

Original Research Article

INTELLIGENT INFORMATION SYSTEMS FOR EDUCATIONAL MANAGEMENT: A FRAMEWORK FOR DATA-DRIVEN DECISION-MAKING IN NIGERIAN COLLEGES OF EDUCATION

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Abstract: The increasing volume of digital information generated by Colleges of Education creates opportunities for evidence-based educational management, yet institutional data are often distributed across separate administrative systems and are not adequately transformed into actionable intelligence. This study developed an Intelligent Information Systems (IIS) framework for data-driven decision-making in Nigerian Colleges of Education. The study adopted a Design Science Research (DSR) approach, focusing on the identification of the educational-management problem, definition of system requirements, framework design, conceptual demonstration and evaluation. The proposed framework integrates institutional data sources, data integration and quality management, an institutional data repository, Business Intelligence and analytics, Artificial Intelligence and Machine Learning, decision-support mechanisms, management dashboards, and governance, security and human oversight. The framework demonstrates how data relating to students, academic programmes, examinations, personnel, institutional resources and other administrative functions can be transformed from operational records into information and intelligent insights for management decisions. The study argues that integrating heterogeneous institutional data with appropriate analytical and intelligent technologies can strengthen evidence-based planning, monitoring, resource allocation, academic administration and institutional performance management. The framework also emphasises that Artificial Intelligence should complement rather than replace professional judgement, with privacy, security, data quality, transparency and human oversight incorporated into institutional implementation. The study contributes a Computer Science-oriented framework for addressing educational-management information challenges in Nigerian Colleges of

Education and provides a conceptual foundation for subsequent prototype development and empirical evaluation.

Keywords: Artificial Intelligence, data-driven decision-making, educational management, Intelligent Information Systems, Nigerian Colleges of Education, Business Intelligence, data analytics, decision-support systems.

INTRODUCTION

a. Background to the Study

The increasing digitisation of educational institutions has changed the way educational information is generated, stored, processed and used for management. Colleges of Education now generate substantial volumes of information from admissions, student registration, academic records, examinations, staffing, finance, learning platforms, library services and institutional planning activities. Educational Management Information Systems (EMIS) were developed partly to make such information available for planning and decision-making; however, the usefulness of institutional data depends not only on its availability but also on its accuracy, integration, timeliness and capacity to generate actionable information (Salako, 2012). Recent studies similarly indicate that higher education institutions increasingly require integrated data and analytics capabilities to support decisions across academic and administrative functions.

The development of Business Intelligence (BI), learning analytics, artificial intelligence (AI) and machine learning has expanded the role of information systems from routine data storage and reporting towards intelligent decision support. Contemporary intelligent systems can combine information from different sources, identify patterns, generate predictions and present analytical outputs to decision-makers. Wang et al. (2024), for example, found that AI research in education increasingly encompasses intelligent management, profiling and prediction alongside teaching, assessment and personalised learning. Similarly, recent research on BI in higher education indicates that institutions require systematic approaches for integrating data from different systems to support decision-making at strategic and operational levels.

Data-driven decision-making is particularly relevant to educational management because administrators routinely make decisions involving students, personnel, academic programmes, institutional resources and quality assurance. Rather than depending exclusively on experience, intuition or isolated administrative reports, managers can use integrated institutional data to identify trends, monitor performance and support planning. Nwoko and Ogar (2025) observed that higher education institutions in Nigeria generate and use data for institutional planning, staff appraisal, policy formulation and other management purposes. Similarly, Ogunode et al. (2024) emphasised the importance of effective data management to planning and decision-making in Nigerian university administration.

The Nigerian higher education environment, however, presents particular challenges for the effective use of institutional information. Studies have identified problems associated with fragmented information management, inadequate infrastructure, limited technical capacity and weaknesses in the availability and use of current data for educational management (Kankia & Atiku, 2023; Ogundipe et al., 2023). Ogundipe et al. (2023), for instance, examined Management Information Systems in government-owned universities in Ogun State and highlighted the importance of information management to effective university administration. More recent Nigerian research has also connected AI and data analytics with administrative efficiency, institutional planning and evidence-based decision-making.

The development of AI in Africa provides an additional opportunity for strengthening educational information systems. Mhlanga (2023), writing from the South African context, noted that digital technologies and AI have implications for education in emerging economies, while recent South African research has examined the use of analytics to support student success and data-informed educational decisions (Janse van Vuuren, 2020; Mashile et al., 2023). These developments suggest that African educational institutions can move beyond conventional information storage towards analytics-supported management, provided that technological capacity, institutional context and responsible data governance are adequately considered.

At the global level, responsible use of AI and educational data has become an important consideration. UNESCO (2023) stresses human-centred approaches, privacy, inclusion, transparency and appropriate institutional safeguards in the use of generative AI in education and research. UNESCO's AI Competency Framework for Teachers further emphasises human agency, ethics and appropriate AI knowledge as essential components of AI-enabled education (Miao & Cukurova, 2024). These principles are relevant to educational management because an intelligent information system should not replace institutional managers; rather, it should provide reliable evidence and interpretable insights that enable managers to make informed decisions.

Recent scholarship also indicates that the value of educational analytics depends on more than sophisticated algorithms. Interoperable data, appropriate governance, organisational capacity, explainability and human oversight are necessary for analytical outputs to become useful institutional decisions. Purwanto et al. (2026) argue that higher education institutions need to move beyond dashboard-centred approaches towards integrated decision-intelligence processes linking data acquisition, integration, analytics, human validation, governance and feedback. This perspective is particularly useful for Colleges of Education, where information may exist across separate administrative units without necessarily being transformed into coordinated intelligence for management.

Consequently, an Intelligent Information System (IIS) for educational management can be conceptualised as an integrated socio-technical system that collects institutional data from multiple sources, processes and analyses the data, applies appropriate intelligent techniques and communicates relevant insights to authorised decision-makers. Such a

system could support areas such as student performance monitoring, enrolment planning, staff workload management, examination administration, resource allocation, quality assurance and institutional performance monitoring. The proposed framework, therefore, seeks to connect the technological capabilities of Computer Science with the practical requirements of educational administration and planning in Nigerian Colleges of Education.

b. Statement of the Problem

Despite the increasing generation of digital information within Nigerian Colleges of Education, institutional data is not always transformed into timely, integrated and actionable intelligence for educational management. Information relating to students, staff, academic programmes, examinations, finance and institutional resources may be maintained by different administrative units, making comprehensive analysis and coordinated decision-making difficult. Conventional information systems often emphasise data capture, storage and retrieval rather than predictive analytics, intelligent pattern recognition and decision support. Existing Nigerian studies have identified weaknesses in data management, information-system utilisation and evidence-based decision-making within tertiary education, while international literature increasingly demonstrates the potential of Business Intelligence, analytics and AI for institutional decision support (Ogunode et al., 2024; Nwoko & Ogar, 2025; Piedade et al., 2024). The specific problem addressed by this study is therefore the absence of an integrated framework that connects heterogeneous institutional data, intelligent analytics and managerial decision-support mechanisms to support data-driven educational management in Nigerian Colleges of Education.

c. Aim of the Study

The aim of the study is to develop an Intelligent Information Systems framework for supporting data-driven decision-making in Nigerian Colleges of Education.

d. Objectives of the Study

The study specifically seeks to:

1. examine the conceptual foundations of Intelligent Information Systems relevant to educational management;
2. Identify institutional data sources and management functions relevant to data-driven decision-making in Nigerian Colleges of Education;
3. examine the role of data analytics, Artificial Intelligence and decision-support technologies in educational management;
4. design an integrated Intelligent Information Systems framework for Nigerian Colleges of Education; and
5. demonstrate how the proposed framework can support institutional planning, monitoring and managerial decision-making.

e. Research Questions

The study is guided by the following questions:

1. What are the major components of Intelligent Information Systems relevant to educational management?
2. What institutional data sources and management functions are relevant to data-driven decision-making in Nigerian Colleges of Education?
3. How can data analytics, Artificial Intelligence and intelligent decision-support technologies enhance educational management?
4. What framework can integrate institutional data, intelligent analytics and decision-support mechanisms for Nigerian Colleges of Education?

f. Significance of the Study

The study is significant to **educational administrators** because the proposed framework can provide an organised approach for converting institutional data into information that supports planning, monitoring and managerial decisions. It can potentially assist administrators in examining student performance, staff workload, enrolment patterns, examination outcomes and institutional resources.

For **Colleges of Education**, the framework provides a conceptual basis for integrating information generated by different administrative units rather than treating each information system as an isolated source. Such integration can improve institutional visibility and facilitate more coordinated management.

For **educational planners and policymakers**, the framework demonstrates how institutional data and analytics can support evidence-based planning and monitoring. This is particularly relevant in an educational environment where reliable and current information is needed for resource allocation and institutional development.

For **Computer Science and information systems researchers**, the study contributes an educational-management application of databases, data integration, Business Intelligence, analytics, Artificial Intelligence and decision-support systems. For researchers in **Educational Management**, it provides a technology-oriented framework for examining how institutional information can be transformed into managerial intelligence.

g. Scope of the Study

The study focuses on the application of Intelligent Information Systems to educational management in **Nigerian Colleges of Education**. The proposed framework covers institutional data relating to students, academic programmes, examinations, personnel, institutional resources and administrative activities. Technologically, the framework encompasses data integration, institutional data repositories, Business Intelligence, data analytics, Artificial Intelligence, decision-support mechanisms and management dashboards.

CONCEPTUAL REVIEW

a. Intelligent Information Systems

An Intelligent Information System (IIS) can be understood as an information system that combines conventional information-processing capabilities with analytical and

intelligent techniques to transform organisational data into useful knowledge and decision support. Unlike conventional systems that primarily focus on data capture, storage, retrieval and reporting, intelligent systems can incorporate data analytics, machine learning, artificial intelligence and automated reasoning to identify patterns and generate insights. In higher education, this distinction is increasingly important because institutions generate data from numerous academic and administrative processes that can be used for planning and management (Stojanov & Daniel, 2024; Sequeira et al., 2024).

The intelligence of an information system should therefore not be interpreted simply as the presence of an AI algorithm. It involves the coordinated interaction of data, information infrastructure, analytical methods, organisational processes and human decision-makers. Recent research on university decision intelligence similarly argues that analytical sophistication alone does not guarantee decision value; interoperability, governance, explainability and human oversight are also required (Purwanto et al., 2026).

In the context of Nigerian Colleges of Education, an IIS can integrate information generated by admissions, registration, examinations, personnel, finance, library, learning management and other institutional systems. Analytical tools can then transform these data into trends, alerts, predictions and management reports. The system consequently serves not merely as a repository of institutional information but as a mechanism through which managers can obtain timely evidence for planning and operational decisions.

b. Educational Management Information Systems

Educational Management Information Systems (EMIS) are designed to collect, process, organise and disseminate educational information required for administration, planning and monitoring. Their importance arises from the fact that educational organisations depend on reliable information about learners, staff, programmes, facilities, finance and institutional performance. In Nigeria, research on tertiary institutions has demonstrated the relevance of Management Information Systems to record management and administrative decision-making (Ogundipe et al., 2023; Buhari et al., 2026).

However, conventional EMIS may remain largely transactional. They can answer questions such as *How many students are enrolled?* Or *what are the examination results?* But may not adequately answer higher-order questions such as *Which programmes are experiencing declining enrolment?*, *Which students show patterns associated with academic difficulty?*, or *How might staff and resource requirements change with projected enrolment?* Such questions require analytical and predictive capabilities.

Nwoko and Ogar (2024) argue that data in Nigerian higher education supports institutional planning, staff appraisal, policy formation, financial management and regulatory reporting. Their work reinforces the need to move from simply possessing institutional data towards systematically using it for management decisions.

Thus, the proposed IIS does not replace EMIS. Rather, it extends the traditional EMIS concept by adding data integration, analytical intelligence, predictive capabilities and decision-support mechanisms.

c. Data-Driven Decision-Making in Educational Management

Data-driven decision-making refers to the systematic use of relevant data and evidence to inform organisational decisions. In education, it involves collecting appropriate information, analysing it and using the resulting evidence to guide planning, monitoring, resource allocation and intervention. Nwoko and Ogar (2024) identify institutional planning, staff appraisal, policy formulation and financial management among the areas in which higher education data can support decision-making in Nigeria.

At the international level, Stojanov and Daniel's (2024) systematic review of 75 studies found that big data and analytics in higher education have been applied mainly to learning and teaching, with administrative decision-making receiving comparatively less attention. This finding suggests an opportunity to strengthen the administrative dimension of educational analytics.

Data-driven management can operate at three broad levels. Descriptive analytics explains what has happened through reports, indicators and dashboards. Diagnostic analytics examines patterns and relationships to help explain why particular outcomes occurred. Predictive analytics uses historical data and statistical or machine-learning models to estimate likely future outcomes. A mature IIS can combine these levels to support both routine management and strategic planning.

For Colleges of Education, examples include analysing enrolment trends, monitoring student performance, examining staff workload, identifying resource shortages and forecasting future institutional requirements. The objective is not to make decisions automatically but to provide managers with stronger evidence on which to base their decisions.

d. Business Intelligence and Data Analytics in Higher Education

Business Intelligence (BI) involves technologies and processes for transforming organisational data into information and insights that support decision-making. BI environments commonly incorporate data integration, data warehouses, analytical processing, dashboards and reporting tools. Within higher education, BI can provide managers with a consolidated view of institutional activities and performance.

Sequeira et al. (2024), in a systematic review of BI implementation in higher education institutions, found that BI has applications across several institutional processes but that the literature still contains gaps concerning comprehensive implementation roadmaps and reference architectures. They also emphasised the importance of integrating data from different systems to provide a comprehensive institutional view.

This observation is directly relevant to the proposed framework. Colleges of Education may have different information systems or databases operating within separate units. Without appropriate integration, management may receive fragmented information. An IIS can therefore employ an integration layer that extracts, cleans, standardises and consolidates data before analytical processing.

The distinction between BI and IIS is important. BI primarily transforms organisational data into analytical information, whereas an IIS can incorporate BI together with AI, machine learning, predictive models and intelligent decision-support mechanisms. The proposed framework, therefore, positions BI as one component within the broader intelligent information environment.

e. Artificial Intelligence and Machine Learning in Educational Management

Artificial Intelligence provides computational techniques capable of identifying patterns, classifying information, making predictions and supporting complex decision processes. Machine learning, as a subset of AI, enables systems to learn patterns from data and use those patterns for prediction or classification.

Research on AI in educational analytics demonstrates that machine-learning models can support prediction and decision-making across different educational processes (Maia et al., 2023). In higher education, predictive models have also been applied to educational event data to generate actionable recommendations for academic planning (Learning recommendations from educational event data in higher education, 2024).

Within educational management, AI could support several functions. Predictive models can analyse historical enrolment data to assist institutional planning; classification models can identify patterns in student performance; anomaly detection can highlight unusual records or institutional trends; and natural-language interfaces can make analytical information easier for authorised managers to query.

Nigerian scholarship is increasingly examining this relationship. Ogundipe et al. (2023) established the continuing relevance of information systems to university administration, while recent Nigerian studies have specifically discussed AI applications in university administration, including decision support, student information management, resource management and predictive analytics.

However, AI should operate within institutional governance rather than replace professional judgement. Issues of data quality, algorithmic bias, privacy, cybersecurity, explainability and human oversight must therefore be incorporated into the proposed IIS.

f. Learning Analytics and the African Context

Learning analytics involves the collection and analysis of educational data to understand and improve educational processes. Although learning analytics has developed substantially internationally, its adoption and research base in Africa remain comparatively limited. Prinsloo and Kaliisa (2022), in their scoping review of learning analytics on the African continent, observed that research and adoption have been predominantly concentrated in the Global North and argued for greater attention to African contexts.

This African context is important because technological frameworks developed elsewhere cannot simply be transferred without considering local infrastructure, institutional capacity, data governance, organisational culture and resource constraints. South African scholarship has also raised concerns about excessive datafication and the risk

of treating educational institutions simply as collections of measurable data points (Rationalising learning analytics in higher education, 2023).

The proposed framework, therefore, adopts a human-centred and context-sensitive orientation. Analytics should provide useful evidence while educational administrators retain responsibility for interpreting information and making institutional decisions.

g. Intelligent Decision-Support Systems

A Decision-Support System (DSS) is an information system designed to assist users in making decisions involving structured, semi-structured or complex problems. Traditional DSS typically combines databases, analytical models and user interfaces. Intelligent DSS extends this capability by incorporating AI, machine learning and other intelligent techniques.

In educational management, an intelligent DSS can transform raw institutional data into actionable outputs such as performance indicators, forecasts, alerts, recommendations and scenario analyses. For example, instead of merely displaying historical student results, the system could identify a pattern of declining performance and provide an alert for managerial review.

Recent research proposes moving beyond dashboard-centred approaches towards an end-to-end decision-intelligence pipeline connecting heterogeneous data, integration, analytical modelling, explainability, human validation, governance and feedback (Purwanto et al., 2026). This approach closely aligns with the present study because the intended framework is not merely a dashboard; it is a complete pathway from institutional data to informed managerial action.

Table 1: Conceptual Components of the Proposed Intelligent Information System

Component	Primary Function	Educational Management Relevance
Institutional data sources	Generate operational data	Student, staff, academic and administrative information
Data integration	Combine data from different sources	Creates a consolidated institutional view
Data repository	Store structured institutional data	Supports historical and comparative analysis
Business Intelligence	Generate reports and indicators	Supports monitoring and performance review
Data analytics	Identify trends and relationships	Supports evidence-based planning
AI/ML	Prediction, classification and pattern recognition	Supports forecasting and early-warning functions

Decision-support engine	Convert analysis into actionable insights	Assists managerial decision-making
Dashboard/interface	Present insights to authorised users	Enables timely monitoring
Governance/security	Control data access, quality and use	Protects institutional information

h. Conceptual Position of the Study

The reviewed literature indicates that educational institutions are moving from conventional information management towards more integrated and intelligent approaches. However, the major challenge is not simply acquiring more technology. The challenge is establishing a coherent relationship between institutional data, technological infrastructure, analytics, organisational processes and human decision-making.

The proposed study, therefore, conceptualises the Intelligent Information System as a **socio-technical decision-support framework** rather than an autonomous AI system. Its fundamental logic is:

Institutional Data → Data Integration → Data Repository → Analytics/AI → Intelligent Insights → Human Decision → Management Action → Feedback

This conceptual position provides the basis for the framework developed in the subsequent sections.

METHODOLOGY

Research Design

This study adopted the **Design Science Research (DSR)** approach. DSR is appropriate because the principal outcome of the study is a purposeful information-system artifact in the form of an **Intelligent Information Systems framework** for addressing a defined educational-management problem. Hevner et al. (2004) explain that design science focuses on the creation and evaluation of innovative artifacts that extend human and organisational capabilities. Similarly, Peffers et al. (2007) describe DSR as a systematic approach involving problem identification, definition of solution objectives, design and development, demonstration, evaluation and communication.

The choice of DSR is also consistent with the nature of the present problem. The study is not primarily intended to measure the attitudes of administrators or establish statistical relationships among variables. Rather, it seeks to translate findings from the literature and identify educational-management requirements into a structured technological framework. This makes the study a **design-oriented Computer Science and Educational Management study**.

b. Design Science Research Process

The study follows an adapted version of the Design Science Research Methodology (DSRM) proposed by Peffers et al. (2007). The process consists of six interconnected

activities: problem identification and motivation, definition of objectives, design and development, demonstration, evaluation and communication.

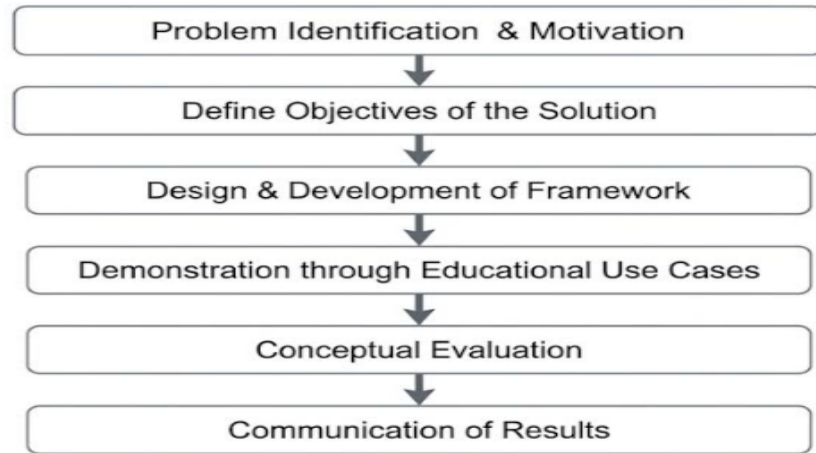


Figure 1: Design Science Research Process

For this study, the process is operationalised as follows:

1. **Problem identification:** Existing challenges associated with fragmented institutional information, limited data integration and insufficient analytical decision support in educational management were established from the literature.
2. **Definition of objectives:** Requirements for an IIS capable of integrating institutional data, analytics, AI and decision-support mechanisms were derived from the identified problem.
3. **Framework design:** The proposed architecture was developed around institutional data sources, data integration, data storage, analytics, AI/ML processing, decision support, dashboards and governance.
4. **Demonstration:** The framework is demonstrated through representative educational-management use cases, including student performance monitoring, enrolment planning, staff workload management, examination administration and resource planning.
5. **Conceptual evaluation:** The framework is examined against established DSR principles, functional requirements and relevant literature concerning higher education Business Intelligence and intelligent decision support.
6. **Communication:** The resulting framework and its educational-management implications are presented for researchers, educational administrators, planners and information-system professionals.

This approach is appropriate because DSR requires the research artifact to address a relevant problem, provide a clear contribution and be evaluated for its usefulness and quality (Hevner et al., 2004).

c. Framework Development Requirements

The framework development was guided by five major requirements. First, the system should support data integration, since educational information may originate from

multiple institutional units. Second, it should provide analytical capabilities for transforming raw data into meaningful information. Third, it should incorporate intelligent techniques capable of prediction, classification, pattern recognition and anomaly detection where appropriate. Fourth, the system should provide decision-support outputs that are understandable to educational managers. Finally, it should incorporate security, privacy, governance and human oversight.

The requirement for integration is consistent with recent higher-education Business Intelligence research, which identifies the need for systematic approaches to implementing BI systems that support decision-making across institutional domains (Sequeira et al., 2024). The requirement for responsible human oversight is also consistent with UNESCO's human-centred approach to AI, which emphasises privacy, transparency, human agency and institutional validation of AI applications in education (UNESCO, 2023).

d. Conceptual Evaluation of the Proposed Framework

The proposed framework will be evaluated conceptually rather than through a full institutional deployment. Four criteria will guide the evaluation:

- i. **Relevance:** whether the framework addresses recognised educational-management information problems;
- ii. **Completeness:** whether the major components required for data-driven decision-making are represented;
- iii. **Integration:** whether data sources, processing, analytics and managerial outputs are logically connected;
- iv. **Practicality:** whether the framework can reasonably be adapted to the operational realities of Nigerian Colleges of Education.

This approach maintains the distinction between a **framework-level contribution** and an implemented software product. A subsequent institutional implementation could provide empirical evaluation using real institutional data, but such an implementation is beyond the scope of this paper.

PROPOSED INTELLIGENT INFORMATION SYSTEMS FRAMEWORK

a. Framework Architecture

The proposed Intelligent Information Systems framework is organised into interconnected layers that transform institutional data into managerial intelligence. The architecture follows the principle that effective data-driven management requires more than data collection; it requires a continuous process through which data are integrated, analysed, interpreted and converted into evidence for managerial action.

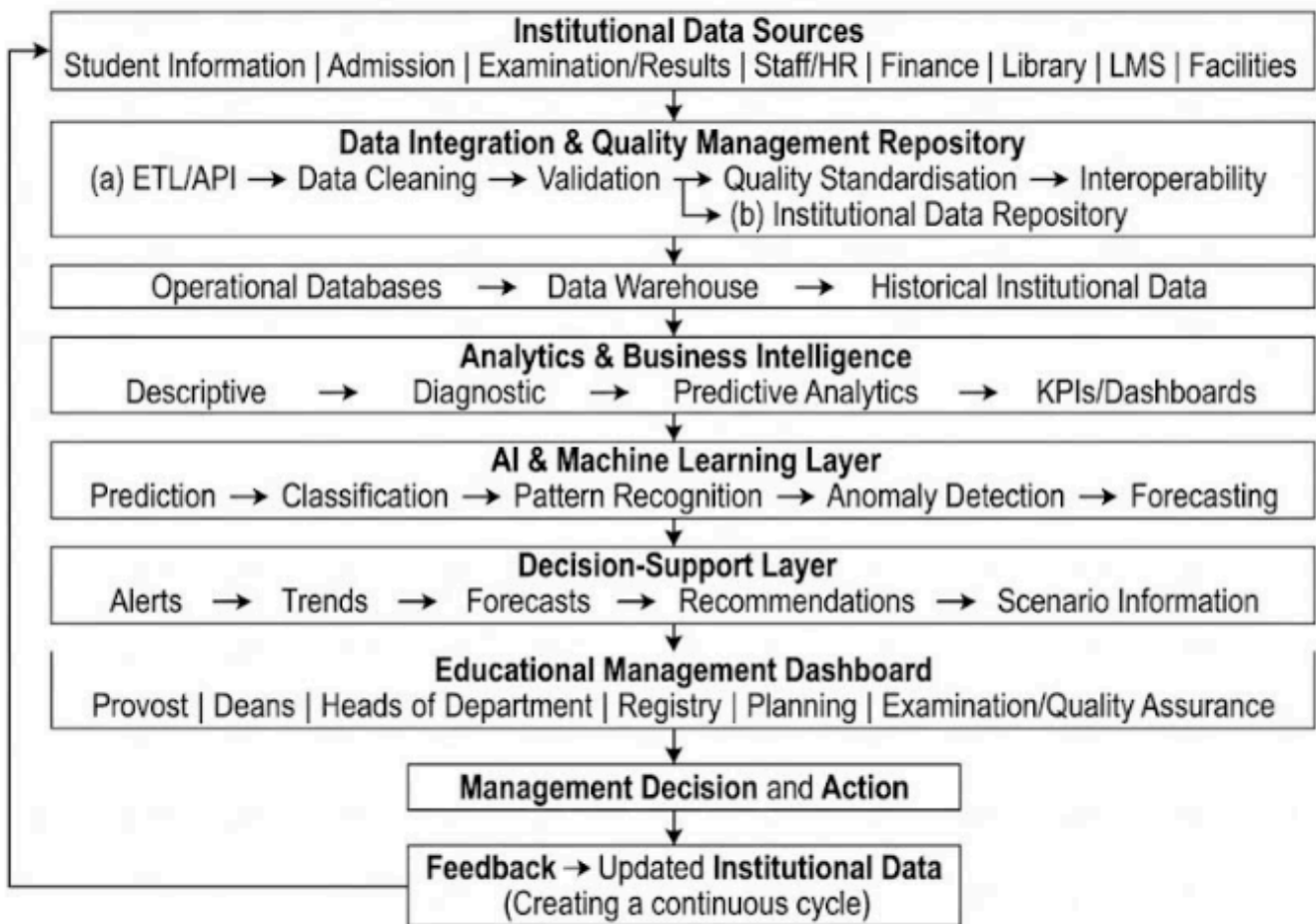
The framework consists of seven major layers:

- i. Institutional Data Sources
- ii. Data Integration and Quality Management
- iii. Institutional Data Repository
- iv. Analytics and Business Intelligence

- v. Artificial Intelligence and Machine Learning
- vi. Decision-Support and Management Dashboard
- vii. Governance, Security and Human Oversight

The architecture is intended to function as a continuous cycle rather than a one-way data pipeline. Management decisions generate actions whose outcomes can subsequently become new institutional data, thereby creating a feedback mechanism for continuous monitoring and improvement.

Figure 2: Proposed Intelligent Information Systems Framework for Data-Driven Educational Management



Source: Authors' conceptualisation, 2026.

The architecture extends the conventional EMIS by introducing an intelligence layer between institutional data and managerial decisions. This is consistent with recent research showing that higher education institutions require integrated BI environments to support decision-making across different organisational levels (Sequeira et al., 2024).

b. Institutional Data Sources

The first layer comprises the major sources of institutional information. These include student admission and registration records, academic records, examination results,

personnel information, financial information, library records, learning-management systems and institutional facilities.

The framework does not require all sources to be replaced by a single application. Instead, existing systems can remain operational while appropriate integration mechanisms provide authorised access to relevant data. This makes the framework adaptable to institutions with different levels of technological maturity.

c. Data Integration and Quality Management

The second layer addresses one of the major challenges of institutional information management: fragmented data. Application Programming Interfaces (APIs), Extract-Transform-Load (ETL) processes or other appropriate integration mechanisms can be used to transfer data from different sources.

Before analysis, data should undergo validation, cleaning, standardisation and quality checks. Poor-quality data can produce misleading analytical outputs regardless of the sophistication of the AI model. Consequently, **data quality is treated as a foundational requirement rather than a secondary technical issue.**

d. Institutional Data Repository

The integrated data can be stored within an institutional data warehouse or other appropriately governed repository. Historical data are particularly important because many analytical functions require longitudinal information.

For example, enrolment forecasting requires previous enrolment patterns, while student-performance analytics may require multiple semesters of academic records. The repository, therefore, provides the historical foundation for both descriptive and predictive analytics.

e. Analytics and Business Intelligence Layer

The analytics layer converts institutional data into meaningful information. **Descriptive analytics** can present current and historical institutional performance. **Diagnostic analytics** can help managers investigate patterns and relationships. **Predictive analytics** can estimate likely future conditions.

This layer can also provide Key Performance Indicators (KPIs), trend analyses and management reports. Sequeira et al. (2024) found that BI has an important role in higher education decision-making but that institutions still require clearer implementation approaches.

f. Artificial Intelligence and Machine Learning Layer

AI/ML provides the framework with advanced analytical capabilities. Depending on the institutional problem and availability of suitable data, supervised or unsupervised techniques may be applied.

Potential applications include:

1. enrolment forecasting;
2. student-performance prediction;
3. identification of unusual examination patterns;
4. workload analysis;
5. resource-demand forecasting;
6. student-support early-warning indicators; and
7. institutional performance pattern detection.

Importantly, the framework does not prescribe one algorithm for every management problem. The appropriate technique should depend on the nature, quality and volume of available data and the decision problem being addressed.

g. Decision-Support and Management Dashboard

The final technological stage transforms analytical outputs into information that educational managers can interpret. Rather than exposing administrators to raw datasets or complex machine-learning outputs, the system can present relevant indicators, alerts, trends, forecasts and recommendations through role-specific dashboards.

For example, a senior administrator may require institutional enrolment and resource indicators, while a Head of Department may require information on student performance, course workload and examination outcomes. Role-based access can therefore improve both usability and information security.

h. Governance, Security and Human Oversight

Governance and security cut across all layers of the framework. Educational institutions process information that may contain personal, academic and administrative records. Access should therefore be based on authorised roles, with appropriate authentication, audit trails, data protection and cybersecurity mechanisms.

Human oversight is equally important. UNESCO (2023) emphasises a human-centred approach to AI in education, including data privacy and protection of human agency. Therefore, the proposed system provides **decision support rather than autonomous institutional decision-making**. Final administrative decisions remain the responsibility of authorised educational managers.

APPLICATION OF THE FRAMEWORK TO EDUCATIONAL MANAGEMENT

The practical value of the proposed IIS becomes clearer when its components are connected to specific management functions in Colleges of Education.

Table 2: Application of the Proposed IIS to Educational Management

Management Function	Major Data Sources	Intelligent Processing	Potential Management Output
Student management	Registration, academic records	Performance analytics	Performance trends and alerts
Enrolment planning	Admission and historical enrolment	Forecasting	Projected enrolment
Examination management	CA, examination and result records	Pattern/anomaly analysis	Performance indicators
Staff management	Staff and course records	Workload analytics	Workload distribution information
Resource planning	Facilities and inventory	Trend/forecast analysis	Resource requirements
Quality assurance	Academic and administrative KPIs	Comparative analytics	Institutional performance indicators
Planning	Integrated institutional data	Predictive analytics	Planning scenarios and evidence

The framework can therefore support different administrative levels without requiring each management function to operate as a completely independent information system. The integration of institutional information provides a common evidence base for management.

For example, enrolment information can be combined with staff and course data to support workload planning. Similarly, examination information can be combined with student and programme data to identify performance patterns. Such cross-functional analysis is difficult when institutional information remains isolated within individual administrative units.

DISCUSSION

The proposed framework responds to the central problem identified in this study: the gap between institutional data availability and its transformation into actionable management intelligence. Conventional information systems remain important for capturing and storing information, but an intelligent information environment adds analytical and predictive capabilities.

The framework also reflects the growing importance of Business Intelligence in higher education. Sequeira et al. (2024) identified the need for structured approaches to BI implementation in higher education institutions, particularly for supporting decisions across institutional domains. The present framework extends this logic by incorporating AI/ML and an explicit human decision-support layer.

A further contribution is the framework's emphasis on integration. Educational management decisions frequently cross administrative boundaries. Enrolment affects staffing; staffing affects course delivery; course delivery affects student performance; and performance information contributes to quality assurance and institutional planning. An integrated IIS can therefore provide a more comprehensive institutional view than isolated administrative applications.

The framework also recognises that technological intelligence must operate within organisational and ethical boundaries. AI-generated predictions may contain errors or biases, while poor-quality institutional data can undermine analytical reliability. Consequently, governance, privacy, cybersecurity and human validation are incorporated into the architecture. This is consistent with UNESCO's human-centred approach to AI in education (UNESCO, 2023).

IMPLICATIONS FOR EDUCATIONAL MANAGEMENT AND SUPERVISION

The proposed framework has implications for educational administration, planning and supervision in Nigerian Colleges of Education. First, it provides administrators with a basis for moving from predominantly reactive management towards more evidence-informed planning. Second, integrated information can strengthen institutional monitoring by allowing managers to observe relevant performance indicators from different administrative areas.

For educational supervision, the framework can support systematic monitoring of academic performance, staff workload, examination outcomes and programme-level indicators. It can also facilitate early identification of areas requiring managerial attention.

For institutional planning, predictive analytics can provide evidence for enrolment projections, staffing requirements and resource allocation. However, such predictions should be interpreted within institutional and socioeconomic contexts rather than treated as automatic decisions.

From a Computer Science perspective, the framework demonstrates how databases, data integration, Business Intelligence, AI and decision-support systems can be combined to address a concrete educational-management problem. From an Educational Management perspective, it provides a technology-enabled model for strengthening evidence-based institutional administration.

CONCLUSION

This study developed a conceptual Intelligent Information Systems framework for supporting data-driven decision-making in Nigerian Colleges of Education. The framework integrates institutional data sources, data-quality processes, repositories, Business Intelligence, analytics, AI/ML, decision-support mechanisms and management dashboards within a governance and human-oversight structure.

The central proposition is that the value of institutional information does not reside merely in its collection and storage but in the ability to transform it into reliable and

actionable intelligence. By connecting previously separated information sources with appropriate analytical and decision-support mechanisms, Colleges of Education can establish a more integrated foundation for planning, monitoring and management.

The framework is therefore positioned as a design artifact that connects Computer Science capabilities with educational-management requirements. Its conceptual nature means that institutional implementation and empirical testing remain separate stages beyond the present framework-development study.

RECOMMENDATIONS

Based on the framework, the following recommendations are made:

1. Colleges of Education should progressively integrate their major institutional information systems to reduce fragmentation and improve access to reliable management information.
2. Institutional data-governance policies should be established to address data quality, access control, privacy, security and accountability.
3. Management should promote the use of analytics and Business Intelligence alongside conventional reporting systems to strengthen evidence-based planning.
4. AI applications should be introduced cautiously and with human oversight, particularly where predictions may influence student, staff or institutional decisions.
5. Capacity development should be provided for educational administrators and ICT personnel so that institutional users can appropriately interpret and apply analytical information.

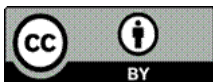
FUTURE RESEARCH

Future research can implement the proposed framework as a prototype in a Nigerian College of Education and evaluate its usability, interoperability, predictive performance and contribution to institutional decision-making using appropriately governed institutional datasets.

References

1. Buhari, M., Ogwu, J., Samaila, M., & Levi, D. H. (2026). Impact of management information system on the administration of tertiary institutions in Niger State, Nigeria. *Kwasu International Journal of Educational Management and Leadership*, 1(2), 38–50.
2. Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75–105.
3. Janse van Vuuren, E. C. (2020). Development of a contextualised data analytics framework in South African higher education: Evolvment of teacher (teaching) analytics as an indispensable component. *South African Journal of Higher Education*, 34(1), 137–157. <https://doi.org/10.20853/34-1-3661>
4. Kankia, H. A., & Atiku, U. (2023). Education management in Nigeria: Problems and solutions. *International Journal on Integrated Education*, 6(7). <https://doi.org/10.31149/ijie.v6i7.4602>
5. Maia, J. de S. Z., Bueno, A. P. A., & Sato, J. R. (2023). Applications of artificial intelligence models in educational analytics and decision making: A systematic review. *World*, 4(2), 288–313. <https://doi.org/10.3390/world4020019>

6. Mashile, E. O., Fynn, A., & Matoane, M. (2023). Curriculum analytics of an Open Distance Learning (ODL) programme: A data-driven perspective. *South African Journal of Higher Education*, 37(3), 161–182. <https://doi.org/10.20853/37-3-4835>
7. Mhlanga, D. (2023). Digital transformation education, opportunities, and challenges of the application of ChatGPT to emerging economies. *Education Research International*, 2023, Article 7605075. <https://doi.org/10.1155/2023/7605075>
8. Nwoko, C., & Ogar, [initials/details to be confirmed]. (2024). [Title/details require verification before inclusion in the final manuscript].
9. Ogundipe, M. A., Anise, K. K., Adelana, O. P., & Adeniji, A. M. (2023). Management information system and university administration: The case of government-owned universities in Ogun State, Nigeria. *Management Research Journal*, 12(1), 12–25. <https://doi.org/10.37134/mrj.vol12.1.2.2023>
10. Ogunode, N. J., Abiodun, O. J., & Idowu, O. M. (2024). Effective data management and university education administration in Nigeria. *Synergy: Cross-Disciplinary Journal of Digital Investigation*, 2(1).
11. Park, G., Liß, L., & van der Aalst, W. M. P. (2024). Learning recommendations from educational event data in higher education. *Journal of Intelligent Information Systems*. <https://doi.org/10.1007/s10844-024-00873-w>
12. Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), 45–77. <https://doi.org/10.2753/MIS0742-1222240302>
13. Prinsloo, P., & Kaliisa, R. (2022). Learning analytics on the African continent: An emerging research focus and practice. *Journal of Learning Analytics*, 9(2), 218–235. <https://doi.org/10.18608/jla.2022.7539>
14. Sequeira, R., Reis, A., Alves, P., & Branco, F. (2024). Roadmap for implementing Business Intelligence systems in higher education institutions: Systematic literature review. *Information*, 15(4), 208. <https://doi.org/10.3390/info15040208>
15. Stojanov, A., & Daniel, B. K. (2024). A decade of research into the application of big data and analytics in higher education: A systematic review of the literature. *Education and Information Technologies*, 29, 5807–5831. <https://doi.org/10.1007/s10639-023-12033-8>
16. UNESCO. (2023). *Guidance for generative AI in education and research*. UNESCO.
17. Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications*, 252, Article 124167. <https://doi.org/10.1016/j.eswa.2024.124167>



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