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HYBRID OPENAI AI SYSTEM FOR MEDICAL ACADEMIC WORKFLOW OPTIMIZATION

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ABSTRACT

Medical education institutions often face challenges due to semi-manual and fragmented academic workflows, particularly in enrollment, academic evaluation, and student progression tracking. This study aimed to assess current academic workflows and develop an AI-enhanced framework to optimize enrollment processing, evaluation, and student progression monitoring. Using a descriptive-developmental mixed-methods design, data were gathered from 212 respondents through surveys, semi-structured interviews, document analysis, and workflow observation. Results revealed that existing processes remain predominantly manual, leading to repeated document verification, encoding redundancy, and limited system integration.The study proposes an AI-assisted architecture incorporating automated information extraction using OCR, rule-based validation, deficiency detection, and intelligent recommendation generation. The proposed system further leverages the hybrid AI approach for the system flow using OpenAI: Rule-based engine + Predictive ML + LLM. Whereas, Random forest prediction model was utilized to maximize reusing student's historical data. The developed framework demonstrates strong potential to reduce processing time, minimize errors, enhance evaluation quality, and enable real-time student progression tracking while maintaining data security. This research contributes to a practical model for AI-driven digital transformation in medical education environments.

***Keywords**: Academic Workflow Automation, Artificial Intelligence, Medical Student Enrollment, Academic Evaluation, Student Progression Tracking, Digital Transformation*

1. INTRODUCTION

Student Information Systems (SIS) have been positioned as a critical infrastructure for managing student data across the entire academic lifecycle. SIS platforms serve as centralized systems that support admission, enrollment, evaluation and academic records management. These systems are essential for ensuring continuity and integrity in student records, enabling institutions to maintain accurate documentation of academic performance and institutional requirements This end-to-end management of student data strengthens institutional accountability and supports efficient decision-making in academic administration [1].

Modern student information systems further integrate multiple academic functions into a unified platform, allowing real-time updates and reducing redundancy in data handling. Such integration minimizes fragmentation across departments and improves overall workflow efficiency [2]. Centralized information systems also significantly reduce manual processing, errors, and duplication in administrative tasks, thereby enhancing operational accuracy and institutional responsiveness [3].

In addition, computerized student record systems streamline registrar operations by standardizing processes such as transcript generation, report compilation, and academic record retrieval. These systems improve efficiency and support real-time reporting, which is essential for institutional transparency and compliance [4].

Collectively, these studies suggest that SIS frameworks are fundamental to improving academic administration through centralized, integrated, and automated data management systems. However, despite these advancements, many processes remain semi-manual. Modern AI technologies offer powerful solutions to further enhance efficiency in critical academic processes, particularly during enrollment, academic

evaluation, and student progression (migration) tracking.

The primary goal of this study is to modernize the administrative and academic operations of the SWU PHINMA School of Medicine by assessing current semi-manual workflows, identifying their limitations, and developing an AI-assisted Medical Student Information System (MSIS) that features a centralized, automated, and intelligent framework to enhance workflow efficiency, data accuracy, accessibility, and support informed decision-making.

Academic Information Systems, Workflow Automation, and Institutional Integration

Workflow automation improves academic operations by reducing delays in enrollment, verification, and transcript processing through minimized manual intervention and improved data accuracy [5]. It also integrates key academic functions such as enrollment, grading, and attendance to ensure seamless data flow and reduced redundancy [6], while further enhancing efficiency by lowering workload and duplication in administrative tasks [7].

Academic management systems similarly unify academic and administrative processes, enabling real-time access to student data and improving coordination among stakeholders [8]. Digital transformation supports paperless operations and consistent data management across departments [9], while real-time reporting improves transparency and decision-making efficiency [10].

At a broader level, digital transformation is essential for improving efficiency and service quality in higher education, despite challenges such as fragmented systems and limited resources [11]. These inefficiencies contribute to reduced performance, which digital transformation addresses by embedding technology into core processes [12]. National AI policy frameworks further support this shift toward intelligent, integrated academic systems [13].

AI-Assisted Systems in Education

Artificial intelligence (AI) has become a transformative component of academic management systems by improving data processing, decision-making, and personalized learning experiences. AI-driven assessment systems enhance evaluation accuracy and provide individualized feedback, allowing educators to better address diverse student needs and improve instructional effectiveness and engagement [14]. Likewise, AI-based analysis of multidimensional student data, including academic performance and behavioral indicators, supports evidence-based decision-making by enabling institutions to identify learning patterns and strengthen academic interventions [15].

In addition, machine learning models contribute to early identification of at-risk students, enabling timely interventions that improve retention and academic success [16]. Natural Language Processing (NLP) further enhances system efficiency by automating student inquiries and improving administrative responsiveness through intelligent text processing and query handling [17]. Moreover, AI-enabled adaptive learning systems significantly increase user satisfaction by delivering personalized academic support and predictive insights that enhance both student experience and institutional responsiveness [18]. Collectively, these studies emphasize AI's growing role in building intelligent, adaptive, and student-centered academic systems.

Challenges of Semi-Manual and Fragmented Systems and Architectural Requirements

Despite advances in digital systems, many medical education institutions still struggle with semi-manual and fragmented information systems. Hybrid processes often cause inefficiencies, data inconsistencies, and delayed academic processing [18], while fragmented architectures create data silos that limit real-time access to unified student information and disrupt clinical tracking, academic monitoring, and competency evaluation [19]. Security and privacy risks also persist, requiring strict safeguards such as role-based access control and encrypted storage for sensitive academic and clinical data [20]. In addition, fragmented systems weaken academic advising by limiting access to complete student profiles, delaying interventions for at-risk students [21]. Collectively, these issues highlight the need for fully integrated and secure systems in medical education.

Addressing these challenges requires a robust architectural framework that ensures scalability, interoperability, and system integration. Enterprise architecture aligns technology with institutional goals and improves data flow across departments [22], while modular and service-based designs

enable seamless integration of academic and clinical systems for greater flexibility and scalability [23]. Cloud-based architectures further enhance performance through centralized data storage, real-time access, and improved security [24]. Emerging technologies such as machine learning and predictive analytics support early identification of at-risk students and targeted interventions [25], while Natural Language Processing improves system responsiveness through automated communication and query handling [26]. However, ethical considerations remain important, as excessive automation may reduce human judgment in academic decision-making, particularly in medical education [27]. Finally, successful implementation depends on institutional readiness and digital literacy, with faculty competence, training, and organizational support identified as critical success factors [28]

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2. RESEARCH METHODOLOGY

This study employs a descriptive–developmental mixed-methods research design to examine current academic workflows and develop an AI-enhanced framework focused on improving efficiency in enrollment, evaluation, and student progression tracking within the Southwestern University PHINMA School of Medicine. The design is appropriate as it allows the researchers to both describe current institutional processes and develop an AI-assisted Medical Student Information System (MSIS) aimed at improving workflow efficiency, data management, and decision-making support. The descriptive component focuses on analyzing existing workflows in enrollment, academic records management, evaluation, and document processing, while the developmental component focuses on system design and implementation. The study integrates both qualitative and quantitative approaches, where qualitative data are used to explore stakeholder experiences and workflow processes, and quantitative data are used to measure the frequency and severity of identified operational issues.

The participants of the study consist of medical students, evaluators, the college secretary, and administrative staff, who are directly involved in academic and administrative processes. The total population is estimated at 477 individuals, and a sample size of 212 respondents is determined using Slovin's Formula with a 95% confidence level and 5% margin of error. A stratified sampling technique is used to ensure proportional representation of each group, with students categorized by year level and staff categorized according to role. This approach ensures that all relevant stakeholders are adequately represented in the analysis of current workflows and system requirements.

Prior to data collection, Institutional Review Board (IRB) clearance was obtained from the Southwestern University PHINMA Research Ethics Committee to ensure adherence to ethical standards. Informed consent procedures were strictly followed, whereby all participants were provided with detailed information about the study's purpose, procedures, potential risks, and their right to withdraw at any time without penalty. Data collection was then conducted through semi-structured interviews, structured surveys, document analysis, and workflow observation. Interviews with key administrative personnel and evaluators provide in-depth qualitative insights into existing processes and challenges, while surveys administered to students and staff quantify the frequency and severity of issues using Likert-scale measurements. Document analysis and workflow observation are used to validate and triangulate findings by examining actual institutional records and procedures, ensuring consistency and accuracy of gathered data.

For data analysis, the study employs both qualitative and quantitative techniques. Quantitative data are analyzed using frequency distribution, percentage, weighted mean, and standard deviation to summarize and interpret survey responses. The weighted mean is computed using the formula $WM = \Sigma fx$ N, where f represents frequency, x represents the assigned scale value, and Nrepresents the total number of respondents. Qualitative data are analyzed through thematic analysis to identify recurring patterns, workflow inefficiencies, and stakeholder concerns, which are further supported by workflow mapping for visualization of process structures.

The study adopts the Agile Software Development Methodology, specifically a sprint-based framework, to guide the development of the proposed MSIS. This iterative approach includes repeated cycles of

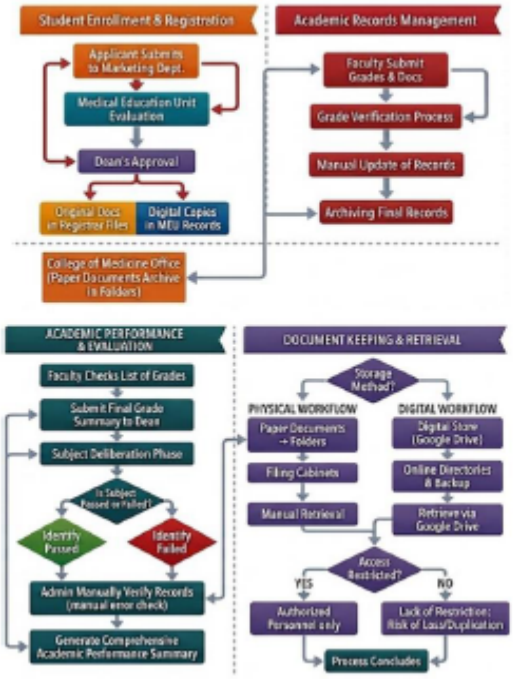
requirements analysis, system design, development, testing, and deployment, allowing continuous refinement based on stakeholder feedback. Supporting tools such as Google Forms and Google Sheets are used for data collection and statistical analysis, while Figma FigJam and Lucidchart are used for workflow visualization and system modeling, including data flow diagrams and entity-relationship diagrams.

3. RESULT AND DISCUSSION

Existing Operational Workflows and Data-Handling Processes in Academic Record Management

The qualitative findings from interviews with the evaluators and administrators reveal that academic and administrative workflows at SWU PHINMA School of Medicine remain predominantly semi-manual and fragmented despite the presence of limited digital tools. As shown in Figure 1, the overall process aligns with the four areas identified in the research question.

Figure 1. Current Workflow within the School of Medicine

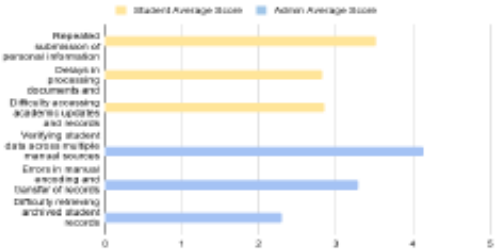


For enrollment and registration, workflows involve multiple manual verification and approval stages, resulting in delays and queue congestion. In academic records management, processes remain dependent on manual encoding, grade processing, and cross-verification, increasing risks of redundancy and data inconsistencies. For academic evaluation and monitoring, continuous tracking of student performance requires repeated encoding, verification, and coordination among stakeholders, reflecting an iterative and labor-intensive system. Meanwhile, document handling and administrative processing follows a hybrid setup, but remains fragmented due to duplicated submissions and inconsistent integration of digital and physical records. Thematic keyword density further supports these findings, with frequent terms such as “manual,” “verification,” “encoding,” “grades,” and “documents” consistently appearing across all categories, indicating persistent reliance on manual processes. Overall, the results show that all identified workflows remain largely semi-manual, leading to inefficiencies, delays, and limited system integration [3][4].

Identified Limitations and Challenges in Semi-Manual and Fragmented Academic and Administrative System

The combined findings from students and administrative personnel reveal a consistent pattern of inefficiencies across the academic and administrative processes at SWU PHINMA School of Medicine. As summarized in Figure 2, both groups identified that the current system is predominantly semi-manual and fragmented, characterized by repeated encoding of information, multi-step verification processes, and limited integration across offices.

Figure 2. Perceived Limitations in Academic and Administrative Processes

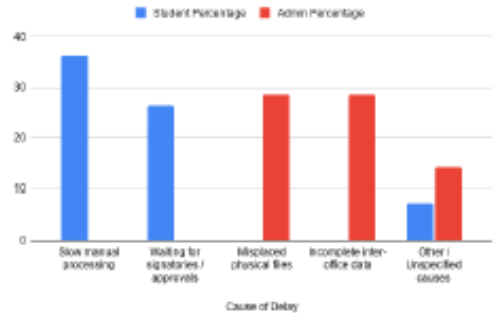


From the student perspective, key issues include repeated submission of information (M = 3.52), delays in processing documents (M = 2.82), and moderate difficulty in accessing academic updates and records (M = 2.84). These experiences are closely aligned with administrative findings, where high difficulty in verifying student data across multiple sources (M = 4.14), manual encoding errors (M =

3.29), and difficulty retrieving archived records (M = 2.29) were reported. Collectively, these results confirm that inefficiencies are not isolated per group but are system-wide, primarily driven by fragmented data handling and the absence of full system integration [5][19].

Further analysis of the underlying causes of these inefficiencies is presented in Figure 3.

Figure 3. Major Causes of Delays in Academic and Administrative Processes

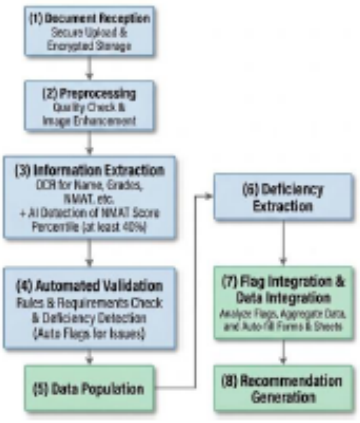


The results show that both students and administrative personnel attribute delays to similar operational bottlenecks, reinforcing the consistency of their experiences. Among students, the most common causes of delays are slow manual processing (36.27%) and waiting for signatories (26.42%), indicating dependency on sequential approval workflows and manual handling of documents. On the other hand, administrative staff identify misplaced physical files (28.57%) and incomplete inter-office data (28.57%) as the primary contributors to processing delays, reflecting weaknesses in document organization and inter-departmental coordination. When combined, these findings highlight that delays are primarily rooted in manual, paper-based workflows and fragmented information exchange between offices. Overall, both visualizations support the conclusion that the current system lacks centralized integration, resulting in inefficiencies, redundancy, and delayed academic and administrative transactions [8][19].

Design Framework and Technological Architecture for an AI-assisted Information System

The cumulative effect of fragmented academic and administrative workflows results in persistent delays, redundant encoding, and inconsistent record handling across offices. Findings indicate that these inefficiencies are mainly driven by decentralized data storage, reliance on physical documents, and sequential approval processes, reflecting a low-to-moderate level of system integration where partial digitization fails to support interoperability [1]. To address these issues, thematic analysis identified key requirements for an AI-assisted MSIS, focusing on automation of manual tasks, centralized data management, and transition to paperless transactions. The system must also support real-time tracking and retrieval of records to improve processing speed and accessibility. Additionally, the proposed architecture must streamline workflows by integrating departmental processes into a unified platform, reducing redundancy and improving coordination across offices. Ultimately, the AI-assisted MSIS provides a consolidated and intelligent system that enhances efficiency, ensures data consistency, and supports faster, more reliable academic and administrative decision-making [2][23][24]. Specifically, the system leverages a hybrid AI approach for the system flow using OpenAI: Rule-based engine + Predictive ML + LLM, and a Random Forest prediction model is utilized to maximize the reuse of student's historical data. Figure 4 illustrates the AI Model Workflow of the proposed Medical Student Information System (MSIS)

Figure 4. AI Model Workflow



The process begins with (1) Document Reception, where secure upload and encrypted storage of student documents take place. These files undergo (2) Preprocessing, including quality checks and image enhancement, to optimize text legibility. An

AI-based (3) Information Extraction engine utilizing OCR pulls key data fields like names, grades, and NMAT scores, specifically detecting if the NMAT percentile is at least 40%. The system then runs (4) Automated Validation, which is enhanced by the OpenAI model to improve the accuracy and intelligence of rule checking, anomaly detection, and contextual validation of extracted data. Next, (5) Data Population maps the validated data to auto-fill internal forms and database sheets. This feeds into (6) Deficiency Extraction and Flag Integration, which aggregates and analyzes the system flags. Finally, (7) Recommendation Generation synthesizes the data and flags to output an automated evaluation status.

This AI model demonstrates how artificial intelligence can significantly improve academic workflows. In enrollment, AI automates document extraction and validation, reducing processing time from days to hours. For academic evaluation, the system performs intelligent rule-based checking and deficiency detection, ensuring consistent and accurate assessment while minimizing human error. For student progression tracking, real-time flag integration and recommendation generation enable advisors and administrators to monitor student migration across program stages and provide timely interventions. Overall, the AI-enhanced framework reduces manual workload, improves data accuracy, and supports proactive decision-making.

4. CONCLUSION

This study concludes that the current academic and administrative workflows at SWU PHINMA School of Medicine remain semi-manual and fragmented, particularly in enrollment, records management, evaluation, and student progression tracking. These conditions result in recurring delays, redundant encoding, and inconsistencies in data handling due to reliance on physical documents and sequential approval processes. Findings further show that both students and administrative personnel experience similar challenges, including delayed processing of requirements, repeated submission of information, and difficulties in accessing, verifying, and retrieving records. These issues are primarily driven by the lack of a centralized and fully integrated information system.

In response, the study establishes the need for an AI-enhanced framework that supports automation of enrollment processes, intelligent academic evaluation, real-time student progression tracking, centralized data management, and streamlined workflows. This research demonstrates how AI can transform these workflows by automating repetitive tasks, enhancing evaluation accuracy through OCR and rule-based validation, and enabling proactive student progression monitoring. The proposed system further leverages the OpenAI model to strengthen data validation processes. With appropriate security mechanisms and system integration, the proposed AI-assisted Medical Student Information System (MSIS) significantly improves overall academic and administrative efficiency within the institution and offers a practical model for AI adoption in medical education.

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