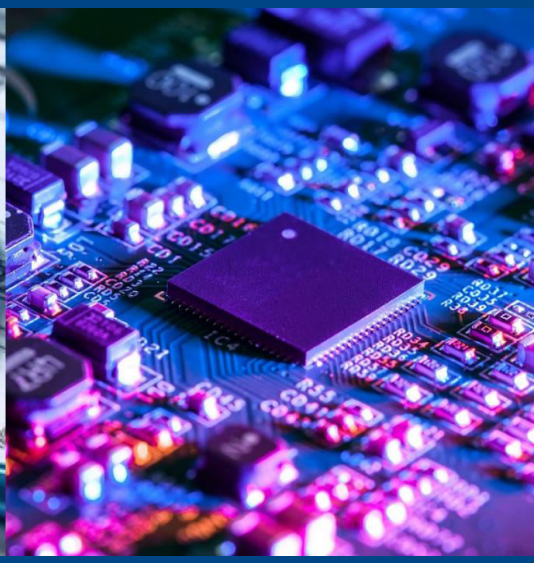
ISSN: 2582-7219





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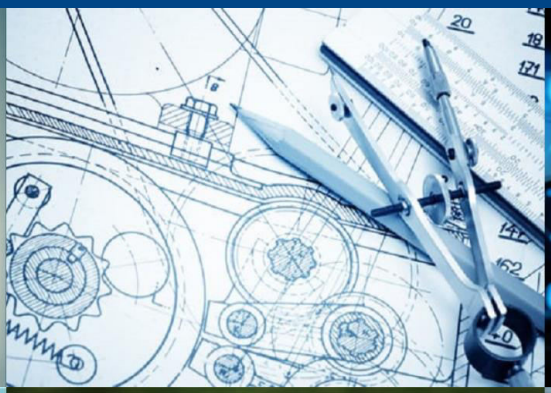

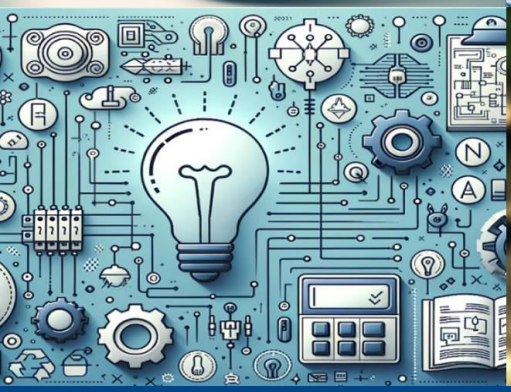

Impact Factor: 9.864

Volume 9, Issue 5, May 2026

© 2026 IJMRSET | Volume 9, Issue 5, May 2026| DOI:10.15680/IJMRSET.2026.0905096

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 9.864| ESTD Year: 2018|

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

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Predictive Analytics on Student Enrollment Trends at NEMSU Cantilan Campus

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ABSTRACT: This study developed and evaluated a Predictive Analytics on Student Enrollment Trends at NEMSU Cantilan Campus. The system aimed to improve institutional planning and enrollment management through data-driven forecasting using machine learning and time-series analysis. The study utilized a descriptive-developmental research design and Agile Software Development Life Cycle methodology. The developed model integrated historical enrollment records, forecasting algorithms, administrative dashboards, and predictive analytics tools to support strategic decision-making. Evaluation using ISO/IEC 25010 revealed that the system achieved "Strongly Agree" ratings in functionality, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability.

KEYWORDS: Predictive Analytics, Enrollment Forecasting, Facebook Prophet, Machine Learning, Agile SDLC

I. INTRODUCTION

State universities in the Philippines continue to experience challenges in balancing increasing student populations with limited institutional resources. At North Eastern Mindanao State University (NEMSU) Cantilan Campus, enrollment management still relies heavily on manual estimation and historical assumptions, which often lead to overcrowded classrooms, faculty shortages, and inefficient resource allocation. These issues highlight the need for a data-driven forecasting system capable of supporting proactive institutional planning.

Several studies emphasize the importance of predictive analytics and machine learning in improving educational management systems. Dela Cruz and Santos (2024) explained that the implementation of the Universal Access to Quality Tertiary Education Act caused significant fluctuations in student demographics, making traditional enrollment estimation methods less reliable. Similarly, Hsu and Lin (2024) noted that machine learning models such as Long Short-Term Memory (LSTM) networks and time-series forecasting algorithms effectively capture complex enrollment behaviors and long-term trends.

Despite the advancement of predictive systems globally, many local higher education institutions still lack localized forecasting tools tailored to regional enrollment patterns and socio-economic conditions. Existing systems often focus on national-level analysis and fail to address the unique operational realities of provincial campuses such as NEMSU Cantilan.

To address these problems, the researchers developed a Predictive Analytics Model for Enrollment Trends at NEMSU Cantilan Campus. The system integrates historical enrollment data, forecasting algorithms, machine learning techniques, and administrative visualization tools to support data-driven planning and decision-making.

The study is significant because it assists university administrators, registrars, department heads, and faculty members in forecasting future enrollment demands, improving resource planning, and supporting institutional sustainability. Furthermore, the study serves as a reference for future researchers exploring predictive analytics and educational data science applications.

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II. LITERATURE SURVEY

Educational institutions worldwide continue to adopt predictive analytics and machine learning technologies to improve institutional planning, enrollment forecasting, and resource management.

Xu et al. (2021) emphasized that accurate enrollment forecasting supports institutional sustainability and long-term strategic planning. Armstrong and Brown (2022) further explained that data-driven decision-making transforms educational administration by improving evidence-based management practices.

Taylor and Letham (2021) highlighted the effectiveness of Facebook Prophet in handling time-series forecasting with seasonal fluctuations and non-linear trends. Similarly, Merkurius et al. (2026) compared forecasting algorithms such as ARIMA, Prophet, and LSTM and found that machine learning significantly improves enrollment prediction accuracy.

Local studies in the Philippines also support the integration of predictive systems in educational institutions. Arriola (2024) explained that predictive analytics helps reduce overcrowding and supports proactive faculty allocation. Garcia (2025) further identified data siloing as a major challenge in state universities, emphasizing the importance of centralized forecasting systems.

Villanueva and Reyes (2025) additionally stated that many local studies fail to address the unique socio-economic characteristics of satellite campuses, creating a need for localized predictive frameworks specifically designed for provincial universities.

Table 1. Summary of Related Literature

No.	Paper Title	Author/s	Key Points	Remarks
1	Forecasting at Scale with Additive Regression Models	Taylor & Letham (2021)	Facebook Prophet improves time-series forecasting accuracy.	Supports forecasting engine implementation.
2	Enrollment Forecasting for Institutional Stability	Xu et al. (2021)	Predictive analytics supports strategic educational planning.	Supports enrollment forecasting objectives.
3	Data-Driven Decision-Making in Universities	Armstrong & Brown (2022)	Evidence-based management improves institutional operations.	Supports administrative decision support.
4	Machine Learning-Based Enrollment Prediction	Mawarni & Wibisono (2025)	Predictive systems improve program-specific forecasts.	Supports machine learning integration.
5	Predictive Recruitment and Faculty Planning	Arriola (2024)	Forecasting systems reduce overcrowding and staffing issues.	Supports proactive institutional planning.
6	Data Siloing in State Universities	Garcia (2025)	Centralized data systems improve long-term planning.	Supports integrated analytics platform.

The reviewed literature collectively supports the development of the Predictive Analytics Model by demonstrating how forecasting systems, machine learning algorithms, and educational analytics improve institutional planning, operational efficiency, and data-driven decision-making.

III. METHODOLOGY / APPROACH

Research Design

This study utilized a descriptive-developmental research design to develop and evaluate the Predictive Analytics Model for Enrollment Trends at NEMSU Cantilan Campus. The study focused on designing, implementing, and assessing a forecasting platform intended for administrators, registrars, department heads, and academic planners.

The Agile Software Development Life Cycle (SDLC) was adopted as the primary development methodology. Agile development enabled iterative refinement of forecasting models, dashboards, and predictive tools through continuous evaluation and stakeholder feedback.

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System Features

The developed system integrated the following major components:

1. Enrollment Forecasting Module

Provides projected enrollment trends using time-series forecasting and machine learning algorithms.

2. Administrative Dashboard

Displays enrollment statistics, projections, and data visualization reports.

3. Data Analytics Module

Processes historical enrollment records and generates predictive insights.

4. Program-Specific Forecasting

Allows departments to view projected student populations and capacity requirements.

5. Automated Reporting System

Generates reports and statistical summaries for institutional planning.

Respondents of the Study

The respondents of the study were selected using purposive sampling and included:

- Campus Administrators – 3
- Registrar Staff – 5
- Department Heads and Program Chairs – 7
- IT Faculty and Technical Experts – 5

Total Respondents: 20

Data Collection

Data collection was conducted through interviews, consultations, historical data retrieval, prototype testing, and ISO/IEC 25010 evaluation questionnaires. Respondents evaluated the system by performing forecasting tasks, dashboard monitoring, report generation, and enrollment analytics activities.

Data Analysis

The collected data were analyzed using the following statistical treatments:

1. Weighted Mean – Used to determine software acceptability based on ISO/IEC 25010 quality criteria.
2. Mean Absolute Percentage Error (MAPE) – Used to measure forecasting accuracy.
3. Root Mean Square Error (RMSE) – Used to evaluate model prediction performance.
4. Qualitative Analysis – Applied to summarize user feedback and system observations.

IV. RESULTS & DISCUSSION

System Features

The results revealed that the Predictive Analytics Model successfully implemented its intended enrollment forecasting and analytics functionalities.

Enrollment Forecasting Feature

The system generated accurate enrollment projections using historical institutional data and machine learning forecasting techniques.

Administrative Dashboard Feature

The dashboard provided centralized monitoring of enrollment statistics, projected trends, and institutional planning reports.

Automated Reporting Feature

The reporting module enabled administrators and departments to generate enrollment summaries and forecasting reports efficiently.

Performance Evaluation

The developed Predictive Analytics Model was evaluated using the ISO/IEC 25010 Software Quality Model to determine its quality, reliability, usability, and effectiveness. Respondents composed of administrators, registrar staff,

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department heads, and IT experts evaluated the system based on functionality, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The evaluation results revealed that the system achieved "Strongly Agree" ratings across all categories, indicating strong user acceptance and excellent system performance.

Table 2. Performance Evaluation of Predictive Analytics Model

Table	Quality Characteristics	Mean	Verbal Interpretation
1	Functional Suitability	4.78	Strongly Agree
2	Performance Efficiency	4.63	Strongly Agree
3	Compatibility	4.59	Strongly Agree
4	Usability	4.46	Agree
5	Reliability	4.59	Strongly Agree
6	Security	4.83	Strongly Agree
7	Maintainability	4.53	Strongly Agree
8	Portability	4.58	Strongly Agree
	Grand Mean	4.62	Strongly Agree

The evaluation results showed that the Predictive Analytics Model achieved high ratings across all software quality characteristics. Security obtained the highest mean of 4.83, indicating that respondents highly trusted the system's authentication and data protection mechanisms. Functional suitability also received a high rating, confirming that the forecasting system effectively supports enrollment analytics and administrative planning requirements.

Usability obtained the lowest mean of 4.46; however, it was still interpreted as "Agree," indicating that the platform remains user-friendly despite opportunities for interface and orientation improvements. Overall, the findings confirm that the developed system is reliable, efficient, secure, and highly effective for enrollment forecasting and institutional planning at NEMSU Cantilan Campus.

V. CONCLUSION

The study successfully developed and evaluated the Predictive Analytics Model for Enrollment Trends at NEMSU Cantilan Campus. The system effectively addressed the existing challenges in enrollment forecasting, resource allocation, and institutional planning through data-driven predictive analytics and machine learning techniques.

Through the integration of historical enrollment records, forecasting algorithms, administrative dashboards, and automated reporting tools, the system provided a more organized, accurate, and reliable forecasting platform for administrators, registrars, and academic planners.

The evaluation results based on the ISO/IEC 25010 Software Quality Model confirmed that the system achieved high ratings across all software quality characteristics, including functionality, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. These findings demonstrate that the system is dependable, efficient, secure, and capable of supporting strategic enrollment management effectively.

Therefore, the Predictive Analytics Model is considered an effective and acceptable forecasting platform that improves institutional planning, enrollment management, and data-driven decision-making at NEMSU Cantilan Campus.

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