***Understanding the Effectiveness of Clustered vs Semester-Based Classes on
Computer Engineering Students' Academic Performance in
Cebu Institute of Technology - University***

Jundith D. Alterado, Cebu Institute of Technology - University, Philippines
Johnalyn L. Figueras, Cebu Institute of Technology - University, Philippines

Abstract

This study aims to understand and compare the effectiveness of clustered and semester-based classes on student performance in higher education institutions, specifically for Computer Engineering students at Cebu Institute of Technology University. It focuses on academic proficiency, knowledge application, retention, collaboration, and logical thinking. A survey was conducted with 98 respondents who have experienced both clustered and semester-based classes to measure these areas. Using a within-subject research design, the study conducts a comparative analysis with a paired, one-tailed t-test. Additionally, the study will use a linear regression model to determine the significance of the two approaches that influence the students overall academic performance. The results reveal that students perform better in semester-based classes, as indicated by a negative t-statistic and a p-value well below the threshold for statistical significance. Furthermore, the regression analysis confirms that semester-based classes have a more substantial impact on academic performance. These findings suggest that semester-based classes are more effective in enhancing student performance, which could inform future course design and teaching strategies in Cebu Institute of Technology—University.

Keywords: Clustered, Semester-Based, Student Performance, Comparative Analysis, Within-Subject Research Design

Introduction

Education plays a pivotal role in shaping students' academic and professional futures. As educational institutions continually seek ways to enhance learning outcomes, the structure of academic programs becomes a crucial area of exploration. One such structural variation is the difference between the traditional semester-based system and the clustered-based system, which have distinct impacts on how students engage with course content and manage their academic workload.

The semester-based system and the clustered-based system are the two different academic models used at the Cebu Institute of Technology University (CIT-U). This study seeks to understand how these two systems influence students' academic performance. The semester-based system at Cebu Institute of Technology - University spans 18 weeks, with students typically taking 8 subjects per week. This structure allows students a longer period to absorb the course content and engage with a broad array of subjects. However, the burden of managing multiple subjects at once can be overwhelming, especially for students who struggle with time management and balancing academic demands. While under the clustered-based system, which was implemented in response to the COVID-19 epidemic, students usually take four subjects each week and shorten the academic calendar to nine weeks. This system emerged as a result of the sudden transition to online education, where the traditional face-to-face teaching methods were no longer viable. The pandemic forced institutions to adapt to pure online learning, which introduced significant challenges for both students and faculty. One of the most prominent challenges was the strain in balancing the workload. Faculty members had to quickly shift from delivering traditional classroom lectures to preparing online modules and digital learning materials, a transition that often led to an increased workload in terms of content preparation and delivery. Similarly, students were faced with the challenge of adjusting to a completely new mode of learning, dealing with the complexities of online learning platforms, and managing the compressed nature of the clustered schedule. In response to these challenges, the clustered-based system was introduced as a more focused and intensive approach to learning, with the aim of reducing the number of subjects students had to manage at any given time. By grouping related subjects into blocks and offering them in a concentrated, shorter period, the clustered model was designed to mitigate some of the strain caused by the sudden shift to online education.

Research Goals and Objectives

The purpose of this study is to examine the aspects in which CIT-U students evaluate their academic performance differently in these two educational systems; specifically, it seeks to compare the academic proficiency, knowledge application, retention, collaboration, and improvement in logical thinking between students participating in both the semester-based and clustered-based systems. Furthermore, this study will look at how the students view both systems and how the way the course is delivered affects their learning, time management, and general academic performance. Accordingly, this study seeks to address several key research objectives. It aims to determine whether significant differences exist in computer engineering students' academic performance, knowledge application, retention, teamwork, and logical reasoning between clustered and semester-based systems. Additionally, it seeks to identify which approach produces better results in terms of perceived academic proficiency, knowledge application, retention, collaboration, and the enhancement of logical thinking skills. The study also examines whether these different approaches influence students' overall academic performance across these metrics. Furthermore, it explores which system students

believe better equips them to tackle future academic and professional challenges. By achieving these research objectives, this study will provide valuable insights into how different educational structures impact students' academic performance. It will also contribute to the ongoing discussion of optimizing learning environments in response to the challenges posed by the COVID-19 pandemic and the shift to online education. Ultimately, the findings may inform curriculum design and strategies for improving student outcomes in both the semester-based and clustered-based systems at CIT-U.

Methodology

This section presents the research methodology used to examine and compare the impact of clustered and semester-based class systems on the academic performance of computer engineering students at Cebu Institute of Technology University (CIT-U).

The study utilized a within-subject research design, enabling a direct comparison of students' performance in both clustered and semester-based systems. This design was chosen because it minimizes individual differences by evaluating the same group of students under both academic setups. As a result, any observed differences in performance can be attributed to the class structure rather than variations in individual capabilities.

Research Respondents and Data Collection

The study sample comprised 98 computer engineering students at CIT-U who had experienced both the clustered and semester-based systems. Purposive sampling was employed to ensure participants had enrolled in both types of classes during their academic tenure. To qualify for the study, participants needed to have completed at least one semester in each system, ensuring they had adequate exposure to both environments.

Table 1: Cebu Institute of Technology
– University Computer Engineering Students Who Took Part in The Survey

Year Level	Respondents
3rd Year	50
4th Year	159
Total	209
Sample Size (>30%)	98

The participants, all computer engineering students from Cebu Institute of Technology University in Cebu City, Philippines, had prior experience with computer programming as part of their academic curriculum. This prerequisite ensured that their responses were informed by firsthand exposure to the subject. In total, 209 respondents took part in the survey.

The survey recruited participants through convenience sampling, using official university platforms like the Learning Management System (LMS) and social media to ensure wide accessibility and participation. Data were collected through a structured questionnaire that transformed qualitative insights into quantitative values using a Likert scale. The survey questionnaire focused on students' perceptions of their academic performance across several key areas. It assessed academic proficiency by evaluating students' understanding of core computer engineering concepts, their confidence in meeting assignment and project deadlines, and their preparedness for major exams. It examined the application of knowledge

by exploring how effectively students applied their learning in practical and academic scenarios, with an emphasis on real-world relevance. Knowledge retention was measured by evaluating students' ability to recall and use course material from both systems based on academic performance-related questions. The survey also investigated collaboration and peer interaction by exploring students' experiences with group work and collaborative learning, which are critical components of engineering education. Finally, it evaluated logical thinking and problem-solving by determining how each system influenced the development of students' reasoning and problem-solving abilities.

Data Analysis

The data collected will be analyzed using a combination of statistical methods. A paired one-tailed t-test will be employed to compare students' performance across key metrics in the clustered and semester-based systems. This test will determine if there is a statistically significant difference in academic performance between the two systems, with the null hypothesis asserting no difference and the alternative hypothesis suggesting a significant difference. Descriptive statistics, including mean, median, and standard deviation, will summarize students' performance in both systems, offering insights into central tendencies and variability in outcomes. Additionally, a linear regression analysis will be conducted to assess the impact of the class system (clustered vs. semester-based) on overall academic performance. This model will help determine if the class system is a significant predictor of students' perceived academic success.

Results and Discussion

The results of this study provide valuable insights into the comparative effectiveness of clustered and semester-based class systems on the academic performance of Computer Engineering students at Cebu Institute of Technology University (CIT-U). This section presents an in-depth analysis of the collected data, highlighting trends, patterns, and key findings across various performance metrics, including academic proficiency, knowledge application, retention, collaboration, and problem-solving skills.

The results of the paired two-tailed t-test comparing the clustered and semester-based systems across various academic performance metrics revealed statistically significant differences in favor of the semester-based system.

Table 2: Paired Two-Sample t-Test for Perceived Academic Proficiency
Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.5850	4.0068
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-4.7201	
p-Value (One-Tailed)	3.97×10^{-6}	
Critical t-Value (One-Tailed)	1.6607	

For academic proficiency, the semester system yielded a higher mean score (4.0068) compared to the clustered system (3.5850). The calculated t-statistic of -4.7201 exceeded the critical value of 1.6607 (one-tailed), with a p-value of 3.97×10^{-6}, indicating a significant difference between the two systems.

Table 3: Paired Two-Sample t-Test for Perceived Application of Knowledge
Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.4286	3.8878
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-5.3382	
p-Value (One-Tailed)	3.08×10^{-6}	
Critical t-Value (One-Tailed)	1.6607	

In terms of application of knowledge, the semester system also outperformed the clustered system, with mean scores of 3.8878 and 3.4286, respectively. The t-statistic was -5.3382, with a p-value of 3.08×10^{-7}, further confirming the statistical significance of this difference.

Table 4: Paired Two-Sample t-Test for Perceived Knowledge Retention
Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.1939	3.6735
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-5.7358	
p-Value (One-Tailed)	5.51×10^{-8}	
Critical t-Value (One-Tailed)	1.6607	

For knowledge retention, the semester system (mean=3.6735) again showed higher scores than the clustered system (mean=3.1939). The t-statistic of -5.7358 and a p-value of 5.51×10^{-8} reaffirmed that the observed difference was significant.

Table 5: Paired Two-Sample t-Test for Perceived Collaboration Between
Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.2653	4.1122
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-7.7101	
p-Value (One-Tailed)	5.51E-12	
Critical t-Value (One-Tailed)	1.6607	

The mean collaboration score was 3.27 for the cluster setup and 4.11 for the semester setup. The calculated t-statistic of -7.71 exceeded the critical t-value of 1.66, while the p-value of 5.51E-12 was significantly below the 0.05 threshold. These findings indicate a statistically significant difference in collaboration, with the semester setup demonstrating a clear advantage.

Table 6: Paired Two-Sample t-Test for Perceived Improvement in Logical Thinking
Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.5816	4.000
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-4.2106	
p-Value (One-Tailed)	2.85E-05	
Critical t-Value (One-Tailed)	1.6607	

The mean for improvement in logical thinking score was 3.58 for the cluster setup and 4.00 for the semester setup. Similarly, the calculated t-statistic of -4.21 exceeded the critical t-value of 1.66, and the p-value of 2.85E-05 was far below the 0.05 threshold. These results indicate a statistically significant difference in logical thinking, with the semester setup showing a clear advantage.
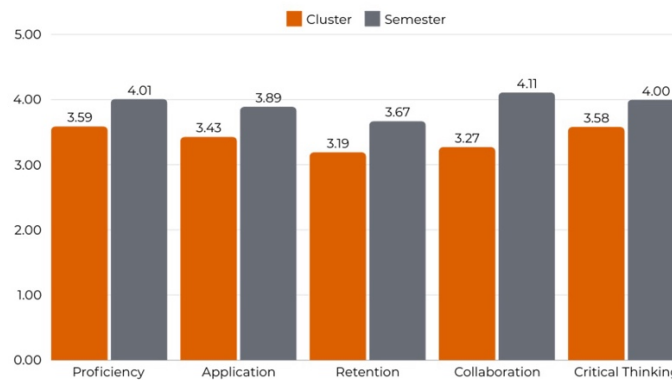

Figure 1: Overall Academic Performance Between Cluster and Semester-Based Models

The data above strongly indicates that students favor the regular semester-based system over the clustering system in all measured aspects. This suggests that the semester-based system may be better suited to fostering academic proficiency, knowledge application, retention, collaboration, and critical thinking. Institutions might consider adopting or emphasizing semester-based structures to maximize student outcomes.

Table 7: Paired Two-Sample t-Test for Overall Perceived Academic Performance

Statistic	Cluster	Semester
Mean	3.4606414	3.95626822
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-6.5803924	
p-Value (One-Tailed)	1.1974E-09	
Critical t-Value (One-Tailed)	1.6607	

Furthermore, the statistical evidence provided by the t-test aligns with the tabulated data analysis, which demonstrated the semester-based system's superiority across all five key points. Notably, collaboration showed the largest difference in average scores (4.11 vs. 3.27), emphasizing that the semester-based system fosters greater peer interaction and teamwork among students. The semester-based system's consistent advantage in knowledge retention

and critical thinking plays a pivotal role in its superior overall academic performance, demonstrating its effectiveness in promoting deeper learning and analytical skills.
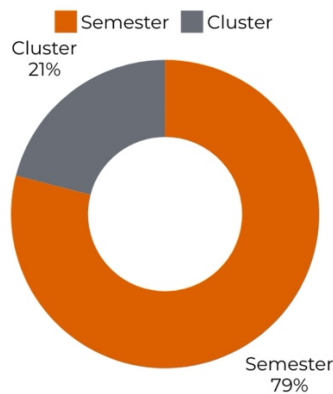

Figure 2: Students' Preferred Educational Model for Future Preparedness

The figure above summarizes the distribution of responses regarding students' preferred system between the cluster-based and semester-based approaches. The semester-based system is perceived by most students (79%) as the more effective setup for preparing them for academic and professional success. This aligns with earlier analyses indicating that the semester system is seen as superior in fostering skills such as academic proficiency, knowledge retention, and collaboration. The cluster-based system, despite being the preference of 21% of respondents, is viewed by a smaller group as more beneficial in preparing for future challenges. This may indicate a preference for the perceived flexibility or structure of the cluster-based approach, even though it scores lower in terms of academic performance metrics. The results suggest that the semester-based system is overwhelmingly favored by students (79%) when considering its potential to better prepare them for future academic and professional challenges. This aligns with the earlier findings showing that the semester-based system leads to stronger academic outcomes. Therefore, while students may have personal preferences for different structures, the semester system is likely more effective in equipping them for future success.

Table 8: Correlation Analysis Between Semester and Cluster Approaches

Metric	Correlation Value	Interpretation
Semester vs. Cluster	0.42	Positively Moderate Correlation

The correlation value of 0.42 indicates a positively moderate relationship between the semester and cluster setups in terms of their effect on academic performance. This suggests that while related, other factors might influence the students' perceived academic performance.

Table 9: Regression Analysis Summary

Metric	Value	Interpretation
Regression Equation	y=2.97+0.496×Class Setup	Academic Performance increases by 0.496 points with the class setup approach.
R Square	0.17	17% of the variance in academic performance is explained by the class setup approach.
Adjusted R Square	0.1666	Slightly adjusted for the sample size; consistent with R Square.
F-statistic	39.98	Overall regression model is statistically significant.
P-value	< 0.0001	Strong evidence against the null hypothesis, indicating significance.

The fitted regression model shows that the class setup approach significantly impacts academic performance, accounting for 17% of the variance. The positive coefficient of 0.496 suggests that shifting to a more semester-oriented approach can enhance academic outcomes.

Conclusion

The findings of this study reveal a significant difference in the academic performance and preparedness of students between the cluster-based and semester-based systems. Results from the paired t-tests indicate that students in the semester-based system consistently outperformed those in the cluster-based system in terms of academic proficiency and application of knowledge. The semester-based system demonstrated higher mean scores and statistically significant p-values, highlighting its effectiveness in fostering better academic outcomes. Furthermore, the survey responses corroborate these findings, with 79% of respondents indicating that the semester-based system better prepares them for the future. These results suggest that the semester-based system provides a more conducive learning environment for sustained engagement, deeper understanding, and application of knowledge, ultimately equipping students with the skills and competencies needed for future challenges. This study underscores the importance of structured, consistent class schedules in enhancing students' academic and practical readiness. Institutions may consider these findings to refine their curriculum design and class scheduling to maximize student success.

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