw an association that was positive in overall digital transformation and strategic management support. The regression coefficient was positive and statistically significant (B = .537, HC3 SE = .045, beta = .585, t = 12.03, p < .001). Overall, the variance in digital transformation was accounted for by strategic management support alone (34.2%, F(1, 318) = 165.12, p < .001). The 95% confidence interval for the standardised coefficient was [.489, .680] which did not contain zero. H1 was supported.

Table 11: *Hypothesis 2: Infrastructure and Skills Predicting Overall Digital Transformation*

Predictor	B	HC3 SE	β	t	p	95% CI for β	Result
Digital infrastructure	0.548	0.045	0.565	12.19	< .001	[0.474, 0.656]	Positive
Digital skills	0.132	0.047	0.119	2.77	.006	[0.034, 0.203]	Positive

Note. n = 320. R^2 = 0.377; adjusted R^2 = 0.373; F(2, 317) = 95.82, p < .001. Both predictors were significant; H2 was supported. VIF = 1.12 for each predictor.

H2 predicted that infrastructure and skills would jointly predict transformation. The model was significant, F(2, 317) = 95.82, p < .001, and explained 37.7% of the variance. Digital infrastructure had a substantial positive coefficient (B = .548, HC3 SE = .045, beta = .565, p < .001). Digital skills added a smaller but significant positive coefficient (B = .132, HC3 SE = .047, beta = .119, p = .006). Both of the VIF statistics were 1.12 and the residual distribution was acceptable for inference at this sample size (skewness=.36; excess kurtosis = -0.56). The Breusch–Pagan statistic was 22.07 (p < .001), which justified that the HC3 produced robust standard errors. Both predictors were positive and significant, thus supporting H2.

Table 12: *Hypothesis 3: Mediation by Change Readiness*

Mediation path	Effect	HC3 SE	t	p	Bootstrap 95% CI
a: SMS → change readiness	0.337	0.063	5.35	< .001	—
b: readiness → ODT | SMS	0.155	0.034	4.51	< .001	—
c: total SMS → ODT	0.537	—	—	< .001	—
c': direct SMS → ODT	0.485	—	—	< .001	—
ab: indirect effect	0.052	—	—	—	[0.026, 0.081]

Note. SMS = strategic management support; ODT = overall digital transformation. Bootstrap resamples = 5,000. The indirect-effect interval excludes zero; approximately 9.7% of the total effect was mediated. H3 was supported as partial mediation.

H3 suggested that mediation can be achieved via change readiness. The findings suggested that readiness was positively predicted by management support (path a = .337, HC3 SE = .063, p < .001) and readiness was positively predicted by transformation when management support was controlled (path b = .155, HC3 SE = .034, p < .001). The total management-support effect was .537, while the direct effect was .485 (p < .001) when controlling for readiness. The indirect effect was .052 (95% bootstrap CI [.026, .081]). If zero was not included in the interval, then there was mediation. The indirect pathway was roughly 9.7% of the total pathway, with the direct pathway still being strong: the pattern is one of partial mediation. H3 was supported (Vij, et al., 2022).

5. Discussion

The primary finding is a significant readiness / capacity gap. The constructs with low ratings were strategic management support and digital infrastructure, while change readiness was high. This pattern contradicts a widely accepted managerial "explanation" that digital transformation slows down primarily because users are hesitant with change. For this sample the factors of willingness were relatively high, while the factors of institutional were relatively low. Academic transformation continued to be approximately halfway up and administrative transformation was slightly higher. The result aligns with the socio-technical viewpoint on transformation, which claims that it cannot be achieved with just the motivation of people, but must be planned in concert with strategy, structure, technology and people (Castro Benavides et al., 2020; Hanelt et al., 2021). This also aligns with the findings of the studies conducted in India that have reported that learning can be enriching via online or blended learning despite the limitations posed by connectivity, interaction and support (Bordoloi et al., 2021; Kapasia et al., 2020; Muthuprasad et al., 2021). One practical implication is that institutions should not start by campaigns encouraging the adoption of generic products. They need to start by figuring out when services fail to happen again, when they don't integrate, when they take too long to be supported, when they are inaccessible, and when they make digital work harder. While being ready is an asset, the same can be lost if systems are not reliable enough for a longer period of time. The H1 result confirms that strategic management support is a key institutional element in transformation. A one-standard deviation increase in management support was related to a .585 one-standard deviation increase in overall transformation, and accounted for over 1/3 of the variance in outcomes. The size of the association backs the argument that digital strategy has to be more than a technology

roadmap. It needs to link institutional priorities to funding, process ownership, academic governance, data standards, staff development and evaluation (Mohamed Hashim et al., 2022). Rof et al. (2020) highlighted the conflicts that arise when the processes of higher education business models and the possibilities for digital change unfold at different paces. Current evidence indicates that those tensions are resolved through management support which offers a coordinated direction. However, there is a strong positive relationship between management support and infrastructure, which also requires caution. Partly, the technical conditions experienced by the respondents judge leadership. Thus, communication alone is unlikely to lead to improved perceived support by leaders, and it requires credible support in the form of stable infrastructure, timely assistance, and decisions that eliminate operational friction.

H2 explains the relative importance of technical and human expertise. Infrastructure was more strongly associated, and skills contributed to the association to a lesser extent. This doesn't negate the importance of training. It implies that, in the range of variation observed, the limiting condition in the short term was infrastructure. When connectivity is not always reliable, access is not always available, the platform is not always integrated into the school, or there is no support for digital pedagogy, it is impossible to use digital pedagogy consistently by faculty. The fragmented systems cannot be redesigned by the administrative staff, and the students cannot receive equal benefits if the costs of access to the systems or device limitations are passed to the students. The outcome mirrors research on transitioning to the emergency context (Bond et al., 2021; Turnbull et al., 2021) where the platform interactions of access, support and pedagogy, combined with institutional response, has been documented. It is also consistent with the multi-dimensional readiness approach of Zine et al. (2023) and the maturity-assessment approach of Valdivia-Salazar et al. (2025). A sound sequence should then be formalised to set out minimum services reliability and interoperability, followed by the creation of role specific competencies around real workflows. Knowledge can be produced without sustained use if training is provided before systems, permissions, and/or incentives are in place. The mediation outcome brings a more specific organisational explanation. Ready for change was positively correlated with management support, and transformation was positively correlated with ready for change after controlling for management support. However, only 9.7% of the entire relationship was conveyed in readiness. The direct management support association was dominant. This makes good sense in theory, as leadership influences transformation by means of budget, governance, staffing, architecture and policy as well as stakeholder attitudes. This outcome will deter over-dependence on culture programmes, which are not linked to structural change. Systems and clear roles are essential, but participation and communication can help reinforce readiness.While participation and communication can reinforce readiness, functional systems and clear responsibilities are essential. On the other hand, infrastructure investments that don't include readiness work can result in underutilization. Thus, a balanced portfolio should contain both structural enablers and adoption mechanisms with progress tracked in terms of delivered academic and administrative services.

The results have particular implications for sustainable growth. The first opportunity is to shift from project-based to governed and reusable digital capability. Shared identity, integration, data standards, accessible design and reliable support can be used by a number of programmes and services and help to avoid duplication and technical debt. Second, full lifecycle cost and inclusion are to be taken into account in making growth decisions. Hybrid and/or online provision can be sustainable only if course quality, student support, staff workload, cyber security and access are funded over time. Trevisan et al. (2024) highlighted the relationship between digital transformation, smart-campus practices and sustainability

competence, and Abad-Segura et al. (2020) demonstrated that both are becoming increasingly related. The present evidence indicates that management support and infrastructure are the least supportive enabling conditions; that is, institutions need to improve governance and foundations in place before seeking to build a long list of visible innovations. A smaller number of priority services at a reliable institutional scale are more likely to lead to sustainable growth, than a large number of pilots competing for resources. Competitive advantage is also to be interpreted as an organizational ability and not a feature of technology. A coherent system of reliable services, skilled users, responsive governance, and improvement routines is path dependent and widely available platforms can be copied. Academic transformation can be what sets apart an institution by making flexible programmes, learning resources easily accessible and maintaining a consistent digital pedagogy. Administrative transformation can set it apart in terms of quicker admissions, registration, advising, records, and support. Bygstad et al. (2022) illustrated that the notion of the integrated digital learning space is not just about parallel digitisation and Petchamé et al. (2023) proved the importance of the format of the smart-classroom for the user's qualitative experience. This sample shows a slight lead for administrative transformation over academic transformation, which implies that operational aspects of the change may be standardised first, while the pedagogical and disciplinary aspects of change may occur later. Instead, institutions need to consider competitive value based on standards of completion, satisfaction, service time, reach, and quality—and not on platform numbers.

The findings are also relevant for India and other systems where there is significant institutional and regional differences. The source sample is Algerian—do not copy and paste the coefficients. The capability pattern, however, is applicable to the constraints reported in the Indian higher education. Mishra et al, (2020), Muthuprasad et al, (2021), Bordoloi et al, (2021), Kapasia et al, (2020) and Khan et al, (2021) all demonstrate that flexibility and demand for digital learning go hand in hand with infrastructure, interaction and equity concerns. In these contexts, a single main technology mandate can yield very varied results across institutions. It is important that minimum service standards are established through strategic management, with differentiated support, and monitored by stakeholder group and location. Low bandwidth, accessible content and local language support, as well as mobile compatibility and offline continuity are not 'bells and whistles' but factors that shape the inclusiveness of digital growth and its sustainability. The results are limited by several factors. The cross sectional study does not allow for inferences of temporal or causal order. All variables are respondent-based composite measures, which can inflate associations due to common method effects and/or perception bias. The data cannot be used for multilevel analysis or for detailed comparisons of subgroups, because they do not specify exact age ranges or disciplines or institutions. There are 350 responses, of which 320 were sampled, thus these results meet the study design, although they may have smaller confidence intervals if the complete data set was analysed. Most importantly, direct measures of sustainable growth and competitive advantage were not taken. There is a need for more longitudinal, institution specific data to be gathered and linked to academic quality, retention, service time, cost, accessibility, environmental indicators, reputation, and enrolment outcomes in future studies. It should also measure whether management support leads to an increase in infrastructure and readiness in time and whether that comes before measurable gains in performance.

6. Conclusion

This study gives a factual overview of the institutional situation of digital transformation in higher education based on evidence. The relative strength of the change readiness dimension was generally high, whereas the weakest dimensions

were strategic management support and infrastructure. Overall academic and administrative transformation was explained by support from strategic management (34.2%). The two variables, infrastructure and skills together accounted for 37.7%, with the standardised coefficient for infrastructure being larger. Partially mediated the management relationship, which accounted for 9.7% of the total association, with readiness. The results partially confirm all three hypotheses, demonstrating that there is no dismissal of the necessity of structural capacity because of willingness to change. The conclusion is very straightforward and strategic. Higher education institutions need to plan digital transformation as a portfolio of institutional capabilities, over which they must exercise control. Leadership commitment should be demonstrated through prioritization, process ownership, architecture, resources, standards, training time, and reviewing outcomes. Investing in infrastructure should be geared to services that are reliable, interoperable, secure, and accessible. The development of capabilities should be based on a specific role, and should be integrated in the real academic and administrative work. Maintain readiness for change by participation, communication, local support and visible problem resolution. While these practices can build a valid sustainable growth and competitive advantage, it is a conditional relationship. A digital expansion is sustainable if it increases the reach, quality, resilience, inclusion and productivity of resources throughout the technology lifecycle. It generates competitive value when the institution transforms common technologies to become a system of trusted services and learning experiences. The present data are not direct measures of sustainability or competition outcomes, therefore, it is not claimed that they resulted from the readiness factors observed. It delineates the contextual conditions that should be reinforced within the institutions and the effects that future studies on these institutions should quantify.

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