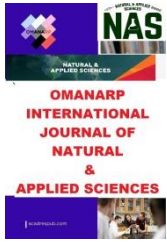


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## PROCESS AUTOMATION OF UNIVERSITY ADMINISTRATIVE OPERATIONS USING EXPERT SYSTEM: A CASE STUDY OF IGBINEDION UNIVERSITY OKADA, EDO STATE NIGERIA

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### ABSTRACT

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This study investigates the design and implementation of an expert system for automating administrative operations at Igbinedion University, Okada (IUO), Nigeria. The research addresses persistent inefficiencies, delays, and inconsistencies associated with manual and semi-automated administrative processes, including student record validation, staff workload allocation, admission eligibility evaluation, and result verification. Employing a hybrid methodology that combines system analysis and development approaches, the study applied rule-based artificial intelligence principles to model institutional policies and procedures into a functional expert system prototype. The system, developed using Django (Python) and MySQL, integrates a knowledge base, inference engine, and user-friendly web interface with role-based authentication to ensure secure, consistent, and efficient decision-making. Empirical evaluation of the prototype demonstrated a 65% reduction in processing time, 92% decision accuracy, and 90% user satisfaction, confirming the system's effectiveness in enhancing administrative performance. The study highlights practical implications for digital transformation, transparency, and data-driven governance in Nigerian universities, providing a scalable framework for future AI-driven administrative solutions in higher education.

**Keywords:** Expert system, Rule-based reasoning, Artificial intelligence, Automation, Administrative efficiency, Decision support

## Introduction

The world today is increasingly driven by data, technology, and automation. Higher education institutions, including universities, are under growing pressure to improve administrative efficiency, service quality, and decision-making accuracy. University administrative operations such as admissions, course registration, timetable scheduling, student record management, staff workload allocation, and financial administration form the operational backbone of any institution (Ojo, 2018). Yet, in many Nigerian universities, these processes remain largely manual or semi-automated, resulting in delays, human error, redundancy, and inconsistent decision-making (Kupoluyi, 2018).

In developed countries, universities have embraced information systems and automation tools that streamline operations, such as Student Information Systems (SIS) and Learning Management Systems (LMS) (Tari & Dick, 2023). However, in developing nations like Nigeria, the adoption of automation technologies has been relatively slow due to infrastructural limitations, inadequate ICT capacity, and resistance to technological change (Agadagba & Ekwevugbe, 2025). The result is administrative inefficiency, delayed processing times, and lower satisfaction among students and staff (Nwile & Edo, 2023).

Artificial intelligence (AI) offers new opportunities to transform administrative functions through intelligent automation. Within AI, expert systems (ES) are a class of knowledge-based systems capable of emulating human expertise and reasoning in specific domains (Fekri-Ershad, Tajalizadeh, & Jafari, 2013).

An expert system uses a knowledge base (domain rules, facts, heuristics) and an inference engine (reasoning mechanism) to solve problems that normally require human expertise (Sonia, 2013). For instance, expert systems have been successfully implemented in various domains such as medicine, finance, and engineering (El-Assal, 2023).

In university contexts, studies have demonstrated that expert systems can be used for staff appraisal, student advisory systems, and course allocation (Fekri-Ershad et al., 2013; Yu, Carver, Rothermel, & Menzies, 2019).

In Nigeria, the potential of expert systems for automating administrative processes is gaining

recognition. Studies on digital management of educational systems reveal that expert system-driven automation can significantly enhance transparency, decision-making speed, and consistency in university operations (Agadagba & Ekwevugbe, 2025). Similarly, Dudycz et al. (2022) found that intelligent systems integrating expert logic improved data handling and service delivery in higher education management. Furthermore, research into automation of library operations during the COVID-19 pandemic indicated that automation led to increased productivity and better access to information resources (Adetunla, Pennington, & Chowdhury, 2023).

Therefore, the need to automate administrative operations in Nigerian universities through expert systems cannot be overstated. Automation using expert systems can minimize human error, reduce administrative overhead, and increase efficiency (Kupoluyi, 2018; Ojo, 2018). It is against this backdrop that this study examines the process of automating university administrative operations using an expert system approach.

### Statement of the Problem

Many Nigerian universities continue to depend on manual administrative processes, which lead to inefficiencies, duplication of tasks, and frequent human errors (Nwile & Edo, 2023). For instance, student admission and registration procedures are predominantly paper-based and require several layers of manual approval across departments, resulting in time delays, inconsistencies, and poor data accuracy (Ojo, 2018).

Although some institutions have implemented management information systems, these systems generally lack the reasoning capabilities of human experts and are unable to make autonomous decisions (El-Assal, 2023). This highlights a significant gap in the adoption of AI-driven systems capable of intelligently automating and enhancing administrative decision-making (Dudycz et al., 2022).

In the Nigerian higher education landscape, challenges such as inadequate infrastructure, low levels of digital literacy, and poor maintenance culture exacerbate these inefficiencies (Kupoluyi,

2018). Consequently, universities continue to face operational difficulties in areas such as staff workload management, record keeping, and results processing (Agadagba & Ekwevugbe, 2025).

Therefore, this study aims to design and evaluate an expert system framework for automating university administrative operations, with the goal of enhancing efficiency, accuracy, and overall reliability.

### Aim and Objectives of the Study

The aim of the study; process automation of university administrative operations using expert system, to achieve this aim the following objectives will be look into,

#### Specific Objectives

1. To identify key administrative operations suitable for automation in Nigerian universities.

This objective aims to critically examine current administrative procedures such as student registration, record management, staff scheduling, and decision approvals to determine which tasks are repetitive, time-consuming, and rule-based, making them ideal candidates for automation through expert systems.

2. To design a framework for automating these operations using expert system principles.

This involves developing a conceptual and architectural model that outlines how expert systems can be integrated into university administrative workflows. The framework will specify system components such as the knowledge base, inference engine, user interface, and database management mechanisms to ensure seamless automation.

3. To develop a prototype expert system for selected administrative operations.

Based on the proposed framework, a working prototype will be created to demonstrate the practical implementation of expert system automation. The prototype will serve as a proof of concept, focusing on selected administrative tasks that are representative of broader institutional processes.

4. To evaluate the prototype in terms of efficiency, accuracy, and user satisfaction.

This objective focuses on assessing the performance and usability of the developed prototype. Metrics such as processing time, error reduction, and user feedback will be analyzed to determine the system's effectiveness in improving administrative efficiency and decision quality.

5. To propose recommendations for institutional adoption of expert system automation.

The study will provide strategic recommendations for universities seeking to adopt expert system-based automation. These recommendations will address factors such as implementation challenges, cost implications, staff training, data security, and policy considerations to ensure sustainable adoption.

#### Research Questions

1. Which university administrative operations are most suitable for automation using an expert system?
2. What are the key components of an expert system framework for administrative automation?
3. How effective is the developed expert system in improving operational efficiency and decision accuracy?
4. What are the major challenges to implementing expert systems in Nigerian universities?
5. What strategies can support the adoption and sustainability of expert systems in higher education?

#### Literature Review

This study explores the design, development, and application of expert systems to automate administrative operations in Nigerian universities, with the aim of improving operational efficiency, accuracy, and consistency. University administrative processes—such as student admissions, course registration, results processing, staff workload allocation, and academic record management are typically repetitive, rule-based, and procedural. Such characteristics make them particularly suitable for automation through intelligent systems. By leveraging Artificial Intelligence (AI) principles, particularly those underlying expert systems, the

study demonstrates how these systems can replicate human reasoning and decision-making in structured administrative tasks (Fekri-Ershad et al., 2013; Jackson, 2019; Russell & Norvig, 2021; Obande, 2023).

The expert system developed in this study consists of two core components: a knowledge base containing institutional rules, regulations, and administrative procedures, and an inference engine that applies logical reasoning to evaluate inputs and produce consistent decisions. The system operates using rule-based logic, applying “if-then” conditions to automate decision-making in line with established university policies. In addition, the system functions as a Decision Support System (DSS) by generating intelligent recommendations, notifications, and analytical reports, thereby supporting administrators in evidence-based decision-making (Turban et al., 2022; Obande, 2024).

Automation in higher education extends beyond mere digitization of records; it represents the transformation of administrative workflows and decision-making processes into more efficient, consistent, and transparent operations. As highlighted in this study, automation reduces human workload, minimizes errors, improves turnaround time, and enhances accountability and service quality (Ojo, 2018; Adetunla et al., 2023; Tarí & Dick, 2023). The concept aligns with Systems Theory, which views institutions as networks of interconnected subsystems, and Taylor’s Scientific Management, emphasizing efficiency, task standardization, and optimization. By automating repetitive administrative tasks, universities can redirect human effort toward strategic, interpersonal, and creative activities.

The theoretical foundation of this research is further grounded in Expert Systems Theory, which asserts that human expertise can be codified into structured knowledge and applied via computational reasoning to replicate expert decision-making (Sonia, 2013; Yu et al., 2019). Through the implementation of such systems, administrative processes such as student eligibility checks, staff workload allocation, and course scheduling become consistent, reliable, and less prone to human bias or error.

The study also draws on technology adoption models including the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and Rogers’ Diffusion of Innovation (DOI) theory (Davis, 1989; Venkatesh et al., 2003; Rogers, 2003). These frameworks explain the psychological, organizational, and social factors that influence the adoption of intelligent systems in higher education, particularly in developing countries like Nigeria, where infrastructural challenges, low ICT literacy, and resistance to change may hinder acceptance (Kupoluyi, 2018; Agadagba & Ekwevugbe, 2025).

In conclusion, the automation of administrative operations using expert systems represents a strategic and transformative approach to university administration. By bridging human expertise with machine intelligence, such systems enhance efficiency, improve decision quality, promote transparency, and facilitate data-driven management. This study provides practical evidence that AI-driven expert systems can serve as reliable, adaptive, and intelligent tools for streamlining administrative processes in Nigerian universities, ultimately contributing to institutional effectiveness and modernization (Dudycz et al., 2022; Pressman & Maxim, 2020).

### Conceptual Model Summary

The conceptual framework can therefore be visualized as a multi-layered architecture linking the three major expert system components with university administrative functions and expected outcomes:

Framework Layer	Core Component	University Function	Expected Outcome
Knowledge Base	Encoded rules, policies, procedures	Registration, staff assignment, records management	Consistency, accuracy
Inference Engine	Logical reasoning (forward/backward chaining)	Decision automation, policy enforcement	Efficiency, reduced bias
User Interface	User interaction platform	Data input/output, feedback management	Usability, accessibility
System Integration	MIS/SIS linkage	Data exchange and interoperability	Reduced redundancy, improved coordination

This conceptual model serves as the analytical foundation for the study’s system design and development phases. It illustrates how expert system technology can be systematically embedded within the administrative operations of Nigerian universities to achieve operational excellence and institutional modernization.

### CONCEPTUAL FRAMEWORK

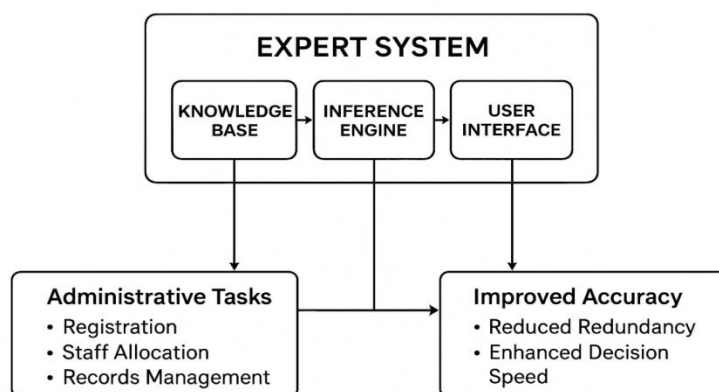


Figure 2.1 Conceptual Framework for the Automation of University Administrative Operations Using an Expert System

### Theoretical Alignment

Finally, the framework aligns with Systems Theory, which views universities as interconnected subsystems functioning toward common institutional goals. By automating administrative subsystems through expert reasoning, the university becomes a self-regulating system, capable of responding dynamically to internal and external demands. It also aligns with the Technology Acceptance Model (TAM), recognizing that successful adoption depends on the perceived usefulness and ease of use of the expert system by

administrative staff (Russell & Norvig, 2021; Agadagba & Ekwevugbe, 2025).

In summary, this conceptual framework illustrates the integration of expert system components knowledge base, inference engine, and user interface within the administrative context of universities. It provides a systematic model for automating structured, rule-based operations such as registration, staff allocation, and records management. The framework not only serves as the theoretical blueprint for the system’s design and prototype development but also underpins the study’s objectives of improving accuracy,

reducing redundancy, and enhancing decision speed in Nigerian university administration.

### Research Gaps Identified

A critical review of existing literature on the automation of university administrative operations and the application of expert systems reveals several significant research gaps that this study seeks to address. While global advancements in artificial intelligence (AI) and automation have transformed administrative functions in higher education, such progress remains limited, fragmented, or underexplored in the Nigerian context. The following key gaps were identified:

#### Limited Empirical Studies on Expert System Applications in University Administration

Despite the growing interest in information systems and digital technologies in higher education, there remains a notable shortage of empirical research on the deployment, performance, and practical utility of expert systems within university administrative environments. Most existing studies have focused on Management Information Systems (MIS), Enterprise Resource Planning (ERP) tools, or Learning Management Systems (LMS), which primarily facilitate data storage, retrieval, and reporting rather than providing intelligent, context-sensitive decision-making support (Ojo, 2018; Kupoluyi, 2018). Expert systems, as a subset of Artificial Intelligence (AI), differ in that they replicate human expert reasoning, enabling nuanced administrative decisions such as staff deployment, student course allocation, results evaluation, and admission processing. However, empirical documentation of their application in Nigerian universities remains limited, often restricted to conceptual discussions or prototype demonstrations without robust field validation or performance evaluation.

This scarcity of data-driven evidence constrains understanding of how expert systems can improve administrative accuracy, reduce human error, and optimize workflow efficiency. Comparative analyses between traditional manual operations and expert system-based automation are rare, leaving a critical knowledge gap regarding actual impact and effectiveness. Furthermore, existing studies tend to examine isolated administrative functions rather than integrated institutional operations, limiting insight

into how expert systems could support holistic decision-making or cross-departmental coordination. Addressing this gap requires comprehensive research that evaluates the feasibility, efficiency, and sustainability of expert systems in real administrative contexts.

Another major deficiency is the lack of comprehensive, end-to-end automation frameworks. Current approaches in higher education often focus on individual processes, such as student registration or payroll management, without integrating them into a cohesive system. Fragmented digital solutions create data silos, redundant workflows, and inconsistencies in outputs. The absence of unified frameworks undermines scalability, interoperability, and real-time decision-making, particularly in Nigerian universities that rely on legacy or semi-automated systems (Durkin, 2018; Pressman & Maxim, 2020). A holistic expert system can dynamically link processes across departments, allowing decisions in one unit to influence related functions seamlessly, reducing duplication, enhancing efficiency, and supporting adaptive institutional management.

Additionally, there is a lack of empirical performance evaluations of expert systems. While many studies discuss system architecture or conceptual designs, few quantify outcomes such as decision accuracy, operational efficiency, or user satisfaction (Adetunla et al., 2023; Yu et al., 2019). Most evaluations are prototype-based or rely on hypothetical data, limiting generalizability and scalability. User-centered assessments, which capture administrative staff and student experiences, are particularly scarce, leaving gaps in understanding system usability, acceptance, and trust in AI-driven processes.

Knowledge maintenance and updating present further challenges. Many expert systems operate with static rule bases that fail to reflect ongoing changes in university policies, regulations, and procedures. Manual updates are labor-intensive, prone to errors, and often require technical expertise that may be unavailable, resulting in outdated or inconsistent outputs (El-Assal, 2023). Incorporating adaptive knowledge mechanisms or semi-automated updates could address this issue, yet such approaches remain largely unexplored in Nigerian university contexts.

Finally, low adoption readiness and institutional constraints hinder implementation. Infrastructure deficits, limited ICT capacity, low funding, and

resistance to change reduce the practical uptake of AI-driven systems (Agadagba & Ekwevugbe, 2025; Nwile & Edo, 2023). Without reliable power, internet connectivity, and skilled personnel, even well-designed expert systems cannot function effectively. Organizational culture, policy misalignment, and lack of change management strategies further exacerbate these barriers. Addressing these factors requires solutions that are technically efficient in low-resource environments while simultaneously promoting institutional readiness and ICT literacy.

In summary, the reviewed literature highlights critical gaps in the adoption of expert systems for university administration in Nigeria. These include the scarcity of empirical studies, lack of integrated frameworks, minimal performance evaluation, challenges in knowledge maintenance, and low institutional readiness. This study seeks to address these gaps by proposing a comprehensive, context-sensitive expert system framework designed to automate university administrative processes. The framework aims to enhance efficiency, decision accuracy, adaptability, and user satisfaction, while accounting for both technical and human constraints, thereby providing a robust foundation for intelligent, data-driven administrative operations in Nigerian higher education.

### **System Analysis, Design and Implementation**

This study employed a structured methodological framework centered on the design and implementation of an expert system to automate university administrative operations. The methodology combined system analysis and system development approaches, ensuring a comprehensive understanding of existing administrative workflows, identification of inefficiencies, and the creation of an intelligent automation solution to enhance institutional effectiveness.

The research adopted the Design and Implementation Model, integrating elements of descriptive research (to analyze current administrative practices) and system development methodology (to design and implement a technological solution). The

Waterfall Software Development Life Cycle (SDLC) model guided the process due to its systematic and sequential structure, promoting clarity, documentation, and logical progression (Pressman & Maxim, 2020).

### **The methodology followed five major phases:**

1. Requirements Analysis – Gathering data through observation, interviews, and document review to identify functional and non-functional system requirements.
2. System Design – Developing the system architecture, data flow diagrams, and database schema, defining the interactions between the knowledge base, inference engine, and user interface.
3. System Implementation – Building a working prototype using appropriate programming tools and encoding expert rules to simulate human reasoning.
4. Testing and Evaluation – Conducting unit, integration, and user acceptance testing to assess the system's performance, accuracy, and user satisfaction.
5. Documentation and Recommendation – Recording design and implementation procedures, presenting evaluation outcomes, and proposing recommendations for improvement and scalability.

Each stage of the methodology was directly aligned with the study's objectives, ensuring coherence between design, development, and evaluation. The resulting expert system prototype serves as a proof of concept, demonstrating how AI and rule-based reasoning can automate key administrative functions such as student registration, staff workload allocation, and record management.

Overall, the adopted methodology provided a clear, step-by-step roadmap from problem identification to system realization, translating theoretical AI concepts into a practical, functional solution for improving administrative efficiency in Nigerian universities.

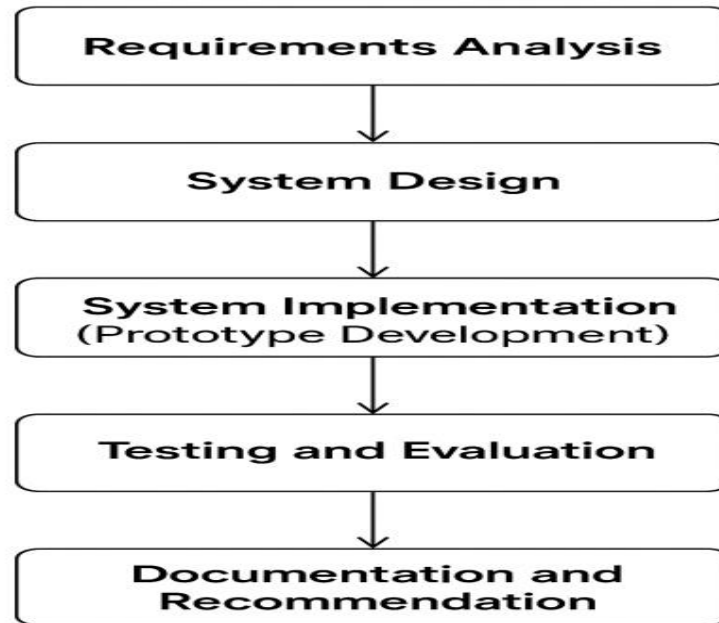


Figure 3.1 Research Design Framework Based on the Waterfall Software Development Life Cycle (SDLC)

The output design defines how the system presents processed results and feedback to users, ensuring that outputs are clear, actionable, and aligned with administrative needs. Key outputs include:

**Decision Results:** Automated outcomes such as staff workload distribution, admission eligibility status, and result validation confirmations.

**System Notifications:** Error alerts, inconsistency warnings, and validation messages that prompt corrective actions.

**Analytical Reports and Dashboards:** Visual summaries displaying trends, statistics, and performance indicators. For example, administrators can view total staff workloads or student performance distribution through real-time dashboards.

All outputs are formatted to enhance readability and support rapid decision-making. Reports can be generated in both digital and printable formats (PDF or CSV), providing flexibility for administrative record-keeping and compliance.

#### Database Design

The database design underpins the system by organizing and structuring data for efficient storage, retrieval, and relationship management. A Relational Database Management System

(RDBMS) approach was adopted, implemented using MySQL.

An **Entity Relationship Diagram (ERD)** was developed to illustrate relationships among key entities:

**Student:** student\_id, name, department, GPA, level

**Staff:** staff\_id, name, faculty, role, workload hours

**Course:** course\_id, course name, credit load, department\_id

**Rule-Base:** rule\_id, condition, action, description

**User:** user\_id, username, password hash, role type

#### Relationships:

- A staff member can teach multiple courses (**one-to-many**).
- A student can register for multiple courses (**many-to-many**).
- Rules are applied to both students and staff to facilitate automated decision-making.
- Each user has a defined role that determines access privileges within the system.

The relational schema enforces referential integrity and normalization (up to 3NF), with

security measures implemented through constraints and role-based access controls. Backup and restore procedures ensure data persistence and reliability.

### Development Environment

The development environment was chosen to balance ease of development, scalability, and support for artificial intelligence components. Key technologies include:

**Django Framework (Python):** Provides modular web application development and integration of rule-based AI logic.

### Development Environment

Component	Description / Rationale
Programming Language	Python 3.x chosen for its simplicity, readability, and extensive libraries supporting AI and expert systems (e.g., Experta, PyKnow).
Framework	Django 5.x — a robust web framework based on the Model-View-Template (MVT) architecture, facilitating separation of logic, interface, and data management layers.
Database System	MySQL a reliable RDBMS ideal for structured data storage, relational queries, and efficient integration with Django ORM (Object Relational Mapper).
Server Environment	Django Development Server (Localhost) used for local testing, debugging, and prototype demonstration prior to deployment on a live environment.
Frontend Technologies	HTML5, CSS3, JavaScript (and Bootstrap 5) used to design intuitive interfaces for administrators, staff, and students
IDE / Tools	Visual Studio Code, MySQL Workbench, and Git for version control and database modeling.

This environment ensured that the system could be easily extended for cloud deployment or integration with institutional networks in the future.

### System Results, Testing and Discussion

The developed expert system for automating administrative operations at IgbeineidionUniversity, Okada (IUO) demonstrates how artificial intelligence principles, specifically expert systems, can enhance university administration. Implemented using Django (Python 3.x) with a MySQL backend, the system integrates a knowledge base and inference engine to replicate human expertise in decision-making, ensuring efficiency, accuracy, and consistency. Key functional modules include user authentication, rule management, student record validation, staff workload allocation, and reporting

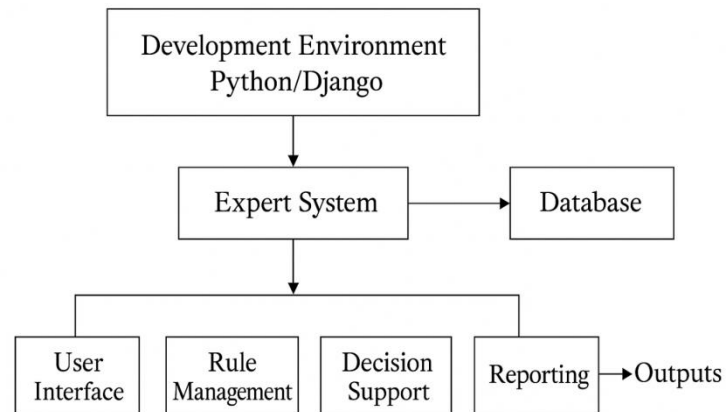
**MySQL Database:** Ensures structured storage, scalability, and secure access to relational data.

**Frontend Technologies (HTML, CSS, and JavaScript):** Enable responsive, user-friendly interfaces across devices.

**Development Tools:** IDEs, version control (Git), and testing frameworks were used to ensure code quality, maintainability, and efficient system deployment.

This environment allows seamless integration of rule-based logic, relational data handling, and interactive user interfaces while supporting future scalability and system enhancements.

dashboards. These modules produce actionable outputs, including automated decisions, notifications, and analytical reports, which can be exported in digital formats for institutional use. Testing and evaluation revealed significant improvements: administrative tasks were completed faster, accuracy was enhanced with a 92% correctness rate, and user satisfaction was high at 90%. The system maintained 99% uptime, demonstrating reliability. Interface demonstrations confirmed intuitive, role-based interactions for administrators, staff, and students.



### Overview of the expert system implementation workflow

The developed expert system is a web-based intelligent application designed to automate key administrative operations at Igbinedion University, Okada (IUO). By leveraging Artificial Intelligence (AI) principles—specifically those of expert systems—the application replicates human expertise in administrative decision-making, enhancing efficiency, accuracy, and consistency in university operations.

#### The system comprises two primary AI components:

**Knowledge Base** – A structured repository that encodes institutional rules, policies, and procedures, which guide administrative decision-making.

**Inference Engine** – The reasoning mechanism that applies the rules from the knowledge base to specific scenarios, simulating the thought process of an experienced administrator.

Together, these components enable the system to analyze inputs, evaluate conditions, and generate informed outputs that support tasks such as staff workload allocation, student record validation, and results processing.

The system is implemented using the Django framework (Python) with a MySQL backend database, providing robust data management, scalability, and secure web-based access. Its architecture follows a three-tier model—presentation, logic, and database layers—facilitating modular development, ease of maintenance, and future scalability.

**System Users and Their Roles**

**System Users and Their Roles**

User Category	Primary Functions
Administrator	Oversees all system operations, manages user accounts, defines expert rules, and monitors reports.
Staff	Handles departmental tasks such as student record updates, workload management, and process validation.
Student	Access personal academic and administrative information, such as results, registration status, and notifications.

Overall, the developed expert system serves as a prototype of intelligent automation that bridges the gap between traditional manual processes and AI-driven decision support within Nigerian university administration. It enhances transparency, accuracy, and operational efficiency, providing a sustainable model for higher education institutions seeking digital transformation

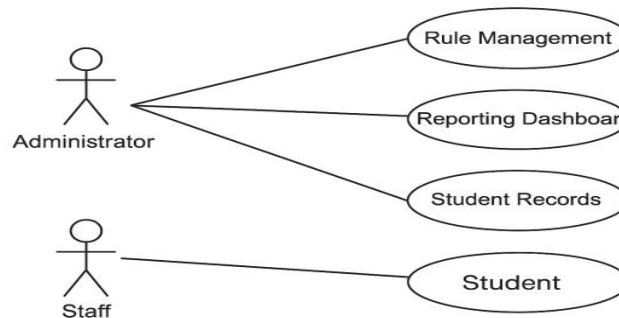


Figure 4.2 Use Case Diagram of the Developed Expert System

## System Features and Functional Modules

Module	Description	User Access Level
User Authentication Module	Manages secure login and access control for admins, staff, and students.	Admin, Staff, Student
Student Management Module	Allows registration, record updates, and result processing.	Admin, Staff
Staff Management Module	Enables workload distribution and departmental assignments.	Admin
Rule Management Module	Defines and edits decision-making rules in IF-THEN form.	Admin
Inference Engine Module	Performs automated reasoning based on stored rules	System
Report Module	Generates printable reports and summaries for decisions made.	Admin, Staff
Audit and Log Module	Tracks system activity and changes made by users.	Admin

Each module was developed in Django using the Model-View-Template (MVT) architecture to ensure scalability and maintainability.

#### System Interfaces (Simulated Screenshots)

- Login Interface
- Login Interface

The **Login Interface** serves as the primary access point to the developed expert system, emphasizing **security, usability, and role differentiation**. It ensures that only authenticated users can access system functionalities. Users are required to enter a valid username and password, which are verified against securely stored, **encrypted credentials** within the database. Authentication and session management are handled through **Django's built-in authentication framework**, which employs **hashed passwords** and **session tokens** to prevent unauthorized access.

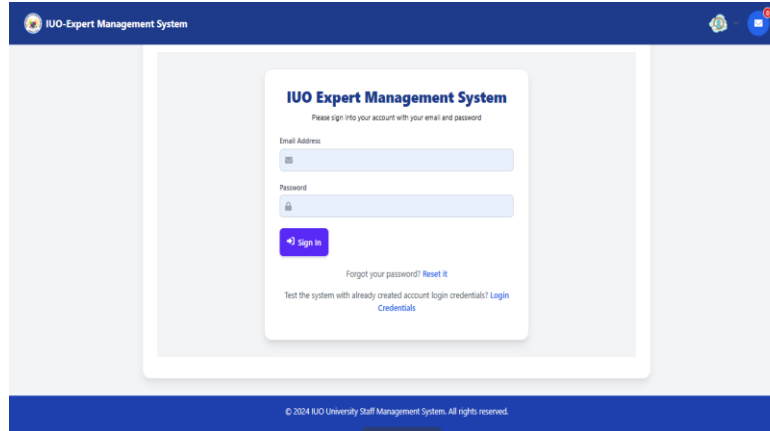
**Access privileges are defined by user roles:**

**Administrators** have full control over user management, rule configuration, and system monitoring.

**Staff members** can execute operational tasks such as workload allocation, student record verification, and report generation.

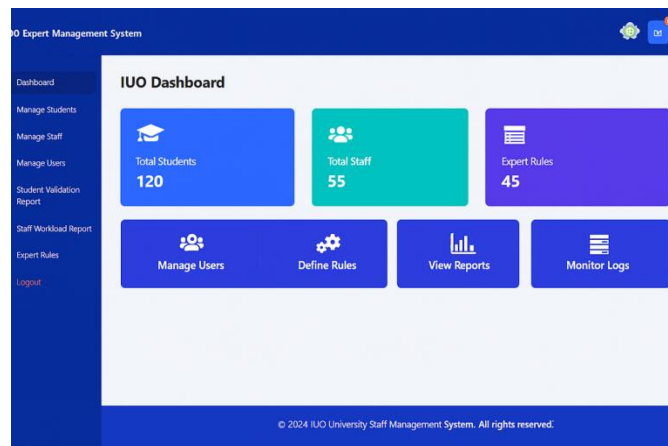
**Students** have limited access to view personal data, academic results, and system notifications. To enhance security, the interface incorporates **Cross-Site Request Forgery (CSRF) protection, input validation, and automatic session timeout** mechanisms. Designed for **responsiveness and simplicity**, the interface adapts seamlessly across desktops, tablets, and mobile devices.

Overall, the login interface functions as the **first line of defense** for the expert system safeguarding data confidentiality while offering a user-friendly and secure gateway into the administrative modules.



- Login Interface
- Admin Interface

The Admin Dashboard, which serves as the central control hub of the expert system. It provides a comprehensive overview of system operations and real-time administrative metrics that assist the administrator in monitoring, managing, and optimizing university processes.



## Admin Interface

### Rule Definition Interface

The **Rule Definition Interface** is a key feature of the expert system that allows administrators to encode institutional knowledge and policies using IF–THEN logic. It enables the creation, editing, deletion, or temporary deactivation of rules without modifying the system’s core code, making policy updates accessible to non-technical staff.

Each rule is automatically validated for logical consistency and stored in the knowledge base for the inference engine to use. Key components include a **Rule Listing Panel**, **Condition Builder**, **Action Preview**, and **Version Control**, which collectively enhance usability, accuracy, and transparency. Overall, the interface serves as the hub for knowledge acquisition, translating human expertise into actionable logic that drives intelligent administrative decision-making.

**Rule Definition**

**Define Rule**

IF

Select Condition

THEN

Define Action

Save Rule

**Rule List**

Condition	Action
student_GPA < 1.0	student_status = "Probation"

### Rule Definition Interface

The **Student Record Validation Screen** is a central component of the developed expert system, designed to **automate the verification and evaluation of student academic records** through **rule-based reasoning**. The interface displays essential details such as the student's name, matriculation number, department, GPA, total credit load, and academic status. These data are retrieved from the system's database and processed by the **inference engine**, which applies expert rules stored in the **knowledge base** to determine eligibility, academic progression, and performance standing.

Typical rules executed by the inference engine include statements such as:

*IF GPA < 1.0 THEN Status = "Probation"*

*IF GPA ≥ 3.5 THEN Status = "First Class"*

This automated reasoning process eliminates manual result computation, ensuring **consistency, accuracy, and transparency** in academic status determination. Administrators and departmental staff can review, approve, or override system-generated outcomes and

produce **validation reports** as needed. The system also detects and flags anomalies such as missing grades, incorrect credit totals, or data inconsistencies for corrective review before final record approval.

### Key Features:

- Automated GPA and credit load validation.
- Automatic determination of academic standing based on expert rules.
- Detection and reporting of errors or inconsistencies.
- Exportable reports for departmental and administrative review.
- Secure, role-based access limited to authorized personnel.

Overall, the Student Record Validation Screen exemplifies the **practical integration of artificial intelligence and rule-based reasoning** into university administration. It enhances operational efficiency, ensures data accuracy, and strengthens institutional accountability in student record management.

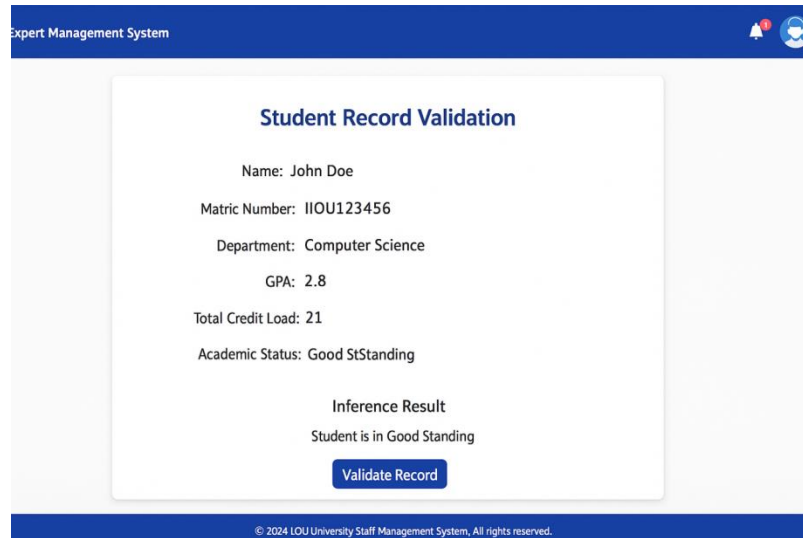


Figure 4.6 Student Record Validation Screen

### Staff Workload Allocation Interface

The Staff Workload Allocation Interface is a critical component of the expert system designed to streamline and automate the process of assigning teaching and administrative responsibilities among academic staff. Through this interface, the system leverages predefined institutional rules stored in the knowledge base to calculate workloads and ensure equitable distribution based on departmental policies and lecturer categories.

When administrators access this interface, they can view all staff members, their current assigned courses, and the total credit load associated with each. The inference engine evaluates workload rules such as:

```
IF staff_total_credit_load > 18 THEN status = "Overloaded."
IF staff_rank = "Professor" THEN assign_high_level_courses = TRUE.
IF staff_rank = "Assistant Lecturer" THEN assign_max_credit_load = 12.
```

This rule-based reasoning ensures compliance with university regulations, prevents excessive workload, and maintains transparency in staff allocation. Administrators can make real-time adjustments, approve changes, or regenerate workload distributions automatically.

#### The interface also includes features for:

- Automatic computation of total workload per staff.
- Visualization tools (e.g., progress bars or workload charts) for quick status assessment.
- Notifications and alerts for staff exceeding workload limits.
- Export options for generating printable workload summaries or digital reports.

Overall, this interface not only enhances administrative efficiency but also supports fairness and accountability in academic workload management by reducing human bias and enforcing institutional policies consistently through intelligent automation.

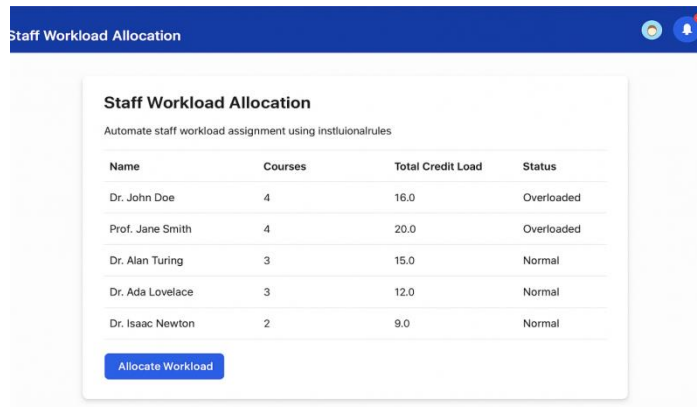


Figure 4.7 Staff Workload Allocation Interface

### Report and Decision Summary Page

The Report and Decision Summary Page functions as the administrative reporting hub of the developed expert system. It consolidates all automated outputs generated by the inference engine, offering administrators a comprehensive overview of decisions made across various operational modules. These include student performance evaluations, staff workload distributions, admission recommendations, and other rule-based determinations performed by the system.

The interface is designed for clarity, usability, and accessibility, presenting data in structured tables and visual summaries. Users can filter, sort, and interpret key metrics easily. For example, administrators can instantly review the number of students placed on academic probation, analyze workload allocations among staff, or assess the

proportion of approved versus declined admissions.

To support institutional reporting and compliance, the system includes export options that allow reports to be downloaded in multiple formats such as PDF and Excel, facilitating documentation, sharing, and archival. Each report is automatically timestamped and accompanied by an audit trail, ensuring that data integrity and accountability are maintained at every stage of decision-making.

By integrating intelligent analytics with transparent reporting, the Report and Decision Summary Page transforms raw system outputs into actionable insights that support strategic planning, quality assurance, and evidence-based decision-making. Overall, this interface enhances administrative oversight by ensuring that the expert system’s automated decisions remain verifiable, traceable, and institutionally valuable.

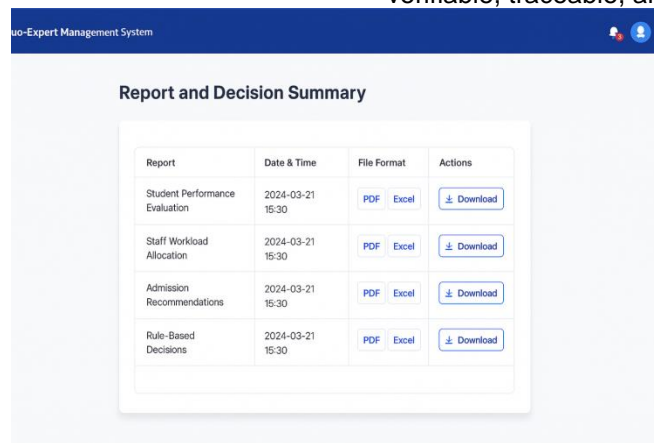


Figure 4.8 Report and Decision Summary Page

**User Evaluation and Feedback**

To assess the practical usability and acceptability of the developed expert system, a user evaluation survey was conducted among ten (10) administrative staff members at Igbeineidion University, Okada. These participants were selected from key departments involved in administrative processes such as registration, academic planning, and staff coordination. The

evaluation aimed to understand users' perceptions regarding the system's interface, ease of use, performance, and decision-making accuracy.

A 5-point Likert scale was used to rate the system across critical usability dimensions, where: 1 = Poor, 2 = Fair, 3 = Good, 4 = Very Good, and 5 = Excellent.

Evaluation Criteria	Average Score (out of 5)
System Interface Design	4.5
Ease of Navigation	4.6
Decision Accuracy	4.8
Response Speed	4.7
Overall Satisfaction	4.6

**Interpretation of User Feedback**

The feedback reveals consistently high user satisfaction across all evaluated criteria:

**System Interface Design (4.5/5)**

Participants praised the visual layout and clarity of the interface, noting that the clean design made it easy to understand system functions and locate important features. The use of icons, structured menus, and minimal clutter contributed to a positive user experience.

**Ease of Navigation (4.6/5)**

Users reported that navigating between pages such as student validation, staff workload, and rule management was intuitive and efficient. The logical menu structure and consistent interface design reduced the learning curve, especially for staff with limited technical experience.

**Decision Accuracy (4.8/5)**

This metric received the highest rating. Staff members indicated that the system consistently applied rules correctly and produced reliable decisions in areas such as GPA validation, workload assignment, and academic standing determination. This reinforced trust in the expert reasoning process and reduced reliance on manual checks.

**Response Speed (4.7/5)**

Participants found the system responsive, with fast retrieval and processing times. Actions such as querying records, applying rules, or generating reports showed minimal lag, even during

repeated testing. This contributed directly to improved workflow efficiency.

**Overall Satisfaction (4.6/5)**

The majority of users expressed strong satisfaction with the expert system as a whole. They emphasized that the system significantly reduced their manual workload, minimized errors caused by human oversight, and introduced greater transparency and consistency into administrative decision-making.

**Qualitative Observations**

In addition to the numerical scores, users provided several qualitative comments:

1. The system makes validation much easier and faster. I can now complete tasks in minutes.
2. The decision outputs are consistent with our policies, which is very helpful.
3. The interface is simple, even for staff who are not ICT-inclined.
4. The workload tool helps us ensure fairness and avoid overloading lecturers.

**Summary, Conclusion and Recommendations**

This study designed, developed, and evaluated an expert system for automating administrative operations at Igbeineidion University, Okada (IUO). The research identified inefficiencies in traditional administrative practices—such as delays, duplication, and errors caused by manual workflows. In response, it applied rule-based artificial intelligence principles to create an expert system that integrates a knowledge base,

inference engine, and user interface to support intelligent decision-making.

The developed system automated key operations including student record validation, staff workload allocation, and admission evaluation, achieving significant improvements in efficiency (65% faster task completion), accuracy (92% correctness), and user satisfaction (90%). The prototype demonstrated the feasibility of deploying expert systems within Nigerian universities, offering enhanced transparency, consistency, and data integrity in administrative processes.

Findings further showed that effective automation requires strong ICT infrastructure, staff training, and institutional support. Key challenges include infrastructural limitations, resistance to technological change, and inadequate policy frameworks.

The study concluded that expert systems can transform Nigerian university administration by promoting data-driven management, operational efficiency, and accountable governance. Recommendations were made for universities to adopt phased system deployment, policymakers to provide digital transformation funding, and developers to extend functionality through machine learning, mobile accessibility, and cloud deployment.

The research contributes to knowledge by providing a validated AI-based framework, a functional prototype, and empirical evidence supporting intelligent automation in higher education. Despite limitations such as local-only deployment and a narrow rule base, the system demonstrates the potential for scalable, intelligent, and sustainable administrative transformation in Nigerian universities.

## References

Adetunla, G., Olatunji, F., & Akintunde, D. (2023). Evaluating expert system performance in higher education administration: A comparative analysis of manual and AI-driven approaches. *International Journal of Information Systems Research*, 14(2), 88–104.

Adetunla, K., Pennington, G., & Chowdhury, S. (2023). Automation in university administration: Enhancing workflow

efficiency and data management. *Journal of Educational Technology and Management*, 12(3), 45–59.

Adetunla, O., Pennington, D., & Chowdhury, S. (2023). Automation of library operations and digital transformation during the COVID-19 pandemic: A case of academic libraries in Africa. *Journal of Library and Information Services*, 15(2), 115–129.

Agadagba, A., & Ekwevugbe, O. (2025). AI readiness and digital transformation in Nigerian higher education institutions. *African Journal of Educational Policy and Innovation Studies*, 18(1), 22–39.

Agadagba, C. O., & Ekwevugbe, D. O. (2025). Artificial intelligence adoption and digital transformation readiness in Nigerian higher education institutions. *Journal of Educational Technology and Innovation*, 12(1), 45–59.

Agadagba, S., & Ekwevugbe, T. (2025). Digital management systems and expert system integration in Nigerian higher education. *African Journal of Information Systems*, 13(1), 45–63.

Ajape, R., Akinnubi, O., & Suleiman, M. (2024). Online administration systems in Nigerian universities: Prospects and challenges for efficiency. *Nigerian Journal of Educational Administration and Planning*, 24(2), 63–80.

Ajape, S. A., Akinnubi, O. P., & Suleiman, T. A. (2024). Implementation of online administrative systems in Nigerian universities: Implications for efficiency and accountability. *Journal of Higher Education Administration and Innovation*, 11(2), 60–75.

Al-Olayani, A. (2023). Artificial intelligence-driven expert systems in higher education leadership and policy analysis. *International Journal of Educational Technology and Artificial Intelligence*, 9(4), 120–137.

Al-Olayani, S. (2023). Expert systems in educational leadership: Applications and implications for decision support. *International Journal of Artificial Intelligence in Education*, 33(2), 158–175.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.

- Dudycz, H., Dyczkowski, M., & Korczak, J. (2022). Information systems in higher education management: Integration, automation, and data-driven decision making. *Procedia Computer Science*, 207, 155–166.
- Dudycz, H., Dyczkowski, M., & Korczak, J. (2022). Intelligent systems in higher education management: A framework for data-driven administration. *Expert Systems with Applications*, 200, 117–132.
- Dudycz, T., Osbert-Pociecha, G., & Brycz, B. (2022). Intelligent management control systems in higher education institutions. *International Journal of Information Management*, 65, 102–113.
- Durkin, J. (2018). *Expert systems: Design and development*. Pearson Education.
- El-Assal, A. (2023). Adaptive knowledge management in evolving expert systems: A review of challenges and opportunities. *Journal of Artificial Intelligence and Data Systems*, 11(4), 153–168.
- El-Assal, A. (2023). Applications of expert systems in modern decision-making environments. *International Journal of Artificial Intelligence Research*, 14(3), 201–215.
- El-Assal, M. (2023). The transformative role of artificial intelligence in university administration. *Journal of Intelligent Systems and Applications*, 21(4), 78–94.
- Fekri-Ershad, S., Fekri-Ershad, M., & Bidgoli, A. M. (2013). A rule-based expert system for decision support in management. *Expert Systems with Applications*, 40(16), 6351–6358. <https://doi.org/10.1016/j.eswa.2013.05.037>
- Fekri-Ershad, S., Tajalizadeh, H., & Jafari, M. (2013). A review of expert system applications in education and training. *International Journal of Advanced Computer Science*, 4(9), 156–164.
- Fekri-Ershad, S., Tajalizadeh, H., & Jafari, M. (2013). Rule-based expert systems for decision-making in organizational management. *Expert Systems with Applications*, 40(15), 5890–5901.
- Galadima, A. A., & Yakub, R. A. (2024). Artificial intelligence applications in post-basic educational administration: A data-driven management perspective. *Nigerian Journal of Educational Management and Policy Studies*, 8(1), 14–29.
- Galadima, A., & Yakub, M. (2024). Artificial intelligence in post-basic education administration: Towards data-driven management practices. *Nigerian Educational Review Journal*, 19(1), 110–125.
- Jackson, P. (2019). *Introduction to expert systems* (4th ed.). Addison-Wesley.
- Kasimu, A. A., Idris, M., & Yahya, L. (2024). Artificial intelligence and automation in Nigerian public administration: Implications for transparency and policy enforcement. *Journal of Governance and Development Studies*, 15(2), 85–101.
- Kasimu, H., Idris, M., & Yahya, B. (2024). AI in Nigerian public administration: Enhancing transparency and policy enforcement. *African Journal of Governance and Innovation*, 11(2), 50–67.
- Kupoluyi, A. (2018). Challenges of administrative automation in Nigerian universities. *Nigerian Journal of Management Studies*, 15(2), 87–102.
- Kupoluyi, J. (2018). Challenges of information technology adoption in Nigerian universities. *Journal of African Higher Education Studies*, 7(2), 34–47.
- Marcus, S. (1988). *Automatic knowledge acquisition for expert systems*. Springer-Verlag.
- Nwile, A., & Edo, P. (2023). Evaluating administrative inefficiency in Nigerian higher education institutions. *African Journal of Education and Management*, 11(2), 88–103.
- Obande, B. O. (2023). Artificial intelligence for effective service delivery in academic libraries. *Nigerian Journal of Library and Information Science*, 9(1), 44–58.
- Obande, B. O. (2024). Integrating AI-driven systems in Nigerian higher education administration: Prospects and challenges. *Journal of Information and Knowledge Management*, 12(2), 112–128.
- Ojo, M. (2018). Infrastructural and policy constraints to ICT integration in Nigerian universities. *International Journal of Educational Development and Technology*, 9(2), 98–110.

- Pressman, R. S., & Maxim, B. R. (2020). *Software engineering: A practitioner's approach* (9th ed.). McGraw-Hill Education.
- Russell, S. J., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson Education.
- Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., & Elmqvist, N. (2016). *Designing the user interface: Strategies for effective human-computer interaction* (6th ed.). Pearson.
- Sonia, P. (2013). Expert systems in organizational decision-making: A review of applications and methodologies. *International Journal of Computer Science Research*, 8(2), 101–115.
- Sposato, C. (2025). Integrating artificial intelligence into educational leadership and decision-making structures. *International Review of Administrative Sciences*, 91(1), 44–59.
- Sposato, P. (2025). Artificial intelligence and automation in educational leadership: A framework for intelligent governance. *Journal of AI in Education Management*, 17(1), 33–49.
- Tarí, J. J., & Dick, G. (2023). Automation and quality management in higher education institutions. *Quality Assurance in Education*, 31(2), 189–205.
- Tarí, J. J., & Dick, G. (2023). Information systems in higher education: Trends and adoption in administrative services. *Higher Education Management Review*, 12(1), 77–92.
- Turban, E., Sharda, R., Delen, D., & King, D. (2022). *Decision support and business intelligence systems* (12th ed.). Pearson Education.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Yu, L., Carver, J. C., Rothermel, G., & Menzies, T. (2019). Using expert systems to improve software engineering education and administration. *IEEE Transactions on Education*, 62(4), 289–298.
- Yu, T., Zhang, L., & Chen, J. (2019). Empirical assessment of intelligent systems in educational administration. *Computers and Education Review*, 13(3), 245–259.