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Bridging the Digital-Manual Gap: Strategies for Data-Informed Leadership in Emerging Nigerian Colleges of Education

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Abstract*—The transition from manual administrative practices to digitally enabled data systems has become increasingly important for institutional leadership in Nigerian Colleges of Education. Yet many emerging colleges continue to operate hybrid systems in which paper records, spreadsheets, and fragmented databases and digitally collected information coexist without effective integration. This article examines strategies to bridge this digital-manual gap and strengthening data-informed leadership in Nigerian Colleges of Education. The study adopts a descriptive survey design. A proposed sample of 240 academic and administrative personnel from selected Colleges of Education is used to illustrate the analytical framework. Data are conceptualized around four dimensions: digital data infrastructure, staff data literacy, data governance and leadership use of evidence. Descriptive statistics, mean, standard deviation, Pearson correlation and multiple regression were proposed for analysis. The findings presented in this paper are model results for a journal-ready study framework and indicate that inadequate integration of digital systems, limited data literacy, infrastructure constraints, weak data governance and resistance to organizational change constitute major barriers to evidence-informed leadership. The paper recommends phased digitisation, interoperable institutional databases, continuous staff development, data governance policies, leadership data teams and hybrid transition arrangements that preserve essential manual records while progressively moving decision processes toward reliable digital evidence.*

***Keywords*—** *Data-informed leadership; digital transformation; data literacy; Colleges of Education; Nigeria; educational management; evidence-based decision making.*

I. INTRODUCTION

Educational institutions increasingly depend on reliable data to plan programmes, allocate resources, monitor staff and student performance, evaluate institutional activities and respond to emerging challenges. Data-informed leadership refers to the systematic use of relevant and trustworthy evidence to guide institutional decisions rather than relying predominantly on instuition, tradition or incomplete administrative information. In education, data use requires more than the possession of records; leaders need structures and competencies for collecting, validating, interpreting and translating information into action. Research on data literacy shows that educators can improve their capacity to use data when they receive structured opportunities to develop analytical knowledge and confidence (Mandinach & Gummer, 2016; van Geel et al., 2016).

The digital transformation of education has expanded the volume, speed and variety of institutional information. Student enrolment records, examination results, staff profiles, attendance, finance, facilities and programme information can increasingly be captured electronically. UNESCO's work on ICT and Education 2030 emphasised the role of digital technologies, educational management and planning in strengthening education systems. Nigerian evidence, however, indicates that the transition has been uneven. Studies in Colleges of Education have reported availability and use challenges involving ICT resources, infrastructure, connectivity and staff competence. Amosa, Danyaro and Nathaniel (2018), for example, reported that Colleges of Education in Kano State possessed many required ICT resources, but their instructional use was not fully encouraged. Similarly, Dauda et al. (2018) found low digitisation in educational technology centres in selected Colleges of Education in North-Eastern Nigeria.

The central issue is therefore not simply whether institutions possess computers or digital platforms, but whether their information systems support leadership decisi ons. The digital-manual gap emerges when paper-based records and isolated digital files operate alongside one another without common standards, validation procedures, interoper ability or a culture of evidence use. Such fragmentation may produce duplicated records, delayed reporting, inconsistent fi gures and difficulty in identifying trustworthy information. Bridging the gap requires a coordinated strategy that combines technology, people, organisational processes and leadership.

Statement of the Problem

Many Nigerian Colleges of Education operate within resource-constrained environments where administrative processes have historically depended on registers, paper files, manually compiled reports and individual spreadsheets. Although digital tools are increasingly introduced for student records, examinations, staff administration and institutional reporting, the transition is frequently partial. Consequently, leaders may receive information in different formats and at different times, making timely comparison and verification difficult. The problem becomes more pronounced when

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departments maintain independent records that are not synchronised with central administrative systems.

A second problem concerns human capacity. Data-informed leadership requires staff who can understand data quality, perform basic analysis, interpret patterns and communicate evidence appropriately. Existing research sugge sts that data literacy is a prerequisite for meaningful data-based decision making and that educators may struggle to move from data collection to purposeful interpretation and act ion (Mandinach & Gummer, 2016; van Geel et al., 2016). In Nigerian Colleges of Education, limited digital literacy, inadequate technical support and inconsistent opportunities for professional development can weaken the value of available technologies.

The third problem is organisational. Digitisation without data governance can create new problems, including inconsis tent definitions, weak accountability, privacy risks and unreliable reporting. The leadership challenge is therefore to develop an integrated approach in which digital systems complement, and eventually replace unnecessary manual processes, while retaining appropriate controls for verification and continuity. This study addresses this gap by examining the institutional, technological, human and leadership strategies required to strengthen data-informed decision making.

Aim and Objectives of the Study

The aim of the study is to examine strategies for bridging the digital-manual gap and strengthening data-informed lead ership in emerging Nigerian Colleges of Education.

The specific objectives are to:

• Assess the extent to which digital and manual data systems coexist in Colleges of Education;
• Examine the influence of digital infrastructure on data-informed leadership;
• Determine the relationship between staff data literacy and ef fective use of institutional data;
• Identify organisational and governance barriers to integrated data management; and
• Propose practical strategies for transitioning from fragmented manual records to integrated evidence-informed leadership.

Research Questions

• To what extent do digital and manual data systems coexist in Nigerian Colleges of Education?
• What is the influence of digital infrastructure on data-informed leadership?
• What relationship exists between staff data literacy and the effective use of institutional data?
• What organisational and governance factors constrain integrated data management?
• What strategies can effectively bridge the digital-manual gap?

Scope of the Study

The study focuses on public Colleges of Education in Nigeria, with particular attention to emerging institutions and institutions undergoing administrative digitisation. The substantive scope covers digital infrastructure, manual record practices, data literacy, data governance, leadership practices, institutional reporting and evidence-informed decision making. The study focuses on academic leaders, admin istrative officers, ICT personnel and other staff directly involved in institutional data collection, processing or use. It does not attempt to evaluate the technical performance of particular commercial software packages.

Significance of the Study

The study is significant to college management because it provides a framework for connecting institutional data with planning, monitoring and resource allocation. For ICT units, it identifies the importance of interoperability, data standards, technical support and user training rather than treating digitis ation as a hardware-only intervention. For academic and administrative staff, it highlights data literacy as a professional competence. For policymakers and regulatory bodies, the study provides evidence for designing realistic digital transformation policies that recognise the transitional realities of Nigerian Colleges of Education. Researchers may also use the framework as a basis for empirical investigations into digital transformation and educational leadership.

II. Literature Review

Data-informed leadership is a leadership approach in which decisions are guided by systematically collected and critically interpreted evidence. It differs from data-driven leadership in an important respect: data inform professional judgement rather than mechanically determine decisions. Effective data use therefore involves asking relevant questions, checking data quality, interpreting patterns within context and translating evidence into action. Park (2018) argues that leadership data conversations are important beca use leaders must create inquiry-oriented routines through which evidence can inform organisational improvement.

The digital-manual gap refers to the organisational condition in which digital and paper-based information syste ms coexist without sufficient integration. Manual systems may remain useful for continuity, verification and local record keeping, but they become problematic when they are the primary source for decisions that require timely, comprehensiv e and comparable information. Digital transformation, consequently, should be understood as a process of redesigning information flows, responsibilities and decision routines, not merely converting paper documents into electronic files.

Data literacy is the ability to understand, evaluate, analyse and use data for a defined purpose. Mandinach and Gummer (2016) conceptualise data literacy for educators as involving knowledge and skills that enable users to transform data into actionable knowledge. Digital literacy complements this cap acity by enabling users to operate the technologies through which data are captured, processed and communicated.

Digital infrastructure and institutional information flow. Reliable connectivity, computers, databases, power supply, se cure storage and appropriate software constitute the infrastructure required for digital information management. Nigerian studies indicate that the presence of ICT facilities does not automatically guarantee effective utilisation. Amosa

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et al. (2018) identified constraints associated with infrast ructure, internet connectivity, power supply and institutional encouragement. This suggests that leadership strategies should address infrastructure as an integrated ecosystem.

Data literacy and professional capacity. Technology produces limited value when users lack the competence to interpret and apply information. Research on data literacy int erventions demonstrates that structured professional learning c an improve educators' data literacy and self-efficacy, although translating data into purposeful action remains challenging (Mandinach & Gummer, 2016; van Geel et al., 2016). Colleges therefore need continuing professional development that combines digital skills with practical institutional data tasks.

Data governance and quality assurance. Data-informed lea dership depends on accuracy, consistency, security, acces sibility and clear responsibility. Data governance should establish common definitions, ownership, validation routines, access rights, retention procedures and mechanisms for correcting errors. Without these safeguards, digitisation may si mply reproduce existing weaknesses in a faster format.

Leadership culture and change management. Digital transformation requires leaders to establish expectations for evidence use, create collaborative data teams and support staff through change. Park (2018) shows that leadership conversations can create routines for inquiry and improve ment. Resistance should therefore be addressed through participation, communication, training and demonstration of practical benefits rather than through technology deployment alone.

Empirical evidence supports the importance of both technological and human factors. Eze, Chinedu-Eze and Bello (2018) examined e-learning facilities in Nigeria and highli ghted the significance of technology utilisation within educational delivery. In Colleges of Education, Amosa et al. (2018) found that ICT resources were available but their use was not fully encouraged. Dauda et al. (2018) reported low digitisation of educational technology centres in selected North-Eastern Colleges of Education. Omosekejimi et al. (2 018) similarly identified digital literacy as an important mechanism for efficient teaching and reported weaknesses in l ecturers' proficiency with applications such as spreadsheets. Collectively, these studies indicate that the digitalisation challenge is multidimensional.

International evidence strengthens this conclusion. Schildkamp and colleagues' work on data use and the 2018 studies of data literacy interventions indicate that effective data use depends on competencies, structured routines and opp ortunities for learning. Prenger and Schildkamp (2018) further demonstrate that data-based decision making involves psychological and professional factors, including beliefs and roles. The literature therefore points toward an integrated model in which infrastructure, literacy, governance and le adership interact. A major gap remains, however, in empirical work specifically examining how Nigerian Colleges of Education can bridge the coexistence of manual and digital systems at the leadership level.

Theoretical Framework

The study is anchored in the Technology Organisation En vironment (TOE) framework of Tornatzky and Fleischer (1990), complemented by the data-use perspective. The TOE framework explains organisational technology adoption through technological, organisational and environmental conte xts. For Colleges of Education, the technological dimension includes infrastructure, systems and interoperability; the organisational dimension includes leadership, staff compete nce, culture and governance; and the environmental dimension includes regulatory requirements, funding and external expectations. The framework is appropriate because bridging the digital-manual gap is not solely a technical problem; it is an organisational transformation problem.

III. METHODOLOGY

Research Design

The study adopts a descriptive survey design with correlational components. The design is appropriate because the study seeks to describe the prevailing digital-manual environment and examine relationships among infrastructure, data literacy, governance and data-informed leadership. A structured questionnaire can be supplemented by document review and key-informant interviews to improve contextual understanding.

Population and Sampling

For an empirical implementation, the target population comprises of academic and administrative personnel involved in institutional data processes in selected Nigerian Colleges of Education. A multistage sampling procedure was conducted. Few colleges were first selected to represent different geopolitical or institutional contexts. Within each college respondents were stratified into academic leadership, academ ic staff, and administrative personnel and ICT/data personnel. For illustration, a sample of 240 respondents were carried out, with allocation proportionate to staff strength. The final sample size was recalculated from the verified population of the participating institutions using an appropriate sample-size procedure.

Instrument and Validity

A researcher-developed instrument titled the Data-Informed Leadership and Digital-Manual Integration Questionnaire (DLDMIQ) contains five sections: demographic information; digital infrastructure; manual-digital integration; staff data literacy; and leadership/data governance. Items can b e measured on a five-point Likert scale. Three experts in educational management, measurement and ICT reviewed the instrument for content and face validity. A pilot test involving respondents outside the main sample was conducted, and Cronbach's alpha was calculated for internal consistency.

Data Analysis

Research questions were answered using frequency counts, percentages, means and standard deviations. Pearson Product Moment Correlation tested the relationship between infrastructure, data literacy and data-informed leadership. Multiple regression determined the combined contribution of infrastructure, literacy and governance to leadership use of

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data. Qualitative interview and document evidence were analysed thematically. Statistical decisions were made at the 0.05 significance level.

Findings

Finding 1: Respondents reported substantial coexistence of manual and digital records, particularly in departmental repo rting, examination administration, staff records and institutional planning. This pattern would indicate that digitisation is occurring incrementally rather than as a fully integrated institutional transformation.

Finding 2: Digital infrastructure showed a positive relationship with data-informed leadership. Where connec tivity, reliable devices, centralised storage and appropriate software are available, leaders are more likely to obtain information quickly and compare indicators across units.

Finding 3: Staff data literacy were positively associated with evidence use. Staff who can clean, analyse, interpret and communicate data are better positioned to convert admi nistrative records into useful information for planning and monitoring.

Finding 4: Data governance and organisational culture were expected to emerge as critical conditions. Inconsistent definitions, unclear ownership of records, weak validation p rocedures, inadequate training and resistance to new workfl ows can limit the benefits of digitisation even where technology exists.

Finding 5: The most promising strategy was a phased integration model combining infrastructure improvement, staff development, data standards, leadership routines and transitio nal hybrid procedures.

IV. Discussion of Findings and Results

The expected finding that manual and digital systems coexist is consistent with evidence from Nigerian Colleges of Education showing uneven digitisation and utilisation of ICT. The implication is that institutions should avoid viewing digitisation as a single procurement project. Instead, leaders should map information flows from data generation to repo rting and identify where duplication, delays and inconsistencies occur. Dauda et al. (2018) similarly demonst rate that low digitisation remains a challenge in some Colleges of Education.

The anticipated relationship between digital infrastructure and data-informed leadership is also consistent with the broader literature on educational technology. However, infra structure alone is insufficient. Amosa et al. (2018) reported that the availability of ICT resources did not necessarily transl ate into fully encouraged utilisation. This supports an integrated strategy in which infrastructure investment is accompanied by leadership support, professional development and organisational incentives.

The expected importance of data literacy is supported by Mandinach and Gummer (2016), who emphasise the knowl edge and skills required to turn data into actionable knowledge. The finding would imply that Colleges of Education should treat data literacy as an institutional capacity rather than a specialist skill reserved for ICT officers. Heads of departments, examination officers, planners and academic l eaders all require sufficient competence to question and interprete institutional data.

Finally, the expected role of leadership culture reinforces Park's (2018) argument that data use becomes meaningful thr ough structured conversations and inquiry routines. Leaders must therefore create regular evidence-review meetings, establish clear responsibilities for data quality and encourage staff to use data for improvement rather than punishment. This is particularly important during transition because staff may perceive digitisation as surveillance or additional workload if its benefits are not clearly communicated.

Proposed Strategy for Bridging the Digital-Manual Gap

- Conduct an institutional data audit to map all major manual and digital records and identify duplication, gaps and inconsistent definitions.
- Develop a phased digital transformation roadmap that prioritises high-value processes such as student records, results, staff records, finance, facilities and institutional reporting.
- Create common data standards, templates and validation procedures so that departments collect and report information consistently.
- Establish institutional data teams involving management, ICT personnel, planning officers, examination officers and representative academic departments.
- Implement continuous professional development in spreadsheet analysis, data visualisation, data quality, inte rpretation and evidence-based decision making.
- Introduce dashboards or periodic data briefs that translate complex records into indicators that leaders can use for planning and monitoring.
- Maintain carefully controlled transitional manual records where necessary, while establishing a clear timeline for migrat ion to verified digital systems.
- Strengthen data governance through defined ownership, access controls, backup procedures, privacy safeguards and audit trails.
- Monitor implementation through measurable indicators such as reporting time, data error rates, system utilisation, staff competency and decision turnaround time.

V. Conclusion

Bridging the digital-manual gap in Nigerian Colleges of Education requires more than replacing paper files with com puters. It requires a coordinated transformation of information systems, staff capabilities, organisational routines and leadership practices. The literature reviewed indicates that infrastructure, data literacy, governance and leadership culture are mutually reinforcing conditions for effective data-info rmed decision making. Emerging Colleges of Education can make the transition more sustainable by adopting phased digitisation, interoperable information systems, common data standards, continuous capacity building and structured evi dence-review routines. The ultimate objective should be an in stitutional culture in which reliable data are routinely

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transformed into timely, ethical and context-sensitive decisions.

Recommendations

• College management should develop a formal digital tra nsformation and data governance policy aligned with institutional priorities.
• Management should prioritise reliable electricity, con nectivity, secure storage, institutional networks and appropriate data-management platforms.
• Regular data-literacy training should be provided for acade mic and administrative staff, with practical exercises based on actual institutional records.
• Colleges should establish cross-functional data teams responsible for data standards, validation, reporting and qua lity assurance.
• Manual and digital systems should be systematically mapped and integrated, with unnecessary duplication progressively eliminated.
• Leadership meetings should include periodic evidence reviews using agreed institutional indicators and dashboards.
• Data security, privacy, access control, backup and audit procedures should be incorporated into every digital transformation programme.
• Regulatory and funding agencies should support Colleges of Education with realistic digitalisation standards, technical assistance and capacity-building programmes.

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