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## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# Assessment of Digitalization and ICT Adoption in NEMSU Using a Web-based Platform with Predictive Data Analytics

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**ABSTRACT:** This study assessed ICT adoption and digitalization in a Philippine university using a web-based platform with predictive analytics. Data from 721 faculty and staff were analyzed using K-Means clustering and Decision Tree algorithms to segment users and predict adoption trends. Results showed 59.5% Developing Adopters, 31.1% Digital Champions, and 9.4% Technologically Resistant, with an Institutional Digital Maturity Index of 69.5%. The predictive model achieved an accuracy of 98.61%, precision of 99.21%, recall of 98.83%, and an F1-score of 99%, indicating reliable ICT readiness assessment. System evaluation based on ISO 25010 ratings demonstrated high performance across all quality characteristics, with mean scores of Functionality 4.84, Efficiency 4.85, Reliability 4.82, Usability 4.86, Security 4.72, and Maintainability 4.83. These findings provide actionable insights for targeted digital interventions and support informed decision-making for institutional digital transformation.

**KEYWORDS:** ICT adoption, digital maturity, predictive analytics, K-Means clustering, decision tree, higher education

## I. INTRODUCTION

Digitalization and predictive analytics are reshaping higher education operations. Despite global advances, resource-limited universities face challenges integrating digital tools effectively. At North Eastern Mindanao State University (NEMSU), ICT adoption is uneven across campuses and departments. Current Learning and Development practices provide insufficient training, creating gaps in digital readiness. This study develops a predictive analytics web-based platform to evaluate ICT adoption, identify barriers, and support targeted interventions to enhance digital competency and institutional decision-making.

This study integrates multiple theoretical foundations to guide the assessment of ICT adoption and digitalization at NEMSU. The Sequential Model (Creswell & Creswell, 2018) provides a structured, stepwise research approach enabling systematic data collection, analysis, predictive modeling, and evidence-based decision-making. The Technology Acceptance Model (TAM) (Davis, 1989; Venkatesh & Davis, 2000) evaluates perceived usefulness and perceived ease of use of ICT tools, shaping both behavioral intention and actual usage. Predictive Analytics Theory (Machine Learning) (Dasgupta et al., 2011; Curran & Meuter, 2005) supports data-driven classification, trend forecasting, and identification of adoption factors. Agile Software Development Methodology (Beck et al., 2001) guides iterative system development and the integration of real-time predictive analytics within the web-based platform. Collectively, these frameworks support the design, analysis, and interpretation of the digitalization assessment, ensuring alignment with institutional goals, methodological rigor, and practical relevance.



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### Input-Process-Output (IPO) Diagram of the Study

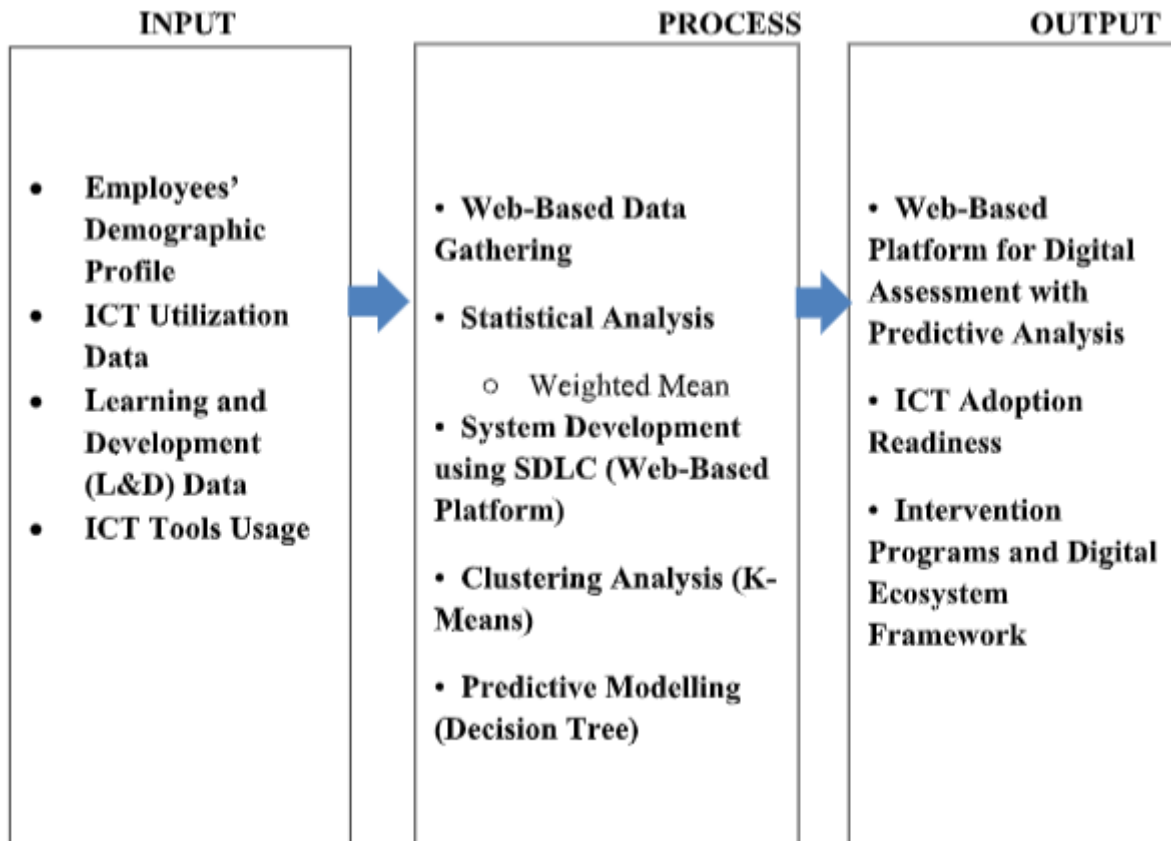


Figure 1. Conceptual Framework of the Study

The Input-Process-Output (IPO) diagram illustrates the flow of data through the study. Inputs include demographic profiles, ICT tool usage, and learning and development data. Processes encompass data preprocessing, K-Means clustering, Decision Tree predictive modeling, and system analytics. Outputs are ICT maturity scores, predictive insights, and the proposed Smart Campus Framework, guiding institutional decision-making and targeted interventions.

## II. LITERATURE SURVEY

Global studies highlight smart campus frameworks and Industry 4.0 technologies to optimize operations and learning outcomes. Integration of LMS, cloud services, and predictive analytics improves efficiency, engagement, and sustainability. Local literature emphasizes barriers such as digital literacy gaps, infrastructure constraints, and limited professional development. Despite existing frameworks, few scalable solutions exist for resource-constrained institutions to assess ICT adoption, predict readiness, and implement targeted training, revealing a research gap addressed by this study.

## III. METHODOLOGY / APPROACH

A descriptive-developmental design was employed, with data collected from 721 permanent faculty and staff across all NEMSU campuses. Survey instruments measured ICT usage, digital competency, training participation, and infrastructure access. Data were processed using K-Means clustering to segment ICT readiness levels, and Decision Tree algorithms to identify key factors influencing adoption. A three-layered web-based platform was developed



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following Agile SDLC principles, integrating real-time dashboards, predictive analytics, and secure data handling. System evaluation utilized ISO 25010 criteria, while weighted mean analysis summarized user competency and adoption metrics.

The AI Predictive Workflow provides a comprehensive visual representation of the study's methodology. The workflow comprises sequential stages, from data collection to the development of the Smart Campus Framework, ensuring clarity, reproducibility, and alignment with established machine learning principles.

1. Data Collection: Survey responses and institutional ICT usage data were gathered from faculty and staff. Eligibility was verified using HR records to ensure accurate sampling.
2. Data Preprocessing: Raw data were cleaned, missing values handled, and features normalized using z-score standardization.
3. Feature Selection: Relevant variables including ICT tool usage, digital competency, training participation, and infrastructure access were selected.
4. Clustering Analysis: K-Means clustering segmented respondents into Digital Champions, Developing Adopters, and Technologically Resistant groups.
5. Predictive Model Development: Decision Tree algorithms were trained to identify key factors influencing ICT adoption.
6. Model Validation: Performance was evaluated using Accuracy, Precision, Recall, and F1-score; expert review ensured interpretability and reliability.
7. Framework Generation: Outputs informed the proposed Smart Campus Framework, guiding interventions, training programs, and institutional planning.

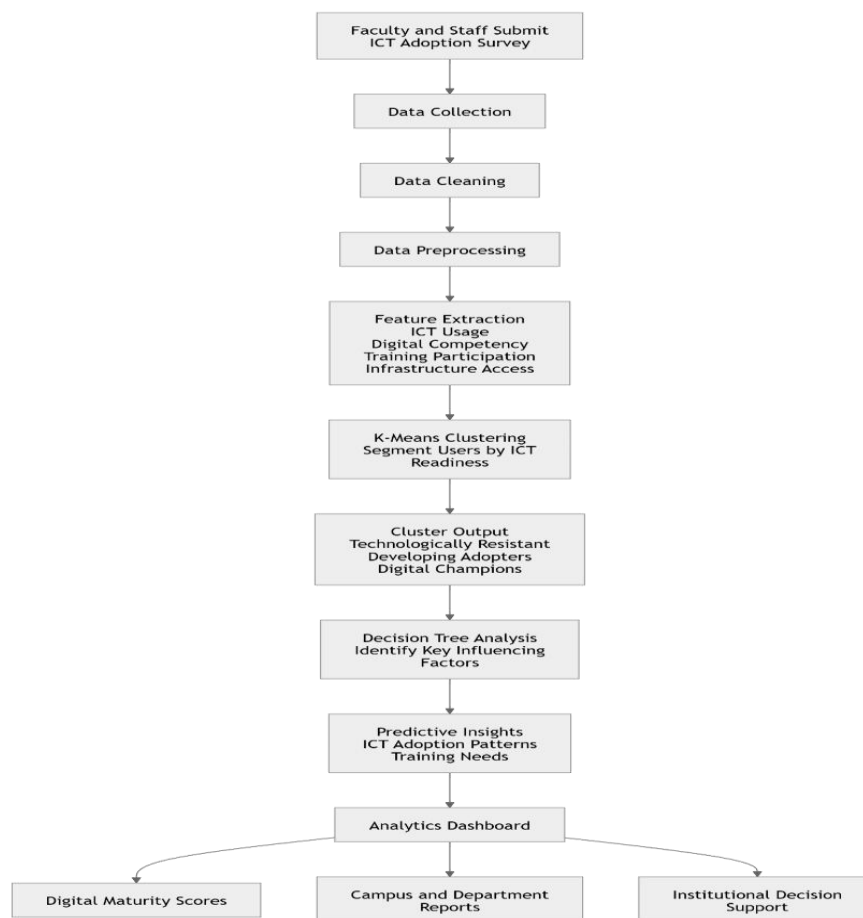


Figure 2. AI Predictive Workflow for ICT Adoption Assessment and Smart Campus Framework Development



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### System Architecture

The System Architecture diagram presents the three-layered web-based platform developed in this study. The User Interface Layer allows faculty and staff to interact with the system, complete surveys, and view dashboards. The Web Application Layer manages survey data, performs clustering and predictive analysis, and provides interactive visualizations. The Application and Data Layers handle authentication, analytics computation, data storage, and report generation. This architecture ensures modularity, scalability, and reliability across all NEMSU campuses.

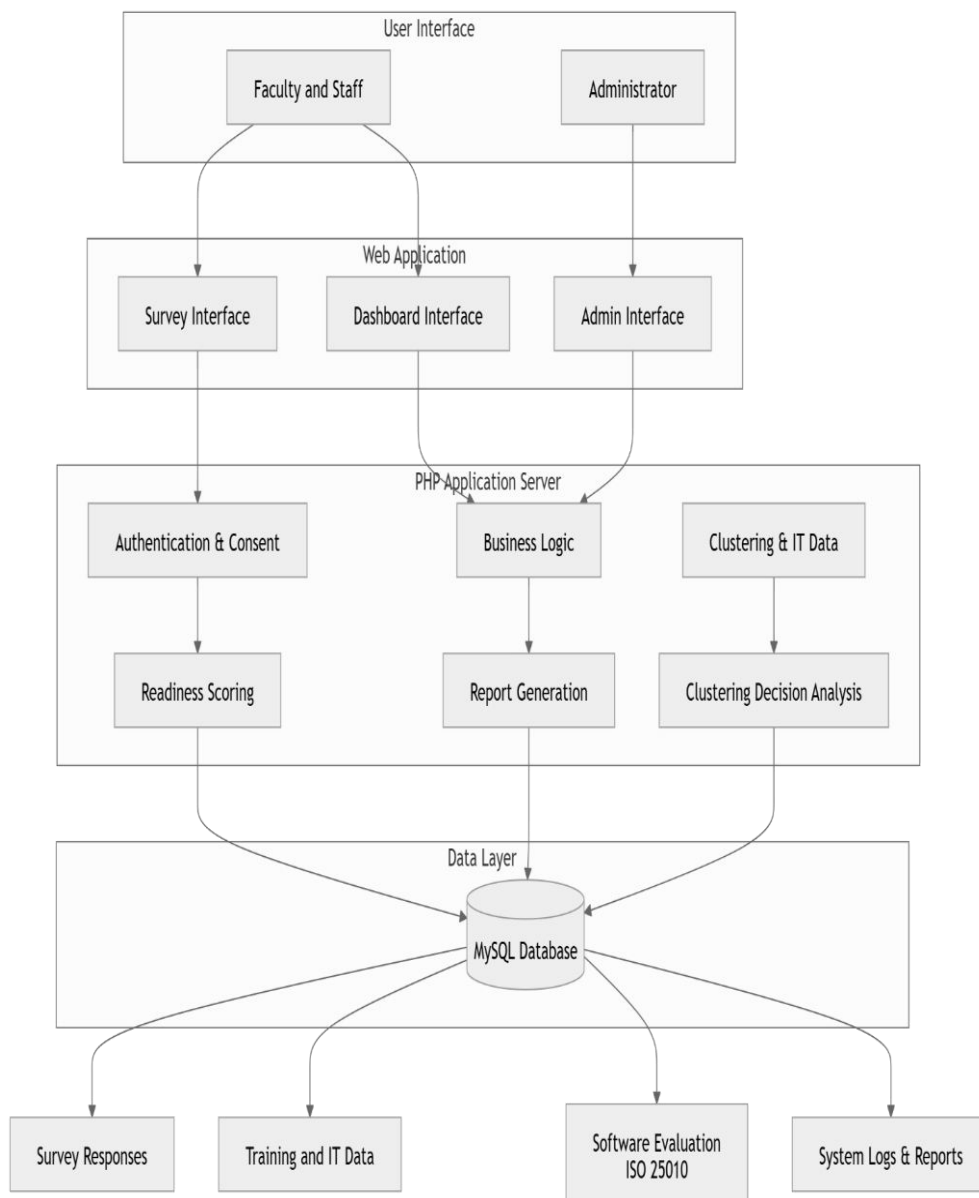


Figure 3. System Architecture Diagram

### IV. RESULTS AND DISCUSSION

Analysis revealed 59.5% Developing Adopters, 31.1% Digital Champions, and 9.4% Technologically Resistant users. The Institutional Digital Maturity Index was 69.5%, reflecting moderate adoption progress. Competency assessment showed high proficiency in CITE, moderate in CET and CAS, and lower in administrative departments. Barriers



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included connectivity issues (21%), outdated hardware/software (20%), limited technical support (20%), and heavy workloads (20%). Training demand was highest for basic computer operations, multimedia content creation, and LMS management, with a preference for face-to-face workshops. Predictive analytics achieved accuracy 98.61%, precision 99.21%, recall 98.83%, and F1-score 99%, confirming reliable readiness predictions. These findings support targeted training, infrastructure improvements, and policy interventions to enhance ICT adoption and digital transformation at NEMSU.

**Table 1.**  
Summarizes the major findings of the study, integrating statistical outcomes, clustering results, predictive analytics outputs, and recommendations for the Smart Campus Framework.

Key Findings	Statistical Outcomes	Cluster Results	Predictive Analytics Output	Framework Recommendations
<b>Institutional Digital Maturity</b>	69.5%	Developing Adopters	N/A	Targeted ICT training
<b>ICT Adoption by Staff</b>	59.5% Developing Adopters; 31.1% Digital Champions; 9.4% Technologically Resistant	3 Clusters	Decision Tree: Key adoption factors	Department-specific training & peer mentoring
<b>Competency by Department</b>	CITE High, CET/CAS Moderate	Clustered by proficiency	N/A	Focus on low proficiency departments
<b>Predictive Forecast</b>	68.1% (2026) → 95% (2029)	Trend Analysis	High Accuracy, F1 99%	Plan phased interventions
<b>Barriers</b>	Connectivity 21%, Hardware 20%, Tech Support 20%, Workload 20%	Identified Resistant Users	Rules & Alerts in System	Upgrade infrastructure, technical support

Each result is interpreted in the context of institutional decision-making. The clustering highlights priority areas for intervention, while predictive analytics identifies key influencing factors. These insights support the implementation of the Smart Campus Framework by informing training programs, resource allocation, and ICT policy development, ensuring alignment with institutional goals and operational efficiency.

**Table 2.**  
Summary of Results

Evaluation Criteria	Mean Score	Interpretation
Functionality	4.84	Strongly Agree
Efficiency	4.85	Strongly Agree
Reliability	4.82	Strongly Agree
Usability	4.86	Strongly Agree
Security	4.72	Strongly Agree
Maintainability	4.83	Strongly Agree
<b>General Mean Score</b>	<b>4.82</b>	<b>Strongly Agree</b>

Table 2 presents a summary of the evaluation of the NEMSU Digitalization and ICT Adoption System across six critical software quality characteristics as defined by ISO 25010. Each criterion—Functionality, Efficiency, Reliability, Usability, Security, and Maintainability—was rated by users through a structured software quality evaluation survey. The mean scores, ranging from 4.72 to 4.86, all fall within the “Strongly Agree” category, indicating that users perceive the system to consistently meet or exceed expectations in each area. Functionality (M = 4.84) reflects the system’s effectiveness in executing its intended tasks without errors. Efficiency (M = 4.85) demonstrates the platform’s responsiveness and resource optimization, including rapid loading times and smooth operation across devices. Reliability (M = 4.82) indicates system stability, with minimal downtime or interruptions, ensuring consistent performance. Usability (M = 4.86) highlights the intuitive interface design and ease of navigation, enhancing user



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experience. Security ( $M = 4.72$ ) reflects user confidence in the protection of sensitive data, including role-based access controls and data privacy measures. Maintainability ( $M = 4.83$ ) underscores the system's capacity for updates, troubleshooting, and retraining predictive models with minimal effort. The overall general mean score of 4.82 reinforces that the platform is highly effective, user-friendly, secure, and adaptable, supporting institutional digital transformation initiatives and informed decision-making.

### V. CONCLUSION

NEMSU has made notable progress in ICT adoption, yet gaps remain across departments and campuses. The predictive analytics platform reliably assessed digital readiness, identifying user clusters and adoption barriers. Focused interventions, including targeted training, infrastructure upgrades, and mentorship by Digital Champions, are recommended. Future research could explore longitudinal adoption trends, cross-institutional comparisons, and AI-driven adaptive learning to further optimize digital transformation in higher education.

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