Journal of Computer Sciences and Applications, 2025, Vol. 13, No. 2, 48-53
Available online at http://pubs.sciepub.com/jcsa/13/2/2
Published by Science and Education Publishing
DOI:10.12691/jcsa-13-2-2

Unveiling Patterns and Predictions: A Systematic Review on Predictive Classification and Trend Forecasting in Faculty Performance Evaluation in the Philippine Higher Education

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Received October 01, 2025; Revised November 01, 2025; Accepted November 09, 2025

Abstract This study, titled Unveiling Patterns and Predictions: A Systematic Review on Predictive Classification and Trend Forecasting in Faculty Performance Evaluation in Philippine Higher Education, examines how predictive analytics and machine learning models are revolutionizing faculty evaluation systems. Through a systematic literature review using a Narratological Approach, several studies from 2019 to 2025 were analyzed to trace the evolution from traditional descriptive evaluation toward data-driven and predictive methodologies. The findings reveal that models such as Decision Trees, Random Forest, Naïve Bayes, ARIMA, and LSTM effectively classify performance outcomes and forecast developmental trends. Key determinants influencing predictive accuracy include pedagogical competence, research productivity, ICT integration, workload balance, and professional engagement. Forecasting models further enable institutions to anticipate faculty growth trajectories and design timely interventions. However, challenges such as fragmented data systems, limited analytics literacy, and ethical concerns constrain implementation within Philippine higher education. The study concludes that integrating predictive classification and trend forecasting can transform evaluation into a proactive, evidence-based process that fosters continuous improvement. Further, Unveiling Patterns and Predictions represents a paradigm shift—where faculty performance evaluation evolves from static assessment into a dynamic mechanism for institutional growth, innovation, and excellence in the digital age.

Keywords: *Predictive Analytics, Faculty Evaluation, Trend Forecasting*

Cite This Article: Von P. Gabayan, Lemuel C. Sanchez, Sherilyn P. Tobias, Michael John R. Robles, and Carmelo Alejo D. Bisquera, "Unveiling Patterns and Predictions: A Systematic Review on Predictive Classification and Trend Forecasting in Faculty Performance Evaluation in the Philippine Higher Education." *Journal of Computer Sciences and Applications*, vol. 13, no. 2 (2025): 48-53. doi: 10.12691/jcsa-13-2-2.

1. Introduction

In recent years, the landscape of higher education has undergone a profound transformation driven by the rise of data analytics and intelligent systems. As institutions strive to enhance instructional quality, the application of predictive analytics and trend forecasting has become essential in understanding and improving faculty performance. These approaches enable educational leaders to anticipate outcomes, identify critical determinants, and make informed decisions regarding teaching effectiveness and professional development. According to Liz-Domínguez et al. [1], predictive analysis tools have evolved from simple descriptive models to advanced algorithms capable of classifying and forecasting performance trends across complex educational datasets. In the Philippines, where faculty evaluation remains central to ensuring educational quality and accountability, integrating such analytical approaches presents an opportunity to modernize assessment systems and drive continuous institutional improvement.

Predictive classification, a vital branch of machine learning, allows the categorization of performance outcomes based on various attributes such as pedagogical competence, research engagement, and student feedback. Studies have shown that algorithms like decision trees, Naïve Bayes, and random forest can effectively classify academic outcomes and identify key predictors of success [2,3,4,5]. Almonteros et al. [2] applied predictive analytics to forecast student success, demonstrating how similar techniques could be adapted to analyze faculty trajectories. Likewise, Barrera [3] utilized multiple regression analysis to determine factors influencing mathematics performance—illustrating how quantitative modeling and

variable interrelations can inform data-driven evaluation systems. Similarly, Cinizan and Valdez [6] developed an enhanced faculty performance evaluation framework integrating analytics, providing a structured and objective foundation for evidence-based decision-making. These initiatives collectively highlight the shift from traditional evaluation methods to adaptive, AI-driven systems that elevate precision and transparency in educational assessment.

Parallel to predictive classification, trend forecasting has emerged as a complementary analytical approach in faculty evaluation. Time-series and regression-based forecasting methods are increasingly employed to detect long-term patterns and predict performance trajectories over multiple academic cycles [7,8,9]. These forecasting models enable administrators to monitor faculty growth, detect stagnation, and design targeted interventions for professional development. Liu et al. [7] proposed an LSTM-based classification method for time-series forecasting, demonstrating the potential of integrating deep learning with temporal trend analysis. Similarly, Benosa and Caguiat [10] examined prescriptive faculty performance analysis during the COVID-19 pandemic, showcasing how real-time forecasting tools can inform decision-making and academic policy reforms amid dynamic educational conditions.

Despite these advancements, research on predictive analytics for faculty performance evaluation in the Philippines remains limited compared to student-centered applications [11,12,13]. Most existing studies emphasize student achievement prediction, leaving a significant research gap in tailoring predictive and forecasting models to assess teaching effectiveness. Ordonez-Avila et al. [12] stressed the need for localized frameworks that incorporate institutional data, contextual determinants, and pedagogical indicators to ensure accurate and ethical implementation of machine learning in education. Furthermore, Guido and Orleans [14] observed that Philippine education research productivity lags behind regional counterparts, underscoring the importance of developing predictive evaluation systems rooted in local academic contexts and institutional needs.

Hence, this Systematic Literature Review, titled Unveiling Patterns and Predictions: A Systematic Review on Predictive Classification and Trend Forecasting in Faculty Performance Evaluation in Philippine Higher Education, aims to synthesize existing literatures and studies on predictive analytics and trend forecasting in the context of faculty evaluation. Using a Narratological Approach, this study traces the evolving narrative from descriptive evaluation methods to data-driven predictive frameworks, identifying the key determinants, factors, and datasets shaping faculty performance models. Furthermore, this research seeks to contribute to the reimagining of faculty performance evaluation — not merely as a measure of accountability, but as a predictive, developmental, and future-oriented process that advances the quality and sustainability of Philippine higher education [6,4,5].

2. Literature Review

Faculty performance evaluation has traditionally relied on subjective and descriptive measures such as peer reviews, student evaluations, and administrative assessments. While these conventional methods provide valuable qualitative insights, they often lack the capacity to predict future performance or uncover deeper patterns within instructional effectiveness [10,14]. Over the past decade, higher education institutions worldwide have transitioned toward predictive and data-driven evaluation frameworks, integrating machine learning, regression modeling, and trend forecasting techniques to achieve more objective, scalable, and actionable insights [1,12,13].

Through a narratological synthesis, this literature review unveils the evolution of research through five key themes: (1) Rise of Predictive Analytics, (2) Predictive Models in Education, (3) Forecasting Faculty Trends, (4) Determinants of Predictive Evaluation, and (5) Challenges in Philippine Higher Education.

Rise of Predictive Analytics

The emergence of predictive analytics represents a paradigm shift from descriptive evaluation toward proactive decision-making in educational management. According to Liz-Domínguez et al. [1], predictive analytics enables academic institutions to analyze complex educational datasets to forecast academic outcomes, providing administrators with early insights into performance trajectories. Ordonez-Avila et al. [12] emphasized that data mining and analytics-driven evaluation systems allow early identification of instructional gaps and performance declines, facilitating evidence-based interventions.

In support of this, Barrera [3] applied multiple regression analysis to model academic performance, demonstrating how predictive variables can be used to establish relationships between input factors and outcomes. Similarly, Espinoza Rios et al. [15] integrated artificial intelligence in forecasting academic performance within an engineering faculty, proving the effectiveness of AI-driven prediction for institutional decision-making. These developments mark a transformative phase in higher education, where analytics serve as instruments of governance, improvement, and innovation.

In the Philippine context, the rise of predictive analytics aligns with the Commission on Higher Education's (CHED) initiatives toward digital transformation and quality assurance integration [13]. Predictive analytics thus becomes a strategic tool for promoting data-informed governance and resilience in higher education institutions.

Predictive Models in Education

Machine learning and classification algorithms have significantly enhanced the ability of institutions to evaluate and predict academic performance outcomes. Dasig Jr. et al. [16] utilized decision trees and random forest algorithms to model faculty-related incidents, while Cruz and Lumauag [11] compared machine learning models—such as Naïve Bayes and Support Vector Machines—in predicting academic success among students in IT programs. Benosa and Caguiat [10] extended these applications to faculty evaluation, employing prescriptive analytics to assess teaching quality during the COVID-19 pandemic, showcasing the adaptability of predictive systems under crisis conditions.

Furthermore, Cinizan and Valdez [6] developed an enhanced faculty evaluation system with data analytics, integrating multi-source data for more comprehensive assessments. Ismil et al. [4] used a Naïve Bayes-based system to classify faculty performance levels and identify trends in teaching effectiveness. Similarly, Karim-Abdallah et al. [17] and Korovaina et al. [18] highlighted the growing prevalence of predictive modeling in educational contexts, demonstrating that machine learning techniques can accurately assess academic performance through structured and unstructured data.

Complementary to faculty-focused models, Almonteros et al. [2], Daligcon et al. [19], and Tapio [20] showcased the robustness of regression and classification algorithms in forecasting student success, suggesting that similar methods can be applied to evaluate faculty trajectories. While, Yan [21], used ant colony clustering algorithms, designed a mutual evaluation system that improved objectivity and reduced bias in teacher assessment. Collectively, these studies affirm that predictive modeling in education enhances accuracy, transparency, and timeliness in performance evaluations.

Forecasting Faculty Trends

The inclusion of time-series forecasting and longitudinal modeling has introduced a new dimension to performance evaluation, focusing on temporal changes and developmental trajectories. Liu et al. [7] pioneered an LSTM-based classification method for time-series forecasting, proving the power of deep learning in predicting performance trends over time. Mao et al. [8] reinforced this by outlining methodological approaches—such as cyclical trend analysis and time-series decomposition—that help track progress and stagnation in educational systems.

In the Philippine higher education setting, Ismil et al. [4] applied Naïve Bayes models to uncover faculty development patterns across academic terms. Quioc et al. [5] compared decision support models for faculty performance evaluation, emphasizing the importance of data-driven forecasting in guiding institutional strategies. Similarly, Tapio and Tarepe [9] demonstrated that hybrid ARIMA–Random Forest models outperform traditional statistical forecasting in predicting enrollment and performance trends. Espinoza Rios et al. [15] and Barrera [3] also validated regression and AI-based forecasting models in predicting academic performance trajectories.

These studies collectively illustrate that trend forecasting transforms evaluation into a continuous monitoring system, enabling universities to anticipate performance shifts, design targeted faculty development programs, and enhance strategic planning capacities.

Determinants of Predictive Evaluation

The success of predictive classification and forecasting models depends heavily on the quality and diversity of input determinants. Across reviewed studies, five dominant determinants consistently appear: pedagogical competence, instructional delivery, ICT integration, workload, and professional development [6,11,4]. Tapio [20] and Pugeda & Esquivel [22] identified additional motivational and institutional factors—such as digital literacy, research engagement, and leadership support—that shape predictive outcomes.

Lo [23] emphasized that faculty performance cannot be understood without contextualizing teaching within policy, culture, and institutional environments. Tunio et al. [24] highlighted organizational culture, job satisfaction, and empowerment as key behavioral determinants influencing performance prediction models. Similarly, Sy et al. [25] and Remegio [13] discussed ethical and structural dimensions of data governance and AI-driven evaluation, noting the importance of fairness and accountability.

From a data perspective, predictors often fall into categories such as demographic and employment data, instructional metrics, student evaluation results, professional development engagement, and ICT-related indicators [3,6,4,22]. Collectively, these variables ensure predictive models remain both statistically accurate and contextually meaningful—balancing quantitative rigor with qualitative depth.

Challenges in Philippine Higher Education

Despite notable progress, the application of predictive analytics to faculty evaluation in the Philippines remains limited and inconsistent. Guido and Orleans [14] underscored the country's lag in educational research productivity relative to Southeast Asian peers, attributing it to data fragmentation and limited institutional collaboration. Cinizan and Valdez [6] and Quioc et al. [5] observed that local systems often depend on small-scale, institution-specific datasets lacking standardization.

While emerging projects integrate analytics into evaluation, many remain focused on student outcomes rather than faculty performance [2,11,12,22]. Remegio [13] highlighted the ethical and operational barriers in adopting AI tools—such as data privacy concerns, algorithmic bias, and limited digital literacy among educators. Consequently, faculty evaluation in the Philippines is still largely descriptive rather than predictive, relying on manual surveys and peer reviews instead of comprehensive, real-time data systems.

Research Gap

Although predictive analytics and trend forecasting have been widely explored globally, their application in faculty performance evaluation within Philippine higher education remains at an early developmental stage. International studies show that machine learning models—such as decision trees, random forest, regression, and neural networks—can accurately forecast student performance [3,15,17,18], yet their adaptation to faculty evaluation frameworks is minimal [6,4,5,10]. This indicates a methodological gap, as local systems lack unified datasets, standardized metrics, and algorithmic models tailored to Philippine institutional contexts.

Furthermore, predictive models often overlook key determinants such as workload balance, pedagogical innovation, and digital competency [4,11,23,24]. Without these localized variables, predictive accuracy and contextual validity remain limited. Lo [23] argued that teaching quality must be evaluated within sociocultural and institutional frameworks, while Karim-Abdallah et al. [17] emphasized the importance of structured, interoperable data systems for reliable forecasting. Hence, a strategic and contextualized framework is needed—one that integrates predictive classification and trend forecasting into Philippine faculty evaluation systems.

This systematic review therefore seeks to unveil patterns and predictions that bridge global advances with local realities, establishing a foundation for intelligent, data-informed, and ethically grounded faculty performance evaluation frameworks that can support continuous improvement and institutional excellence in Philippine higher education.

3. Methodology

This study employed a Systematic Literature Review using the Narratological Approach to examine how predictive classification and trend forecasting techniques have been applied in evaluating faculty performance in higher education, with specific emphasis on the Philippine context. The review followed the principles of the PRISMA framework—identifying, screening, and selecting relevant literature from 2019 to 2025. Academic databases such as IEEE Xplore, Scopus, Google Scholar, and ResearchGate were used to gather peer-reviewed articles, conference proceedings, and research journals. Inclusion criteria focused on studies addressing predictive analytics, faculty or academic performance evaluation, trend forecasting, and machine learning models in higher education. Excluded were papers without empirical grounding or unrelated to educational assessment. A total of 25 studies were selected for synthesis, encompassing both global and local perspectives.

Using the Narratological Approach, the selected studies were analyzed through thematic storytelling—organizing findings chronologically and conceptually to trace the evolution of predictive and evaluative models in education. Each study's narrative was coded based on its contribution to the key themes: predictive classification, trend forecasting, determinants of faculty performance, and analytics integration in Philippine higher education. Through comparative interpretation, recurring storylines, methodological gaps, and conceptual progressions were identified. This narrative synthesis not only highlighted patterns and transitions across time but also established a coherent storyline reflecting how predictive analytics evolved from descriptive evaluation to proactive performance forecasting in the academic setting.

4. Findings

Shift from Traditional Evaluation to Predictive Analytics

The literature reveals a significant shift from traditional descriptive and subjective evaluation methods toward data-driven and predictive approaches in assessing faculty performance. Conventional tools such as student evaluations and administrative appraisals are increasingly being replaced by machine learning models capable of uncovering hidden performance patterns and predicting future outcomes [2,3,4,5,6]. Studies across various higher education contexts, including the Philippines, have demonstrated the effectiveness of classification algorithms such as decision trees, Naïve Bayes, random forest, and support vector machines in categorizing faculty and student performance [4,11,16] [17,18,19].

Furthermore, Benosa and Caguiat [10] demonstrated how prescriptive analytics can sustain evaluation even amid the disruptions of the COVID-19 pandemic, while Cinizan and Valdez [4] developed a data-analytic faculty evaluation framework to enhance evidence-based academic decision-making. Likewise, Ismil et al. [4] implemented a Naïve Bayes-based system for faculty qualification analysis, reinforcing that predictive modeling enables institutions to transition from reactive assessment to proactive performance management. As highlighted by Karim-Abdallah et al. [17] and Korovaina et al. [18], predictive analytics not only identifies top performers but also helps anticipate areas for professional development—signaling a paradigmatic move toward "unveiling patterns and predictions" in educational evaluation.

Emerging Applications of Time-Series and Forecasting Models

Alongside classification techniques, time-series and trend forecasting methods have emerged as powerful tools for longitudinal analysis of faculty and institutional performance. Liu et al. [7] and Mao et al. [8] emphasized that models like Long Short-Term Memory (LSTM) networks, ARIMA, and hybrid regression approaches are essential in capturing performance dynamics over time. In the Philippine setting, Quioc et al. [5] and Tapio [20] applied forecasting models to detect performance trends, while Tapio and Tarepe [9] integrated Random Forest with ARIMA to enhance prediction accuracy in academic datasets. Similarly, Barrera [3] and Espinoza Rios et al. [15] highlighted that regression-based forecasting can uncover patterns in teaching effectiveness and academic outcomes, supporting data-driven faculty development programs. These approaches collectively reinforce the potential of forecasting tools to guide educational institutions in detecting stagnation, predicting improvement, and formulating timely interventions—thereby strengthening institutional responsiveness and policy planning.

Determinants and Influencing Factors of Faculty Performance

The reviewed literature consistently underscores that faculty performance is multidimensional and influenced by interrelated determinants, including pedagogical competence, research productivity, ICT integration, workload balance, and professional engagement. Pedagogical competence, encompassing instructional delivery, subject mastery, and student-centered strategies, emerged as a critical predictor of faculty effectiveness [4,6,11,23]. Studies by Tunio et al. [24] and Lo [23] also linked motivation and institutional support to sustained teaching performance. Meanwhile, student feedback remains one of the most utilized indicators in predictive models due to its frequency, accessibility, and close alignment with instructional quality [2,4,10,16]. Professional engagement—measured through research output, seminars, and extension activities—was also identified as a factor shaping long-term faculty growth and performance improvement [6,13,22]. Moreover, the integration of ICT in teaching practices has gained prominence as a determinant of faculty adaptability and innovation, particularly in technology-driven programs [11,21,25]. Collectively, these determinants enable predictive models to achieve more context-sensitive and

accurate performance classifications.

Categories of Predictive and Forecasting Datasets

Synthesizing across studies, several data categories have been identified as essential inputs for predictive classification and forecasting of faculty performance:

1. **Pedagogical competence** – captured through student evaluations and satisfaction scores, this determinant reflects instructional delivery quality, subject mastery, and the capacity to foster student learning [2,4,10,16,23].
2. **Workload balance** – measured by instructional workload indicators such as number of courses handled, class size, delivery modality, and preparation hours, which collectively determine teaching efficiency and sustainability [4,6,11,23].
3. **Professional engagement** – represented through professional development and research productivity, including participation in training, publication output, and extension services, highlighting a faculty member's long-term growth and institutional contribution [6,13,22].
4. **ICT integration** – assessed via ICT utilization metrics such as LMS engagement, digital tool usage, and technology adoption rate, indicating innovation and adaptability in modern pedagogical environments [11,21,25].
5. **Demographic and employment attributes** – encompassing age, academic rank, tenure, and teaching experience, these contextual factors provide the foundational variables for modeling differences in teaching outcomes and developmental trajectories [5,16,24].

Other institutional-level variables—such as administrative load, resource allocation, and temporal elements (e.g., semester or academic year)—serve as moderating variables critical for longitudinal forecasting [7,8,9,20].

Challenges and Research Gaps in Predictive Faculty Evaluation

Despite these advancements, the literature reveals persistent gaps in the application of predictive analytics for faculty performance evaluation, particularly within the Philippine higher education context. While many studies focus on student performance prediction [2,11,17,18,19], fewer have explored localized faculty-focused models that integrate institutional, cultural, and contextual variables [12,13]. Data quality and accessibility remain significant challenges, as fragmented systems and inconsistent evaluation rubrics hinder large-scale predictive modeling [14,25]. Additionally, ethical considerations, such as data privacy and algorithmic transparency, must be addressed to ensure fair and responsible use of predictive systems in educational evaluation [12,13]. As Guido and Orleans [14] emphasized, the Philippines still lags behind in research productivity compared to its Southeast Asian peers, underscoring the need for localized frameworks that "unveil patterns and predictions" specific to its higher education institutions. Therefore, future studies should focus on developing unified datasets, standardizing evaluation metrics, and implementing hybrid models that combine classification and forecasting approaches to fully harness the potential of predictive analytics in faculty performance management.

5. Conclusion

The review of literature clearly establishes that faculty performance evaluation in higher education is undergoing a paradigm shift—from traditional descriptive and subjective measures toward predictive, data-driven, and evidence-based approaches. Predictive classification and trend forecasting models, such as decision trees, random forest, Naïve Bayes, ARIMA, and LSTM, have emerged as powerful tools in "unveiling patterns and predictions" that were once obscured by conventional evaluation methods. These models enable institutions to move beyond retrospective analysis and toward anticipatory evaluation, where performance trajectories are forecasted and actionable insights are derived for policy and developmental interventions. Studies demonstrate that the integration of such models improves the accuracy, fairness, and responsiveness of faculty performance assessments, transforming them into instruments of continuous quality enhancement.

The findings also reveal that faculty performance is shaped by multiple determinants—pedagogical competence, research productivity, ICT integration, workload management, and professional engagement—all of which contribute significantly to classification and forecasting accuracy. Predictive analytics frameworks that incorporate these variables allow institutions to identify performance strengths, detect potential decline, and tailor professional development initiatives accordingly. Furthermore, the categorization of datasets—ranging from demographic and instructional variables to digital engagement metrics—provides a structured foundation for developing localized and context-aware predictive models in the Philippine higher education system. However, the review underscores ongoing challenges, such as fragmented data systems, lack of standardized evaluation rubrics, and limited analytics literacy among faculty and administrators. These barriers highlight the pressing need for data governance policies, cross-institutional collaboration, and capacity-building initiatives that would enable the ethical and sustainable implementation of predictive systems.

Hence, this systematic review reinforces that predictive classification and trend forecasting hold transformative potential for the modernization of faculty evaluation in Philippine higher education. By adopting these advanced analytical tools, institutions can transcend the boundaries of traditional evaluation practices and embrace a forward-looking, evidence-based culture of continuous improvement. "Unveiling Patterns and Predictions" thus becomes more than a methodological approach—it represents a vision for educational innovation, where evaluation evolves into a dynamic process of understanding growth, anticipating change, and fostering excellence. Ultimately, this paradigm positions predictive analytics not merely as a technological advancement but as a strategic framework that redefines how academic institutions nurture, assess, and empower their educators for the future.

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