

COMPARING BLENDED AND FACE-TO-FACE INSTRUCTION IN COLLEGE MATHEMATICS: EFFECTS ON LEARNING SATISFACTION AND MATHEMATICS PERFORMANCE

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ABSTRACT

The continued integration of blended learning in higher education has raised important questions regarding its effectiveness in supporting both cognitive and affective learning outcomes, particularly in mathematics-related courses that require structured instruction and guided problem-solving. This study compared blended learning and face-to-face instruction in terms of learning satisfaction and mathematics performance among first-year college students in a local college in Northern Mindanao, Philippines. A quasi-experimental pretest-posttest non-equivalent control group design was employed involving 72 students enrolled in a college mathematics course. The intervention was conducted over five weeks. Data were gathered using a researcher-made learning satisfaction questionnaire and a 50-item mathematics achievement test administered before and after the instructional period. Descriptive statistics and inferential tests, including Mann-Whitney U test and ANCOVA, were used for data analysis. Findings showed that students in both blended and face-to-face instruction improved their mathematics performance, with no significant difference between groups after controlling for pretest scores. However, face-to-face instruction yielded significantly higher levels of learning satisfaction in terms of academic achievement and engagement, while no significant differences were observed in interest and overall satisfaction. The study concludes that instructional modality alone does not determine short-term mathematics achievement. Instead, differences in learning satisfaction suggest that instructional design and interaction patterns may play a more important role in shaping student experience. Future research may examine additional pedagogical and learner-related factors and explore longer intervention periods across different contexts.

Keywords: *Blended Learning, Face-To-Face Instruction, Learning Satisfaction, Mathematics Performance*

1.0 Introduction

The higher education landscape has increasingly shifted toward more flexible and technology-enhanced instructional approaches that catering the needs of the respective diverse learners. In traditional face-to-face instruction, students engage directly with instructors and peers in real-time classroom settings which allow immediate feedback, structured guidance, and active interaction. These are crucial in mathematics-related courses because it helps them develop conceptual understanding and procedural skills especially when they clarifications are properly addressed with guidance in solving the problem (Mohammadi-an et al., 2021; Tong et al., 2023).

However, the emergence of blended learning, widely known as the fusion of traditional face-to-face instruction and online instruction, has been considered a formal education program and one of the recognized teaching approaches in higher education (Boyle, 2023; Tong et al, 2023). This modality provides students with greater flexibility in accessing learning materials, engaging in self-paced study, and utilizing digital resources that support independent learning. From a Self-Regulated

Learning perspective, blended environments allow learners to take greater responsibility for planning, monitoring, and evaluating their own learning processes, which is essential in mathematics where mastery requires repeated practice and cognitive engagement, but its effectiveness largely depends on instructional design, student readiness, and access to appropriate learning resources (Boyle, 2023; Seage & Türegün, 2020).

In the global context, higher education systems have increasingly adopted blended learning due to rapid digital transformation and the demand for flexible learning pathways. In response, many countries have integrated online platforms into traditional instruction to improve accessibility and learning continuity. But in the Philippines, the Commission on Higher Education (CHED) has been pivotal in shaping flexible learning within higher education. For example, CHED Memorandum Order No. 4, s. 2020 calls for the integration of digital platforms into instructional delivery, while CHED Memorandum Order No. 20, s. 2021 provided guidelines for online and modular distance learning during the COVID-19 pandemic but continue to influence post-pan-

demographic instructional practices in higher education institutions. At the institutional level, many colleges and universities have adopted blended learning alongside traditional face-to-face instruction depending on program requirements, faculty readiness, and classroom availability. This ongoing dual implementation highlights the need to evaluate which modality better supports student learning outcomes, particularly in mathematics courses.

Despite the growing body of literature on blended and face-to-face instruction, findings remain inconsistent across different contexts and disciplines. Some studies report that blended learning improves academic achievement due to flexibility and resource accessibility, while others emphasize the advantages of face-to-face instruction in promoting immediate feedback, structured learning, and stronger student engagement. There are also studies reporting no significant differences between the two modalities, suggesting that learning outcomes may depend more on implementation quality than on the mode of delivery itself (Patron, 2021; Reichgelt & Smith, 2024; Wong, 2020). However, in the Philippine higher education context, there is still limited local quasi-experimental

evidence that simultaneously examines both learning satisfaction and mathematics performance within a single intervention design, particularly among non-mathematics-specialist programs such as entrepreneurship. Most existing studies tend to focus on either cognitive outcomes or affective outcomes separately, which limits a more integrated understanding of how instructional modality influences both student experience and academic performance under the same learning conditions. This gap highlights the need for further empirical investigation using a combined analytical framework.

Learning satisfaction, in this study, refers to students' overall evaluation of their learning experience, and it is described in terms of academic achievement, engagement, and interest. Academic achievement refers to students' perceived attainment of learning goals and understanding of lessons, engagement refers to their active participation and involvement in learning activities, while interest refers to their curiosity, enjoyment, and sustained attention toward the subject matter.

This study is anchored on Self-Determination Theory (Deci & Ryan, 2000), which explains that learning becomes more ef-

ffective when students' psychological needs for autonomy, competence, and relatedness are supported. In blended learning, autonomy is strengthened through flexible access to learning materials and self-paced activities, while competence is developed through repeated practice and structured resources. In face-to-face instruction, relatedness and competence are reinforced through direct interaction, immediate feedback, and guided instruction from teachers. These theoretical mechanisms suggest that instructional modality may not only influence academic performance but also shape students' learning satisfaction, engagement, and interest in mathematics.

Therefore, this study aimed to compare blended learning and face-to-face instruction in terms of students' learning satisfaction and mathematics performance among first-year college students during the AY 2024–2025 using a quasi-experimental pretest–posttest non-equivalent control group design over a five-week instructional period. Specifically, it sought to generate comparative empirical evidence on the effects of two instructional modalities on both affective (learning satisfaction) and cognitive (math-

ematics performance) outcomes in a college mathematics course.

Statement of The Problem

This study aimed to compare blended learning and face-to-face instruction in college mathematics in terms of students' learning satisfaction and mathematics performance among first-year college students. Specifically, it sought to answer the following questions:

1. What is the level of learning satisfaction of students in blended learning and face-to-face instruction in terms of academic achievement, engagement, and interest?
2. What is the level of mathematics performance of students in blended learning and face-to-face instruction in terms of pretest and posttest scores?
3. Is there a significant difference in learning satisfaction between students exposed to blended learning and those exposed to face-to-face instruction?
4. Is there a significant difference in mathematics performance between students exposed to blended learning and those exposed to face-to-face instruction?

2.0 Method

This study employed a quasi-experimental pretest-posttest non-equivalent group design to determine the effects of blended learning and face-to-face instruction on students' learning satisfaction and mathematics performance among first-year college students in a local college in Northern Mindanao, Philippines. The participants were 72 first-year Bachelor of Science in Entrepreneurship students from two intact class sections in a local college in Northern Mindanao, Philippines. A total enumeration of students in two intact class sections was employed, wherein all enrolled students in both sections during the semester were included in the study. Each section consisted of 36 students which reflected the existing official enrollment size of the two intact classes as assigned by the institution prior to the conduct of the study. One section was assigned to the blended learning condition and the other to face-to-face instruction. The assignment of instructional conditions was done at the class section level and not through individual randomization; thus, the groups were naturally existing and considered non-equivalent. Since participants were not randomly as-

signed individually, the design is classified as quasi-experimental.

Instructional equivalence was ensured by using the same instructor, learning objectives, lesson content, instructional materials, and assessment tasks for both groups. Both sections followed a standardized lesson plan in Statistical Analysis with Software Application, covering topics such as confidence intervals, hypothesis testing, normality tests, and correlation analysis. This ensured that both groups received identical content and learning competencies, with the instructional modality as the only differing factor.

The face-to-face group received three hours of classroom instruction per week, while the blended learning group received two hours face-to-face instruction and one hour asynchronous learning via Google Classroom and Messenger. Both groups used the same PowerPoint presentations, modules, and worksheets aligned with the syllabus. Asynchronous activities included readings, and guided exercises or activities. The same instructor handled both groups to ensure consistency in delivery and minimize instructional variability.

The learning satisfaction questionnaire was a researcher-made instrument developed

based on established literature on student learning experience and instructional effectiveness. It measured three dimensions: academic achievement, engagement, and interest. Items were constructed based on these theoretical constructs and reviewed by five experts in mathematics education and research methodology to establish content validity in terms of relevance and clarity. The instrument used a 4-point Likert scale ranging from 4 (Strongly Agree/Very Satisfied) to 1 (Strongly Disagree/Very Dissatisfied). Internal consistency reliability was established using Cronbach's alpha ($\alpha = 0.907$) which indicates an excellent reliability.

Mathematics performance was measured using a researcher-developed 50-item multiple-choice test aligned with the course competencies through a Table of Specifications (TOS). The test covered key topics in Statistical Analysis with Software Application, including confidence intervals, hypothesis testing, normality tests (Shapiro-Wilk and Kolmogorov-Smirnov), correlation analysis (Pearson and Spearman), and interpretation of statistical outputs. Each item had four options with one correct answer, and each correct response was awarded one point,

with a maximum score of 50. The same instrument was used for both pretest and posttest to measure learning gains. A test-retest reliability coefficient of 0.810 indicated acceptable reliability. Possible testing effects due to repeated administration of the same test were also considered in interpreting the results.

Ethical clearance and institutional approval were obtained prior to data collection. Informed consent was secured from all participants, and they were informed about the purpose of the study, their rights, and their option to withdraw at any time without penalty. Participation was voluntary, and students' academic performance was not affected by their decision to participate or not.

Confidentiality and data privacy were strictly observed, with all responses anonymized and stored securely for research purposes only. Since the researcher also served as the instructor, procedural controls were implemented, including standardized lesson plans, uniform instructional materials, and identical assessment conditions across both groups to minimize instructional bias.

Prior to conducting ANCOVA, the assumption of homo-

generity of variances was tested using Levene’s Test and showed no significant difference between groups ($F = 3.204, p = .078$), indicating that the assumption of equal error variances was satisfied. To further validate the model, homogeneity of regression slopes was examined by testing the interaction between pretest scores and instructional modality. Results showed that the interaction effect was not significant ($F = 0.022, p = .882$), indicating that the relationship

between pretest and posttest scores was consistent across blended learning and face-to-face groups. In addition, pretest scores were significantly related to posttest performance ($F = 24.920, p < .001$), confirming the appropriateness of including it as a covariate. These results confirm that all key assumptions for ANCOVA were met, supporting the validity of using the method to compare adjusted posttest mathematics performance between instructional modalities.

3.0 Results

Table 1. *Learning Satisfaction of Students in Blended and Face-to-Face Instruction*

Learning Satisfaction Dimension	Blended Learning			Face-to-Face		
	Mean	SD	Interpretation	Mean	SD	Interpretation
Academic Achievement	3.16	0.28	Satisfied	3.33	0.34	Very satisfied
Engagement	3.08	0.26	Satisfied	3.24	0.34	Satisfied
Interest	3.17	0.34	Satisfied	3.19	0.41	Satisfied
Overall	3.14	0.25	Satisfied	3.25	0.62	Satisfied

Legend. *Very dissatisfied (1.00-1.75); Dissatisfied (1.76-2.50); Satisfied (2.51-3.25); Very satisfied (3.26-4.00)*

The learning satisfaction of students in both blended learning and face-to-face instruction was generally positive across all dimensions. Face-to-face instruction consistently obtained slightly higher mean scores than blended learning in academic achievement, engagement, and overall satisfaction. The largest difference was observed in

academic achievement, where the face-to-face group reported a very satisfied rating, while the blended learning group reported a satisfied rating. In contrast, interest yielded nearly identical mean scores across the two instructional modalities. These findings suggest that although both instructional approaches were associated with favor-

able learning experiences, students in the face-to-face setting tended to perceive greater support for their academic achievement and classroom engagement.

Table 2. *Mathematics Performance of Students in Blended and Face-to-Face Instruction*

Group	Pretest			Posttest			Gain (Post-Pre)
	Mean	SD	Interpretation	Mean	SD	Interpretation	
Blended Learning	21.31	5.22	Moderate	30.22	9.78	Moderate	8.91
Face-to-Face Instruction	20.72	5.95	Low	27.28	8.11	Moderate	6.56

Legend. *Very Low Performance (0-10); Low Performance (11-20); Moderate Performance (21-30); High Performance (31-40); Very High Performance (41-50)*

The mathematics performance of students improved from pretest to posttest in both instructional modalities. Students in the blended learning group demonstrated moderate performance at both testing periods and obtained a larger gain score compared to those in the face-to-face group. In contrast, students in the face-to-face group improved from low performance during the pretest to moderate performance in the posttest. These findings suggest that both instructional modalities

supported students' learning in mathematics over the five-week intervention period. The higher gain observed in the blended learning group may indicate that the combination of face-to-face instruction and asynchronous learning activities provided additional opportunities for practice and review of mathematical concepts. However, the descriptive results alone do not indicate whether the observed difference between groups is statistically significant, which was further examined through ANCOVA.

Table 3. *Mann-Whitney U test of Learning Satisfaction differences between blended and face-to-face modalities*

Learning Satisfaction	Mode	Mean Rank	U	Z	P-value	Effect Size	Interpretation
Academic Achievement	Blended	31.50	468.000	-2.815	0.005*	0.33	Significant
Engagement	Face-to-Face	41.50					
	Blended	33.00	522.000	-2.017	0.044*	0.24	Significant
	Face-to-Face	40.00					

Interest	Face						Not Significant
	Blended	37.19	623.000	-0.343	0.732	0.04	
Overall Satisfaction	Face-to-Face	35.81					Not Significant
	Blended	34.00	558.000	-1.521	0.128	0.18	
	Face-to-Face	39.00					

Legend. * Significant at 0.05 level (2-tailed).

The Mann-Whitney U test revealed significant differences between blended learning and face-to-face instruction in the dimensions of academic achievement (U = 468.00, p = .005, r = .33) and engagement (U = 522.00, p = .044, r = .24). In both cases, the face-to-face group obtained higher mean ranks than the blended learning group, indicating more favorable perceptions of academic achievement and engagement. The effect size was

moderate for academic achievement and small for engagement.

In contrast, no significant differences were observed in interest (U = 623.00, p = .732, r = .04) and overall satisfaction (U = 558.00, p = .128, r = .18). These findings suggest that instructional modality was associated with differences in specific dimensions of learning satisfaction, particularly academic achievement and engagement, but not in students' overall satisfaction or interest.

Table 4. ANCOVA Results on Posttest Mathematics Performance by Instructional Method

Source	SS	df	MS	F	p	Partial η^2
Pretest (Covariate)	1499.492	1	1499.492	24.920	.000	.265
Instructional Method	108.808	1	108.808	1.808	.183	.026
Error	4151.952	69	60.173			
Total	5807.500	71				

Adjusted Posttest Means (Estimated Marginal Means)					
Instructional Method	Adjusted Mean	Std. Error	95% CI Lower	95% CI Upper	
Blended Learning	29.98	1.29	27.40	32.56	
Face-to-Face	27.52	1.29	24.94	30.10	

4.0 Discussion

This study compared blended learning and face-to-face instruction in terms of learning satisfaction and mathematics performance among first-year college students enrolled in a mathematics-related course. The findings indicate that the influence of instructional modality was more evident in students' learning satisfaction than in their mathematics performance. While students exposed to face-to-face instruction reported significantly higher levels of academic achievement and engagement, no significant difference was found in mathematics performance after controlling for pretest scores.

This finding is consistent with the studies of Natarajan et al. (2022) and Ocampo (2023), who reported that direct classroom interaction contributes positively to students' perceived learning gains and engagement. Similarly, prior research has shown that teacher presence, peer interaction, and structured classroom routines can strengthen students' participation and sense of academic support. From the perspective of Self-Determination Theory (Deci & Ryan, 2000), face-to-face instruction may more effectively satisfy the needs for relatedness and

competence because students receive immediate feedback, direct guidance, and opportunities for social interaction. These experiences may strengthen students' confidence in completing academic tasks and increase their willingness to participate actively in classroom activities.

However, no significant differences were found in students' interest and overall learning satisfaction. This suggests that although instructional modality influenced specific dimensions of satisfaction, both blended learning and face-to-face instruction were generally capable of maintaining students' interest in learning mathematics. A possible explanation is that both groups were exposed to the same learning objectives, instructional content, assessments, and instructor. The blended learning group also received supplementary learning resources through Google Classroom and Messenger, allowing students to revisit lessons and practice independently. Previous studies have reported that access to flexible learning resources, structured learning activities, and timely feedback can help sustain students' interest regardless of instructional modality (Malasari et al., 2021; Mohd Basar et al., 2021; Tong

et al., 2023). The comparable ratings in interest suggest that students remained motivated to learn mathematics even when instructional delivery differed.

In terms of mathematics performance, the results revealed no statistically significant difference between blended learning and face-to-face instruction after controlling for pretest scores. This finding suggests that the mode of instructional delivery alone may not have been sufficient to produce substantial differences in posttest achievement under the conditions of the present study. Rather than indicating that the two modalities are definitively equivalent, the findings suggest that both approaches were capable of supporting mathematics learning during the five-week intervention period when similar instructional objectives, content, materials, and assessments were provided.

The result supports the findings of Patron (2021), who reported improvements in mathematics achievement in both blended and face-to-face groups without significant differences between them. Likewise, Dayon (2021) found that students exposed to blended learning demonstrated improvements in academic performance, suggesting that well-designed blend-

ed environments can effectively support learning outcomes. Taken together, these findings imply that instructional quality, learning activities, and opportunities for practice may be more influential than delivery mode alone in determining mathematics achievement.

Another possible explanation for the absence of significant differences is the relatively short duration of the intervention. The instructional treatment lasted only five weeks, which may not have been sufficient to produce substantial differences in achievement outcomes between groups. In addition, the sample consisted of only 72 students from two intact class sections, which may have limited the statistical power to detect smaller instructional effects. Consequently, the findings should be interpreted cautiously and should not be taken as evidence that blended learning and face-to-face instruction are universally equivalent across all contexts and learner populations.

The significant influence of pretest scores on posttest performance further highlights the importance of prior knowledge in mathematics learning. Students who entered the course with stronger foundational understanding tended to perform

better regardless of instructional modality. This finding reinforces the cumulative nature of mathematics learning and suggests that instructional interventions may be most effective when accompanied by strategies that address learners' existing knowledge and preparedness.

The findings in a broader aspect suggest that instructional modality influences certain affective dimensions of learning, particularly students' perceptions of academic achievement and engagement, but may not necessarily lead to differences in short-term mathematics performance when instructional content and learning conditions are comparable. The results highlight the importance of designing learning experiences that balance flexibility, interaction, feedback, and learner support, regardless of whether instruction is delivered through blended learning or traditional face-to-face formats.

5.0 Conclusion

This study provides preliminary quasi-experimental evidence regarding the effects of blended learning and face-to-face instruction on learning satisfaction and mathematics performance among first-year college students enrolled in a mathematics-related course. The

findings suggest that both instructional modalities may support improvements in mathematics performance over a short intervention period, as no statistically significant difference was found in posttest achievement after controlling for prior knowledge. However, face-to-face instruction was associated with significantly higher levels of perceived academic achievement and engagement, indicating that direct interaction, immediate feedback, and structured classroom experiences may provide stronger support for certain affective aspects of learning.

The study contributes to the limited Philippine higher education literature that simultaneously examines both learning satisfaction and mathematics performance within a single quasi-experimental intervention. The findings suggest that instructional design, feedback quality, learner support, and engagement structures may be more influential in shaping learning outcomes than instructional delivery mode alone. For mathematics instruction in higher education, the results highlight the importance of providing meaningful learning activities, opportunities for interaction, timely feedback, and adequate academic support regardless of whether

instruction is delivered through blended or face-to-face formats.

Several limitations should be considered when interpreting the findings. The study was conducted in a single institution, involved only 72 students from two intact class sections, and was implemented over a relatively short five-week period. In addition, the use of researcher-made instruments and the repeated administration of the same mathematics test may limit the generalizability of the results. Therefore, the findings should be interpreted as context-specific and should not be generalized to all higher education settings without further evidence.

Despite these limitations, the study offers implications for instructional practice, mathematics pedagogy, and higher education policy. Mathematics instructors are encouraged to focus on high-quality instructional design, clear explanations, structured learning activities, active student engagement, and timely feedback rather than relying solely on a particular instructional modality. At the policy level, CHED and higher education institutions may strengthen flexible learning initiatives by promoting faculty development, quality assurance mechanisms, effective learning resource design, and

student support systems that enhance both academic achievement and learning satisfaction.

Future studies may involve multiple institutions, larger samples, longer intervention periods, and additional variables such as learning motivation, self-regulated learning, digital literacy, and instructional strategies. Mixed-method and longitudinal studies are likewise recommended to provide a deeper understanding of how different instructional modalities influence both cognitive and affective learning outcomes over time.

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