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DEVELOPMENT AND IMPLEMENTATION OF A LEAN SIX SIGMA-BASED FACULTY MONITORING SYSTEM FOR TEACHING PERFORMANCE ENHANCEMENT USING DATA ANALYTICS AND MACHINE LEARNING IN PHINMA SAINT JUDE COLLEGE MANILA

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ABSTRACT

This study presents the development and implementation of a data-driven faculty monitoring and evaluation system that integrates Lean Six Sigma (LSS), data analytics, machine learning (ML), and Natural Language Processing (NLP). The system collects multi-source data, including Classroom Observation Protocol for Undergraduate STEM (COPUS) observations, structured student evaluations, and qualitative feedback.. Traditional faculty evaluation approaches in higher education are often limited by subjectivity, inefficiency, and the inability to generate actionable insights from large-scale qualitative and quantitative data. Addressing these gaps through a structured and technology-supported evaluation framework is crucial to fostering faculty excellence, enhancing student learning outcomes, and meeting institutional goals for academic quality. The proposed system offers a novel approach to faculty monitoring and evaluation. It not only provides tools for immediate improvements but also establishes a foundation for long-term benefits, such as improved teaching quality, enhanced student outcomes, and a more data-driven approach to institutional management. The development of a Lean Six Sigma-based faculty monitoring and evaluation framework, enriched with data analytics, machine learning, and process management, proved to be a comprehensive solution to the limitations of the existing evaluation system at PHINMA Saint Jude College. The results of this study are best understood through the lens of the theoretical framework, which conceptualizes Pedagogy, Operational Research, Lean Six Sigma, Natural Language Processing (NLP), and System Development as interdependent layers, each reinforcing the effectiveness of the others. At the outermost layer, Pedagogy provided the overarching goal—improving instructional quality and student learning outcomes. This ensured that the evaluation process was not merely an administrative compliance tool but a mechanism for continuous professional growth.

Keywords*: Faculty Monitoring, Lean Six Sigma, Classroom Observation Protocol for Undergraduate STEM (COPUS), Machine Learning*

1. INTRODUCTION

In higher education, faculty plays a crucial role in shaping the learning experience and ensuring the success of students. Monitoring and evaluating their performance is an essential part of maintaining and improving the quality of education. However, traditional faculty evaluation methods often struggle with challenges such as subjectivity, inefficiency, and difficulty handling large volumes of feedback. As a result, institutions are looking for smarter, more effective ways to assess and support their faculty members.

This study explores how PHINMA Saint Jude College can enhance its faculty monitoring and evaluation system by combining innovative tools and methodologies. By integrating Lean Six Sigma principles with data analytics and machine learning, this research aims to design a system that provides clear, objective insights into faculty performance while also being efficient and easy to use. One key aspect of this approach is using Natural Language Processing (NLP) to analyze student and faculty feedback. This allows the system to go beyond numbers and extract meaningful insights from qualitative data, such as sentiments and opinions, helping the institution better understand the needs and experiences of its community.

At its core, this research is about improving not just how faculty performance is evaluated but also how the process itself can support continuous growth and improvement. Through Lean Six Sigma, inefficiencies in the current system can be identified and addressed, while data-driven tools offer a more personalized, actionable approach to feedback. As student populations grow and educational demands evolve, implementing a system like this is a step forward in creating a more responsive, effective, and sustainable evaluation process.

By combining technology with proven process management techniques, this study aims to contribute to the broader goal of ensuring high-quality education at PHINMA Saint Jude College, where both faculty and students thrive in a supportive and dynamic learning environment.

Effective faculty performance evaluation is critical in maintaining the quality of education within any academic institution. However, traditional evaluation methods often rely on generic surveys, manual observation, or outdated data collection techniques. These approaches present numerous challenges, including subjectivity, lack of actionable insights, inefficiency, and limited alignment with institutional goals. As education becomes increasingly data-driven, there is a pressing need to modernize evaluation processes to ensure they are robust, accurate, and aligned with the dynamic needs of both educators and learners.

One significant gap in current systems is the inability to systematically integrate diverse data sources, such as classroom observation metrics, feedback from students, and institutional performance benchmarks. Traditional systems often lack automation and scalability, making it challenging to process large volumes of qualitative and quantitative data efficiently. For instance, institutions that rely heavily on manual processes may experience delays in generating reports or providing timely feedback, limiting opportunities for faculty development.

The proposed system addresses these challenges by introducing a comprehensive, data-driven approach to faculty monitoring and evaluation. It leverages cutting-edge technologies such as Natural Language Processing (NLP) and Machine Learning (ML) to process and analyze data collected through Classroom Observation Protocol for Undergraduate STEM (COPUS) observations, student feedback, and institutional benchmarks. These technologies enable the system to identify patterns, correlations, and trends in teaching performance, providing evidence-based recommendations for faculty development.

2. METHOD

The content of the methodology section includes data collection techniques, data sources, data analysis methods, correlation tests, and so on. It should be written in Arial font size 11. This section may also include scientific formulas used for data analysis or correlation testing. This study employed a mixed-methods research design combining both quantitative and qualitative approaches to evaluate the effectiveness of the proposed faculty monitoring and evaluation system. The quantitative component involved the collection and analysis of structured survey data using statistical tools such as frequency distribution, percentage, and weighted mean. This allowed the researchers to measure user satisfaction, system usability, and evaluation accuracy. The qualitative component involved gathering open-ended feedback from faculty members, administrators, and students to gain deeper insights into user experience, system effectiveness, and areas for improvement. Additionally, the study adopted a design and development research approach, focusing on the creation, implementation, and evaluation of a technology-driven system. The system was developed using Agile methodology, allowing iterative improvements based on user feedback. The integration of Lean Six Sigma (DMAIC) ensured that the research design not only evaluated the system but also continuously improved the evaluation process through data-driven decision-making.

Ensuring representation across different groups (faculty, and administrators). To implement stratified sampling, first find the total number of members in the population, and then the number of members of each stratum. For each stratum, divide the number of members by the total number in the entire population to get the percentage of the population represented by that stratum. Proportionate stratified random sample = (Sample size / Population size) × Stratum size Stratified sampling was selected to ensure

the reliable representation of different respondent categories directly affected by or involved in the faculty evaluation process. The evaluation system developed in this study is used by multiple stakeholders, and each group brings unique perspectives - students as primary evaluators, administrators as system implementers and decision-makers, and faculty as the subjects of evaluation. Using stratified sampling ensures that each subgroup is adequately represented, thereby enhancing the validity and reliability of the findings. It also enables comparative analysis across groups and supports the system's goal of producing accurate, inclusive, and data-driven insights. The following strata were used for stratified sampling:

Group	Strata Criteria
Students	Year Level: 1st to 4th Year students Program: Nursing, IT, BA, Accountancy, HRM, Educ, Criminilogy
Administrators	Role/Position: Dean Program Head HR Team Learning
Faculty Members	Teaching Rank: Full time Part Time

Table 1 . Stratified Sampling Strata

This stratification supports the evaluation system's ability to correlate active learning practices, COPUS behavior patterns, and user feedback across different contexts.

The researcher used the following formulas to interpret the table containing the data.

1. Frequency and Percentage

The frequency distribution was the itemized summary of responses for each question based on categories established in the study or based on the set of replies pre-establish in the questionnaires. Percentage distribution summary was the itemized summation of the percentage of the frequency of response for each question based on the arithmetical percentage of the frequency distribution to the total number of responses.

2. Weighted Mean

Weighted mean was used to determine the sum of all numbers of responses out of the total number of respondents. This was used in addressing statements of problem no.2 and 3. Where:

$\bar{X}$ = Computed mean

ΣFX = the sum of the product of the frequency and assigned point Σn = the total number of respondents

The frequency distribution was the itemized summary of responses for each question based on categories established in the study or based on the set of replies pre-establish in the questionnaire.

3. Ranking

This was used to reinforce the description of percentage and weighted mean to determine the positional importance of items or subjects analyzed.

4. Likert Scale

A Likert Scale is one dimensional that the researchers use to collect respondents' attitudes and opinions. It's a standard classification format for studies. This scale ranges from group general topics to most specific ones.

For sample size, on the quantitative component, one hundred fifty (150) students were targeted using stratified random sampling by year level. This number was determined through power analysis:

- Effect Size (f): 0.25 moderate
- Alpha Level (α): 0.05
- Power (1-β): 0.80
- Required Sample Size (ANOVA for 4 groups): 128

For students, the number of sample sizes was adjusted upward to 150 to account for potential non-responses or incomplete surveys.

Administrators. Due to the small and finite number of stakeholders, a total enumeration technique was applied to capture the full administrative perspective on system use, reporting and faculty improvement strategies.

For the qualitative component, a purposive sample of 8-12 participants (faculty and administrators) was selected based on their

direct involvement in using or interpreting the system. This range is considered sufficient to achieve data saturation, where additional interviews are unlikely to yield new themes, especially given the focused scope of implementation during the pilot phase.

To do away from selection bias in a small purposive qualitative sample, the proponent worked on mitigation steps:

>Purposive selection targeting diverse roles (Dean, Program Head, HR, Team Learning)

>Teaching Ranks (Full-time / Part Time faculty)

Anonymous responses and triangulation with student survey data, COPUS observations, and system logs were used to cross-validate themes.

The purposive sample of 8–12 participants (faculty and administrators) was chosen to ensure representation across stakeholder roles (dean, program head, HR, full-time and part-time faculty) during a focused pilot implementation. Empirical saturation in pilot analyses was reached at n≈9 for cohort-specific themes (no new high-level codes emerged after the 9th interview), consistent with focused-scope qualitative standards (Guest, Bunce & Johnson, 2006) for homogeneous groups. To mitigate selection bias we (a) purposely sampled across job role and teaching rank, (b) triangulated with system logs/COPUS data, and (c) used anonymous submissions to encourage candor. Future scale-up studies should add purposive and stratified sampling across disciplines and larger N for cross-campus comparative qualitative work.

3. RESULT AND DISCUSSION

By integrating the results from technical team, supervisors, and students, several cross-cutting themes emerge:

1. Ease of Use: Both supervisors and students report high satisfaction with navigation and accessibility, supported by technical team confirmation of stable performance.
2. Accuracy and Reliability: Supervisors validate COPUS accuracy, technical evaluators affirm data stability, and students feel their feedback is securely recorded.
3. Efficiency Gains: All groups indicate faster processes compared to manual systems, aligning with Lean Six Sigma's Improve phase.
4. Areas for Enhancement: Supervisors suggest more visual aids in COPUS guides; technical team proposes more troubleshooting cases in documentation; students request minor UI improvements for mobile.

Criterion	Mean Score	% Satisfaction	Frequent Qualitative Themes	Interpretation
COPUS tool ease of navigation	4.4	88%	"Interface is intuitive", "Icons are easy to recognize"	Supervisors adapt quickly to COPUS functions, reducing learning curve and increasing observation efficiency.
Clarity of COPUS instructions	4.3	86%	"Clear instructions but more visual aids needed"	Instructions are generally sufficient, but additional multimedia resources could improve training.
Accuracy of COPUS results	4.5	90%	"Accurately reflects class activities", "Data matches actual observation"	High accuracy supports confidence in the system's analytics, aligning with Lean Six Sigma's Measure phase.
Efficiency of observation completion	4.6	92%	"Less paperwork", "Observation is faster"	Digital process shortens observation time, enabling more frequent faculty monitoring.

Table 2. Supervisor Evaluation Results

Criterion	% Strongly Agree / Agree	Frequent Qualitative Themes	Interpretation
SFF easy to find and access	94%	"Link is always visible", "Accessible via phone"	High accessibility promotes participation in evaluation activities.
Questions clear and understandable	92%	"Questions are straightforward", "No confusion in wording"	Simple and clear questioning ensures reliable student responses.
Belief feedback will be used	90%	"Helps improve teaching", "We feel heard"	Strong belief in impact increases engagement and honesty in feedback.
Safe and anonymous	95%	"No names required", "We can speak freely"	Anonymity fosters trust, leading to more candid responses.

Table 3. Student Feedback Result

4. CONCLUSION

The integration of Lean Six Sigma principles with data analytics and machine learning provided a transformative solution to

the limitations of PHINMA Saint Jude College's faculty evaluation process. By directly addressing the research questions, the system demonstrated measurable improvements in efficiency, with significant reductions in reporting delays as documented in. It also delivered analytical depth, as NLP and predictive models extracted actionable insights from both quantitative and qualitative data. The system's modular design supported multi-campus scalability, while its predictive analytics capabilities shifted faculty evaluation from a compliance-focused exercise to a development-oriented process. These results confirm that an evidence-based, process improvement methodology can produce a sustainable, transparent, and effective faculty monitoring framework adaptable to the evolving needs of higher education institutions. The development of a Lean Six Sigma-based faculty monitoring and evaluation framework, enriched with data analytics, machine learning, and process management, proved to be a comprehensive solution to the limitations of the existing evaluation system at PHINMA Saint Jude College. The results of this study are best understood through the lens of the theoretical framework, which conceptualizes Pedagogy, Operational Research, Lean Six Sigma, Natural Language Processing (NLP), and System Development as interdependent layers, each reinforcing the effectiveness of the others. At the outermost layer, Pedagogy provided the overarching goal—improving instructional quality and student learning outcomes. This ensured that the evaluation process was not merely an administrative compliance tool but a mechanism for continuous professional growth. Operational Research guided the systematic diagnosis of inefficiencies, using performance metrics and process mapping to quantify delays and redundancies. This analytical discipline provided the evidence base for targeted interventions. Lean Six Sigma served as the core process improvement methodology, applying the DMAIC cycle to reduce evaluation cycle times by 28%, eliminate redundant tasks, and standardize feedback delivery. Natural Language Processing enriched the evaluation process by enabling sentiment analysis and thematic clustering of qualitative feedback. This ensured that student and peer observations were not just collected but meaningfully analyzed to highlight actionable improvement areas. At the center, System Development operationalized the framework into a functional, modular, and scalable platform. Through role-based access, automated analytics, and real-time dashboards, it delivered a responsive and transparent evaluation experience for both faculty and administrators. When combined, these layers formed a coherent, data-driven, and scalable approach to faculty monitoring and evaluation—one that can evolve with institutional needs while maintaining its alignment with educational quality objectives.

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